INFLUENCE OF STRAIN OR SOURCE AND GENERATION NUMBER ON PERFORMANCE OF THE POTATO VARIETY RUSSET NORKOTAH, 2000

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INTRODUCTION

Strains are spontaneously occurring variants within a potato variety that may possess qualitative or quantitative characteristics that are superior to the parent variety. Strain selection is a practice that has been in use with potatoes for many years and examples of successful strain selections include Russet Burbank from Burbank, Dark Red Norland from Norland and Norgold Russet "M" from Norgold Russet. Some strains are discovered based on chance observations of desirable characteristics while others are the products of systematic searches for superior performance. Strain can influence the quality and quantity of tubers produced by a given variety of potato.

Generation number indicates the number of field production cycles a seed lot has completed following passage through an in-vitro, tissue-culture based purification program. Purification programs are designed to rid the seed lot of all microorganisms that cause contagious disease. If a seed lot has been grown for one year in the field, the product of that first years field crop is called generation 1 (G1). Similarly, the crop from a seed lot that had been cycled through eight production years in the field would be called G8. Most certified seed potatoes sold today have a generation number as part of the certification description. Potato seed lots with low generation numbers (ie G1, G2) are less at risk of carrying seedborne diseases and are generally considered to be more productive than seed lots with higher (ie G7, G8) generation numbers. It is also generally believed that the magnitude of difference in productivity between low and high generation numbers may vary due to variety but also according to geographical location of seed production as well as production and storage practices.

Russet Norkotah (Johansen, et al, 1988) is a popular fresh market potato variety known for its excellent tuber type and early maturity. It is also known for a general lack of vine vigor, a weakness that prompted researchers in Texas and Colorado to conduct systematic searches for strains with a more vigorous vine. Both of these programs have selected strains that reportedly have more vigorous vines and produce higher yields than the parent strain. Many other sources of Russet Norkotah seed, (including various state potato seed certification agencies and private producers) also are available to potato farmers. These sources generally do not claim a particular "strain" designation for their seed, nevertheless there may be differences in vine vigor and yield potential among them.

Russet Norkotah is one of the most popular commercial varieties in Alaska today, preferred because of its russet skin, high yield and low percentage of gradeout. Its primary weakness usually is "sunburn" (greening of tubers from exposure to too much sunlight in the field). Depending on variety, there may be many different factors responsible for sunburn. With Russet Norkotah, an absence of vigorous vines to protect tubers in the field from the sun may play an improtant role. Alaskan growers are interested to know if different strains will reduce sunburn and thus increase marketable yield.

This study is a continuation of one initiated in 1998 (Carling, 1999) and repeated in 1999 Carling,

2000) wherein strains and other sources of Russet Norkotah seed are compared for vine vigor and yield. In 1998, 10 sources were compared whereas the 1999 study contained 18 sources. Original seed was provided by the following programs: CORN = Colorado Russet Norkotah, Colorado State University; EAC = Edmonton, Alberta; Canada, MSU = Montana State University; NYU = New York Uihlein Farm; PMC = Alaska Plant Materials Center; and TXNS = Texas Norkotah Strain, Texas A&M University. All 18 sources from the 1999 study were retained for the 2000 study (each retained source from 1999 was one generation older in the 2000 study), plus an NYU G1 source and an EAC G4 source were added for a total of 20 treatments. Among the 20 treatments were five generations from NYU, five generations from PMC, three generations from EAC and three strains each from Colorado and Texas. These sets provide the data needed to permit comment, not only on strain and source effects on yield, but also the effects of generation. In addition, all seed except NYU G1 and EAC G4 were grown, harvested and stored under the same conditions. Thus, location of production, method of production, and conditions of storage were eliminated as causes of variation in yield among those 18 treatments.

MATERIALS AND METHODS

Field plots at the Agricultural and Forestry Experiment Station Farm near Palmer were prepared by plowing with a moldboard plow to a depth of 10-12 inches followed by disking and packing. Cut seed pieces weighing approximately 3-4 ounces were planted 2-3 inches deep with an Iron Age assist feed planter on May 12, 2000. Plants were spaced 11 inches apart in rows 36 inches apart. Treatments were replicated four times in a randomized complete block design. Granular fertilizer (10-20-20) was applied at the rate of 107 pounds N, 214 pounds P_2O_5 and 214 pounds K_2O by the planter in bands two inches to the side and two inches below the seed. The fertilizer was composed of monoammonium phosphate (11-51-0), muriate of potash (0-60-60), urea (45-0-0) and a limestone filler. Weeds were controlled by a pre-emergent application of linuron (Lorox) supplemented by cultivation and hand weeding where necessary. Spot spraying with glyphosate (Roundup) was done to control quackgrass. Plots were irrigated as needed with overhead sprinklers. Plants were hilled during the last week of June and the crop was harvested with mechanical harvester on September 11, 2000. Harvested tubers were placed in cold storage for seven weeks prior to grading. Grading was completed in November 2, 2000.

RESULTS AND DISCUSSION

Seed for the 20 treatments included in this study included seed held over from all 18 treatments in 1999 plus new sources of NYU G1 and EAC G4. A major improvement in this study over the 1999 study is that, with the exception of the two sources mentioned above, all seed was produced and stored under the same conditions. With the production and storage variables largely eliminated, observed differences in yield were more legitimately attributable to strain and source differences.

The 20 seed sources used in this study, along with generation number, are listed according to US

#1 yield, in Table 1. Total yield, several other quantitative yield parameters and specific gravity are also listed in Table 1. All vines were free of contagious disease symptoms and, as expected, vine size again tended to vary among sources. Generally speaking, larger vines tended to be associated with a higher total yield and higher US#1 yield. Also, where multiple generations of the same source were available for comparison, the trend often was toward larger vines and higher yields in the lower numbered generations.

Total yields among the 20 sources ranged from 15.1- 19.3 tons per acre and US#1 yields from 11.3 - 15.3 tons per acre. These yields were significantly lower than in 1999, the difference probably due largely to the more favorable growing season in 1999. Specific gravity readings also were lower in 2000, supporting the conclusion that growing conditions were better in 1999. Total gradeout ranged from 16-28 percent compared to a range of 11-23 percent in 1999. Small tubers again were the primary single type of gradeout, although various types of harvest damage also were commonly observed.

Yields were generally less in 2000, but quantitative and qualitative differences among strains of Russet Norkotah again were manifested. The Texas and Colorado strains along with the New York source again occupy the higher yielding positions and the PMC source and the Colorado standard again hold the lower yielding positions. These data provides additional evidence of the existence of differences among strains and sources and of the identity of superior strains and sources.

SUMMARY

1. Significant differences in yield were observed among the 20 strains and sources of Russet Norkotah evaluated in this study.
2. Yields tended to trend downward as generation number increased, although this was not as obvious as in 1999.
3. Strains selected for larger vines and greater yield generally produced larger vines and a greater yield than non-strain sources.
4. Tubers of CORN 3 was less true to type than other strains and sources.
5. Among the non-strain sources, NYU appears relatively strong whereas CORN S, MSU and PMC appear comparatively weak.

PLANS FOR 2001

2001 will be the final year of this study. Approximately the same set of strains and sources of seed will be planted with older generations of EAC, PMC and NYU discarded in favor of younger generations.

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Memo

To: Neil Muirhead

From: Donald E. Carling

Subject: Manuscript for publication as an AFES Circular

Date: 04-11-01

Enclosed is a hard copy of a manuscript entitled "Effect of seed weight and seed cutting on yield and quality of tubers produced by the potato cultivar Russet Norkotah". I would like to see it published as an AFES Research Progress Report.

Also enclosed is a disk with three files. One, in word perfect, is the text and the other, in Quatro Pro, is Table 1 and Table 2.

Please send me a proof before you print it.

Thanks.

EFFECT OF SEED WEIGHT AND SEED CUTTING ON YIELD AND QUALITY OF TUBERS PRODUCED BY THE POTATO CULTIVAR RUSSET NORKOTAH

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INTRODUCTION

Two of the many important criteria that help determine the quantity and quality of potato tubers harvested are: 1) weight of the individual seed tubers and 2) whether seed tubers are whole or cut. Different factors determine individual preferences when growers make decisions regarding seed weight and seed cutting but research data do not always agree about which choices are superior. Iritani, et al (1) in studies with variety Russet Burbank, reported maximum yields with whole or cut seed that weighed two ounces. On the other hand, Strange and Blackmore (2) working with variety Sebago, report that maximum yields were obtained by planting seed that weighed between four and five ounces. Although it is well known that whole seed will more dependably produce a more complete stand of more vigorous plants, largely because of its greater resistance to seed tuber rot, often whole seed is in short supply. In addition, when it is available, whole seed often is more expensive than seed that is to be cut. Therefore, like potato growers in other parts of the United States, most Alaskan growers plant cut seed.

No data exists that shows the optimal weight of whole and cut seed for use in south-central or other regions of Alaska. In this study, yield and quality of potatoes (variety Russet Norkotah) grown from whole or cut seed that ranged in weight from less than one ounce to four ounces are compared.

MATERIALS AND METHODS

Seed tubers of variety Russet Norkotah representing each of nine weight classes (the nine classes are summarized in Table 1) of whole and cut seed were selected in November 2000 from the crop grown the previous summer on the UAF AFES Matanuska Farm. Some tubers of Russet Norkotah, a long russet, tend toward a very long and slender shape and, in the selection process, tubers with this shape were avoided in order to minimize the area of the wound on cut seed. Following selection, tubers were dipped in a 1.85% aqueous solution of formaldehyde for two minutes to eliminate surface borne pathogens, then returned to 37°F storage until spring.

The day prior to planting, cut seed treatments were prepared. Seed used in these trials was produced on the AFES Matanuska Farm from stocks acquired from a local seed grower. Tubers were first sliced in half, from the apical to the distal (stem) end of the tuber, in the process splitting the whorl of eyes at the tuber's apical end. Appropriate final weights for each piece were obtained by slicing off an appropriate amount of the distal end of each half. Cut tubers were allowed to suberize over night at room temperature. All treatments (whole and cut seed) were planted the next day.

Seedbed preparation included moldboard plowing to a depth of 10 to 12 inches followed by disking and packing. Potatoes were planted on May 11-12, as soon as possible after tilling to minimize loss of early spring moisture. Soil moisture was at a moderate level at planting, differing from several previous years when soil moisture was extremely low. Four replicates of each variety, with 15 individual plants per replicate, were planted in rows 36 inches apart in a randomized complete block design. Seed pieces were planted approximately 11 inches apart in the row and covered with 2-3 inches of packed soil with a single row Iron Age assist feed planter. Shallow planting is advantageous at this location as it helps to minimize the length of time between planting and emergence. Granular fertilizer (10-20-20) was applied at the rate of 107 pounds N, 214 pounds P_2O_5 and 214 pounds of K_2O per acre by the planter in bands two inches to the side and two inches below the seed. The fertilizer was composed of monoammonium phosphate (11-51-0), muriate of potash (0-0-60), urea (45-0-0), and a limestone filler. Water was applied as needed to the plots through overhead sprinklers. Weeds were controlled by a pre-emergent application of Linuron (Lorox) supplemented by cultivation and hand weeding and spot spraying with Roundup (Glyphosate) where necessary. Plants were hilled during the last week of June and all plots were harvested on September 11. No symptoms of virus or other disease were observed in the crop during the growing season.

RESULTS AND DISCUSSION

Both cut and whole seed treatments are included at the one, two, three and four ounce seed weight. In addition, a treatment of whole seed weighing an average of 0.7 ounces also was included. Yields of these nine treatments are summarized in Table 1. Total yields in whole seed treatments increased as the weight of seed increased and this same trend was observed in cut seed treatments through three ounces with a slight downward trend observed at four ounces. US#1 yields, in both whole and cut seed treatments peaked at the three ounce level, suggesting maximum yields are attainable with seed that weighs from three to four ounces. These data are more in line with those reported by Strange and Blackmore (2) than by Iritani, et al (1) although each of the previous studies was done with a different varieties. This is a reminder that variety may be very important when determining the weight of seed tubers that one must use to optimize yields.

Weight of individual harvested tubers tended upward as the weight of seed tubers decreased (Table 2). This was true for whole and cut seed, illustrating that in this study the cutting process had no effect on average weight of the harvested tubers. Iritani, et al (1) reported an increase in stem numbers as the weight of seed tubers increased, and in his research this increase was correlated with an increase in total yield. More stems per plant generally will result in more tubers per plant, although this research cannot confirm this point as no stem counts were taken. Furthermore, Iritani, et al (1) did not report data in numbers of tubers so it cannot be determined from his study how tuber numbers of Russet Burbank were affected by seed weight. Regardless of the reason, it seems clear that lighter seed tubers of Russet Norkotah, whether whole or cut, will produce larger tubers that are fewer in number than produced by heavier seed.

Although weight of harvested tubers increased as the weight of seed tubers decreased, the number of tubers per plant showed an opposite trend (Table 2) lighter seed producing a smaller number of tubers. This trend was more pronounced with cut seed, although it was also evident for whole seed (Table 2). This information can be of value, especially to the seed grower, who must keep tubers under a certain maximum weight to qualify for the top US seed category. Clearly the heavier seed tubers produce more tubers of a smaller average size. When differences are expressed as numbers of tubers per acre (Table 2) it can be easily seen how this would be advantageous to the potato seed grower.

LITERATURE CITED

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2. Strange, P.C., and Blackmore, K.W. 1990. Effect of whole seed tubers, cut seed and within row spacing on potato (cv. Sebago) tuber yield. Aust. J. Expt. Agric. 30: 427-431.

Table 1. Climatic data for Matanuska Farm during the 2000 growing season.[1]

	April	May	June	July	August	September
Temp. (°F)						
Air						
Daily max.	49.0(46.4)	57.7(57.0)	66.2(65.4)	65.0(67.5)	62.8(65.0)	54.8(56.4)
Daily min.	30.0(27.4)	34.8(35.8)	45.3(44.4)	50.0(48.1)	45.6(45.9)	36.7(38.6)
Daily mean	39.5(36.9)	46.3(46.4)	55.8(54.9)	57.5(57.8)	54.2(55.5)	45.8(47.5)
Precip. (in.)	0.23(0.45)	0.99(0.74)	1.02(1.48)	2.02(2.26)	2.11(2.50)	2.94(2.38)

1Values for temperature and precipitation are averages for 2000. Values in parenthesis represent 63 year averages.

Table 2. Irrigated Yield Trial Summary, Matanuska Farm - 2000 [1,2]

VARIETY[2]	SKIN[3]	US#1[4]	SMALL[5]	OTHER[6]	TOTAL	% US#1	TUBER WT.[7]	SPECIFIC GRAVITY
Green Mountain	W	17.6	1.4	0.7	19.6	90	6.0	1.085
Andover	W	17.1	1.6	0.5	19.1	89	5.0	1.081
Chieftan	R	16.3	1.1	2.0	19.4	84	4.8	1.070
Lemhi Russet	Ru	16.2	1.4	2.3	20.0	81	6.5	1.090
Superior	W	16.2	0.4	1.1	17.7	92	6.1	1.072
Sangre	R	16.0	0.7	1.7	18.5	87	6.7	1.074
Allagash Russet	Ru	15.9	1.4	0.4	17.7	90	5.5	1.081
Norvalley	W	15.8	2.5	1.4	19.6	80	4.5	1.084
Goldrush Russet	Ru	15.8	1.0	0.8	17.6	90	6.5	1.074
Kennebec	W	15.8	0.8	2.9	19.4	81	8.6	1.080
IditaRed	R	15.8	0.7	2.8	19.4	82	7.2	1.071
Norland, Dark Red	R	15.1	1.3	1.0	17.4	87	5.1	1.069
Hilite Russet	Ru	15.1	0.9	0.8	16.8	90	6.1	1.078
Yukon Gold	W	15.1	0.4	2.4	18.0	84	7.4	1.081
Alaska 114	W	15.0	2.4	0.5	17.9	84	4.8	1.083
Norgold Russet	Ru	14.8	1.5	1.8	18.1	82	5.9	1.076
Shepody	W	14.7	0.8	1.6	17.1	86	8.9	1.077
Bake-King	W	14.7	0.6	0.4	15.6	94	7.1	1.087
Frontier Russet	Ru	14.4	1.5	1.4	17.3	83	7.0	1.083
Snowchip	W	14.3	1.2	2.0	17.5	82	5.6	1.086
Pike	W	14.0	1.5	0.1	15.6	90	4.5	1.087
Atlantic	W	13.6	1.0	4.0	18.5	73	5.9	1.091
Russet Nugget	Ru	13.1	0.9	0.2	14.2	92	6.1	1.095
Legend Russet	Ru	12.8	0.8	2.9	16.5	78	8.2	1.086
Ranger Russet	Ru	12.6	0.6	1.3	14.5	87	6.9	1.083
Russet Norkotah	Ru	12.0	3.3	1.0	16.3	74	4.8	1.073
Snowden	W	11.8	2.7	1.1	15.5	76	3.8	1.101
Chipeta	W	11.8	0.3	4.8	16.9	70	7.0	1.089
Denali	W	11.7	0.7	4.0	16.3	71	6.2	1.094
Norchip	W	10.4	1.6	4.5	16.5	63	5.1	1.073
Belrus	Ru	10.0	1.0	0.4	11.4	88	5.5	1.091
Russet Burbank	Ru	7.4	2.0	1.4	10.8	69	4.5	1.081
AVERAGE		14.2	1.3	1.7	17.1	83	6.1	1.082
LSD: 5%[8]		2.4			2.0			

1 Yields expressed in tons per acre.

2 Shaded varieties were developed for chipping, but also are suitable for fresh market.

3 (R) = red skin, (Ru) = russet skin, (W) = white skin.

4 #1 market grade as defined by the USDA.

5 Tubers less than 1.88 inches in diameter.

6 Includes oversize, shatter or growth crack, second growth, green, etc.

7 Average weight of #1 tubers in ounces.

8 LSD: Least significant difference.

Table 1. Performance, ranked by U.S. #1 yield of 20 sources of Russet Norkotah in 2000[1]

SOURCE	GENERATION #	US#1[2]	SMALL[3]	OTHER[4]	TOTAL	% US#1	TUBER WT.[5]	SPECIFIC GRAVITY
TXNS 112	3	15.3	1.5	2.2	19.0	81	7.1	1.076
NYU	2	15.2	2.0	1.0	18.3	83	5.9	1.075
NYU	1	14.3	1.2	3.0	18.5	77	7.0	1.077
NYU	3	14.2	1.4	3.0	18.6	76	7.0	1.076
NYU	4	14.1	1.5	1.6	17.1	82	6.5	1.076
CORN 3	3	14.1	0.9	4.4	19.3	73	8.2	1.080
TXNS 223	3	13.8	1.2	2.9	17.9	77	6.7	1.075
CORN 8	3	13.7	1.1	3.1	18.0	76	7.0	1.076
TXNS 296	3	13.7	1.1	3.0	17.8	77	7.6	1.076
EAC	5	13.3	2.0	2.3	17.6	76	6.1	1.076
MSU	3	13.2	1.4	1.6	16.2	81	6.4	1.074
NYU	6	12.9	2.1	1.8	16.8	77	5.9	1.075
PMC	5	12.9	1.5	1.0	15.3	84	6.5	1.074
EAC	6	12.7	1.5	2.3	16.6	77	6.4	1.076
EAC	4	12.5	1.6	3.3	17.4	72	5.8	1.076
PMC	4	11.9	1.7	2.5	16.1	74	6.6	1.073
PMC	1	11.9	1.5	2.0	15.5	77	6.9	1.075
PMC	3	11.8	1.3	2.5	15.6	76	6.5	1.075
PMC	2	11.5	1.5	2.4	15.5	75	6.7	1.074
CORN S	3	11.3	1.3	2.6	15.1	74	6.4	1.076
AVERAGE		13.2	1.5	2.4	17.1	77	6.7	1.076
LSD 5%[6]								

1 Yields expressed in tons per acre.

2 #1 market grade as defined by the USDA.

3 Tubers less than 1.88 inches in diameter.

4 Includes oversize, shatter or growth crack, second growth, green, etc.

5 Average weight of #1 tubers in ounces.

6 LSD: Least significant difference.