

**RESPONSE OF RUSSET POTATO TO APPLICATION RATE AND APPLICATION  
TIMING OF PLANT NUTRIENT AMENDMENTS, 2021**

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**Study Objective:**

The objective of this study was to evaluate the effect of application rate and application timing of plant nutrient amendments on the performance of Russet Norkotah 296 in the field.

**Experimental Procedure:**

The field experiments were conducted at Colorado State University’s San Luis Valley Research Center during the 2021 potato growing season. Soil analysis of the experimental site are summarized in Table 1. The potato cultivar ‘Russet Norkotah 296’ was evaluated for its response to application rate and application timing of different plant nutrient amendments. The study was laid out as randomized complete block design (RCBD) with each treatment replicated four times. The treatments used in the study are summarized in Table 2.

Table 1. Soil analysis of the experimental site before any plant nutrient application.

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|           | Nitrate Nitrogen   | Phosphorus     | Potassium      | Calcium         | Zinc            | Iron            |
|-----------|--------------------|----------------|----------------|-----------------|-----------------|-----------------|
| <u>pH</u> | <u>(lb N/acre)</u> | <u>(ppm P)</u> | <u>(ppm K)</u> | <u>(ppm Ca)</u> | <u>(ppm Zn)</u> | <u>(ppm Fe)</u> |
| 7.1       | 42                 | 95             | 302            | 1861            | 3.5             | 8.7             |

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Table 2 Experimental Treatments

| Treatment                        | Product  | Rate/Acre   | Remarks  |
|----------------------------------|--|---|--|
| T1 (GSP)                         | KCl<br>10-34-0<br>UAN (32%)  | 50 lb<br>60 lb<br>80 lb   | Applied in-furrow  |
| T2 (GSP + Blackmax 22 + Extract) | KCl<br>10-34-0<br>UAN (32%)<br>Blackmax 22<br>Extract  | 50 lb<br>60 lb<br>80 lb<br>1 gallon<br>1 gallon                   | Applied in-furrow  |
| T3 (Clear #2)                    | Jug 1<br>Jug 2<br>Jug 3<br>Jug 4   | 5 gallons<br>2 gallons<br>1 qt.<br>1 qt.                          | Applied in-furrow  |
| T4 (Black)                       | Black Label Zn<br>Reax K<br>UAN 32%<br>Extract<br>Reax Complete                                  | 6 gallons<br>2 gallons<br>60 lb<br>1 gallon<br>1 qt.              | Applied in-furrow  |
| T5 (Clear)                       | Riser<br>10-34-0<br>UAN 32%<br>LoKomotive<br>Extract   | 3 gallons<br>24 lb<br>60 lb<br>2 gallons<br>1 gallon              | Applied in-furrow  |
| T6 (Foliar K)                    | Reax K<br>NutriSync D<br>Reax K<br>NutriSync D<br>Reax K<br>NutriSync D<br>Reax K<br>NutriSync D | 1 qt.<br>5 oz.<br>1 qt.<br>5 oz<br>1 qt.<br>5 oz<br>1 qt.<br>5 oz | GSP applied in-furrow, then:<br>@ 1 <sup>st</sup> fungicide application<br>@ 1 <sup>st</sup> fungicide application<br>@ 2 <sup>nd</sup> fungicide application<br>@ 2 <sup>nd</sup> fungicide application<br>@ 3 <sup>rd</sup> fungicide application<br>@ 3 <sup>rd</sup> fungicide application<br>@ 4 <sup>th</sup> fungicide application<br>@ 4 <sup>th</sup> fungicide application |
| T7 (Foliar Radiate)              | Radiate<br>NutriSync D<br>Radiate<br>NutriSync D   | 2 oz<br>10 oz<br>2 oz<br>10 oz                                    | GSP applied in-furrow, then:<br>@ 1 <sup>st</sup> fungicide application<br>@ 1 <sup>st</sup> fungicide application<br>@ 2 <sup>nd</sup> fungicide application<br>@ 2 <sup>nd</sup> fungicide application   |
| T8 (Foliar P & K + Meritime)     | Ativus PK<br>NutriSync D<br>Ativus PK<br>NutriSync D   | 2 qt<br>10 oz<br>2 qt<br>10 oz                                    | GSP applied in-furrow, then:<br>@ 2 <sup>nd</sup> fungicide application<br>@ 2 <sup>nd</sup> fungicide application<br>@ 3 <sup>rd</sup> fungicide application<br>@ 3 <sup>rd</sup> fungicide application   |

## **Data Collection**

### *Stem Number, Tuber Set, and Tuber Bulking*

During the growing season plants were sampled from each plot at periodic intervals and evaluated for number of stems produced/plant, tuber set, and tuber bulking, as influenced by application rate and application timing of different plant nutrient amendments.

### *Tuber Yield, Tuber Size Distribution, and Tuber Quality*

At the end of the growing season, tubers harvested from each plot were weighed for total tuber yield. Tubers were then separated into various size distribution groups based on weight (> 4 oz., > 6 oz., > 10 oz., and 4-10 oz.). Tubers harvested from each plot were evaluated for tuber external (growth cracks, knobs, and misshapes) and internal (hollow heart) defects. Ten randomly selected tubers from each plot were used to evaluate tuber specific gravity, using the weight-in-air/weight-in-water method.

## **Results**

### *Number of Stems and Tuber Set*

Plant nutrient amendment did not statistically impact number of stems per plant in this study. However, treatments 3 to 8 increased stem numbers from four to five, compared to the grower standard treatment (Table 3). Similarly, tuber set was not statistically influenced by nutrient amendment. However, treatments 7 and 8 increased tuber set from 10 to 11 and 12, respectively, when compared to all other treatments (Table 3).

### *Tuber Bulking*

Rate and application timing of plant nutrient amendments influenced tuber bulking in this study. In-furrow application of clear #2 (T3) and Black (T4) enhanced early tuber bulking at 96 days after planting (DAP), but by 119 DAP application of GSP+Blackmax 22+Extract (Treatment 2), in-furrow application of GSP + Foliar K (Treatment 6), and foliar P, K, and Meritime (Treatment 8), had increased tuber bulking more than all other treatments (fig 1). The increase in tuber bulking was 16, 16, and 15%, respectively, for treatments 2,6, and 8, compared to the grower standard practice, at 119 DAP.

*Tuber Yield and Tuber Size Distribution*

Total tuber yield and tuber size distribution was influenced by plant nutrient amendment in this study (Table 4). In-furrow application of ‘GPS + Blackmax 22 + Extract’ (Treatment 2) increased total tuber yield and the yield of all tuber size groups evaluated in this study. The yield increases were, 11, 15, and 28%, for total, marketable size (> 4 oz.), and large marketable size (> 6 oz.) tuber yields, respectively, compared to tubers grown under grower standard practice (GSP) – Table 4. In-furrow application of GSP + foliar application of P, K, and Meritime (Treatment 8) produced total, marketable, and medium size (4-10 oz.) tuber yields similar to that produced from in-furrow application of GSP+Blackmax22+Extract (Treatment 2) -Table 4. There was severe hail damage on June 25, 2021, that might have compromised the use efficiency of other nutrient amendment treatments that did not show any significant increase in yields compared to the grower standard practice.

*Tuber Quality*

Clear #2 (T3) and Black (T4) applied in-furrow produced tubers with high incidence of hollow heart (6.6 and 5.3%, respectively), compared to all other treatments in this study (Table 5). It was interesting to note that the two amendments that produced high incidence of hollow heart, as well as treatment 5 (in-furrow application of clear) produced tubers with the highest specific gravities (1.089, 1.088, 1.087, respectively) in this study (Table 5). No significant tuber external defects were observed in any of the tubers harvested in this study.

Table 3 Effect of application rate and application timing of different plant nutrient amendments on stem and tuber number per plant of Russet Norkotah 296 potato, 2021.

| Treatment | Stems/Plant | Tubers/Plant |
|-----------|-------------|--------------|
| 1 (GSP)*  | 4           | 10           |
| 2         | 4           | 10           |
| 3         | 5           | 10           |
| 4         | 5           | 10           |
| 5         | 5           | 10           |
| 6         | 5           | 10           |
| 7         | 5           | 11           |
| 8         | 5           | 12           |

\*GSP = Grower Standard Practice

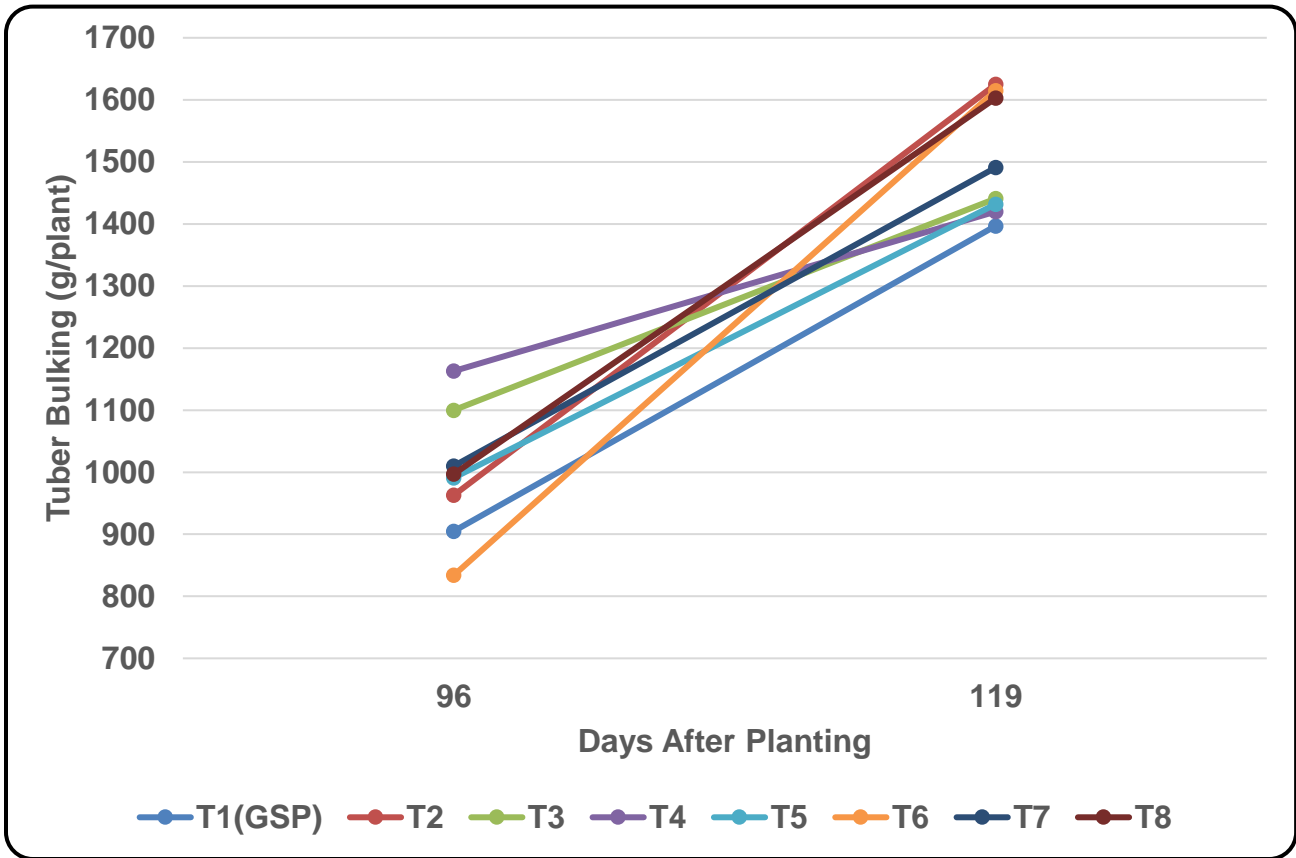


Figure 1. Effect of different plant nutrient amendments on tuber bulking of Russet Norkotah 296, 2021

Table 4. Effect of application rate and application timing of plant nutrient amendments on tuber yield and tuber size distribution of Russet Norkotah 296, 2021.

| Treatment             | Total                         | > 4 oz.           | > 6 oz.          | > 10 oz.         | 4-10 oz.          |
|-----------------------|-------------------------------|-------------------|------------------|------------------|-------------------|
|                       | Yield (cwt/acre)              |                   |                  |                  |                   |
| GSP (T1) <sup>x</sup> | 426 <sup>b</sup> <sub>y</sub> | 343 <sup>b</sup>  | 248 <sup>b</sup> | 115 <sup>a</sup> | 228 <sup>bc</sup> |
| T2                    | 471 <sup>a</sup>              | 393 <sup>a</sup>  | 317 <sup>a</sup> | 130 <sup>a</sup> | 263 <sup>a</sup>  |
| T3                    | 428 <sup>b</sup>              | 336 <sup>b</sup>  | 247 <sup>b</sup> | 110 <sup>a</sup> | 226 <sup>bc</sup> |
| T4                    | 410 <sup>b</sup>              | 325 <sup>b</sup>  | 243 <sup>b</sup> | 119 <sup>a</sup> | 206 <sup>c</sup>  |
| T5                    | 435 <sup>b</sup>              | 346 <sup>b</sup>  | 252 <sup>b</sup> | 106 <sup>a</sup> | 240 <sup>ab</sup> |
| T6                    | 420 <sup>b</sup>              | 324 <sup>b</sup>  | 239 <sup>b</sup> | 105 <sup>a</sup> | 220 <sup>bc</sup> |
| T7                    | 435 <sup>ab</sup>             | 334 <sup>b</sup>  | 244 <sup>b</sup> | 109 <sup>a</sup> | 225 <sup>bc</sup> |
| T8                    | 438 <sup>ab</sup>             | 347 <sup>ab</sup> | 250 <sup>b</sup> | 110 <sup>a</sup> | 237 <sup>ab</sup> |

<sup>x</sup>GSP = Grower Standard Practice

<sup>y</sup> Figures in the same column and bearing the same letters are not significantly different from each other at the 0.10 level of probability

Table 5 Effect of application rate and application timing of plant nutrient amendments on tuber quality of Russet Norkotah 296 potato, 2021.

| Treatment | % Hollow Heart | Tuber Specific Gravity |
|-----------|----------------|------------------------|
| 1 (GSP)*  | 0 <i>c</i>     | 1.079 <i>c</i>         |
| 2         | 0.6 <i>c</i>   | 1.083 <i>b</i>         |
| 3         | 6.6 <i>a</i>   | 1.089 <i>a</i>         |
| 4         | 5.3 <i>ab</i>  | 1.088 <i>a</i>         |
| 5         | 3.0 <i>bc</i>  | 1.087 <i>a</i>         |
| 6         | 0.6 <i>c</i>   | 1.080 <i>bc</i>        |
| 7         | 1.6 <i>c</i>   | 1.083 <i>b</i>         |
| 8         | 1.0 <i>c</i>   | 1.081 <i>bc</i>        |

\*GSP = Grower Standard Practice

<sup>y</sup> Figures in the same column and bearing the same letters are not significantly different from each other at the 0.10 level of probability

## Summary

The purpose of this study was to evaluate the effect of plant nutrient amendments on tuber performance of Russet potato. Data obtained from the study indicate that with significant hail damage, in-furrow application of GSP + Blackmax 22 + Extract and in-furrow application of GSP + foliar application of P,K, and Meritime can produce significantly higher total and marketable tuber yields of Russet Norkotah 296.

In-furrow application of ‘GSP + Blackmax 22 + Extract’ (T2), in-furrow application of ‘GSP + foliar application of K’ (T6), and in-furrow application of GSP + foliar application of P, K, and Meritime’ (T8), could improve tuber bulking of Russet Norkotah 296 significantly.

In-furrow application of clear #2, Black, and clear, can significantly increase tuber specific gravity of Russet Norkotah 296. No significant tuber external defects were observed in this study.



Table 6 Effect of application rate and application timing of plant nutrient amendments on tuber size distribution of Russet Norkotah 296 potato, 2021.

| Treatment | 4-16 oz.     | 6-16 oz.     | 10-16 oz.   |
|-----------|--------------|--------------|-------------|
| 1 (GSP)*  | 310 <i>b</i> | 215 <i>b</i> | 82 <i>a</i> |
| 2         | 349 <i>a</i> | 272 <i>a</i> | 85 <i>a</i> |
| 3         | 317 <i>b</i> | 228 <i>b</i> | 91 <i>a</i> |
| 4         | 300 <i>b</i> | 218 <i>b</i> | 94 <i>a</i> |
| 5         | 316 <i>b</i> | 222 <i>b</i> | 76 <i>a</i> |
| 6         | 305 <i>b</i> | 220 <i>b</i> | 86 <i>a</i> |
| 7         | 318 <i>b</i> | 228 <i>b</i> | 93 <i>a</i> |
| 8         | 320 <i>b</i> | 223 <i>b</i> | 83 <i>a</i> |

\*GSP = Grower Standard Practice

<sup>y</sup> Figures in the same column and bearing the same letters are not significantly different from each other at the 0.10 level of probability