Plant Growth Promotion Inducer in Commercial Potato Production

BENJAMIN HOGUE1, GUODONG LIU1*, STEVEN LANDS2, DAVID DINKINS3, AND STEVEN SARGENT1

1University of Florida, IFAS, Horticultural Sciences Department, P.O. Box 110690, Gainesville, FL 32611
2University of Florida, IFAS, St. Johns County Extension Service, 3125 Agricultural Center Drive, St. Augustine, FL 32092
3University of Florida, IFAS, Putnam County Extension Service, 595 E. St. Johns Ave., PO Box 728, Hastings, FL 32145

Within the last few decades, chemicals promoting plant growth have been employed on several major commercial crops. The use of these chemicals can provide plants with the necessary nutrients for crop production. ‘Langdale’, ‘Red LaSoda’, and ‘Vivaldi’ were grown and plant growth promotion inducer (PGPI) applied in Hastings, FL in spring of 2012. Differences were found among yields, with PGPI slightly but not significantly (P > 0.05) increasing marketable potatoes for both ‘Vivaldi’ and ‘Langdale’ and significantly (P < 0.01) reducing non-marketable ‘Langdale’ potatoes. ‘Red LaSoda’ potato yields were not significantly changed in PGPI plots; however, overall ‘Red LaSoda’ yields were low due to salinity issues caused by drought. Marketable yields were used to determine cost benefits (based on current market values) from the application of PGPI. These results indicated that PGPI can positively impact both ‘Langdale’ ($1,088/acre) and ‘Vivaldi’ ($319/acre) potato production with little impact on ‘Red LaSoda’. Tuber quality in ‘Langdale’ potatoes was significantly improved by PGPI based on the reduction of growth cracks and rots. By applying PGPI chemicals capable of promoting plant growth, both potato yields and tuber quality can be improved, increasing economic gains.

Materials and Methods

Site Description and PGPI Application. Tubers were planted at Blue Sky Farms in Elkton, FL. Soil analysis, before planting and treatment, revealed very high concentrations of phosphorus (P) and calcium (Ca), with adequate levels of zinc (Zn) and magnesium (Mg) in the soil. Potassium was present in low concentrations (Table 1). Soil pH ranged from 6.0 to 6.2, optimum levels for crop production and nutrient availability. The IFAS recommended fertilizer N–P–K–Ca application rates suggested were 200–0–150 for high P concentration soils. The soil testing lab’s recommendation for N–P–K–Ca was 225–0–380–0 with no pH altering lime necessary. The actual applied fertilizer (N–P–K–Ca) for ‘Red LaSoda’ was 180–100–260–186 Ca, while the applied fertilizer rates for ‘Langdale’ and ‘Vivaldi’ were 240–100–260–186 Ca. PGPI was applied with 1 pt of 350 DP (KeyPlex, Winter Park, FL) per acre on 24 Feb., 1 pt each of 350 DP, Nutriphite magnesium (KeyPlex), and N-sure (KeyPlex) per acre on 5 Mar. and 1 pt each of 350 DP and N-sure per acre on 14 Mar. 2012.

Experimental Design. Three potato varieties treated with and without PGPI were planted in this experiment: ‘Langdale’, ‘Red LaSoda’, and ‘Vivaldi’. Each was planted in triplicate plots with or without PGPI, 16 rows × 440 yds each, equaling 1.62 acres per replicate. Planting occurred on 10 Feb, 2012.

Potato Harvest and Grading. Potatoes were harvested 13 weeks after planting on 3 May 2012. Each replicate was sampled in four, 20-ft-long rows for grading and physiological analysis. Grading took place the same day as harvesting and
Table 1. Economic impact differences between PGPI and non-PGPI treatments for ‘Langdale’, ‘Red LaSoda’, and ‘Vivaldi’ potatoes per acre. Minimum (Min), maximum (Max) and average (Avg) are based on the lowest, highest, and average yields measured while KP indicates plots with PGPI applications.

<table>
<thead>
<tr>
<th></th>
<th>Min(KP)-Max</th>
<th>Min(KP)-Min</th>
<th>Avg(KP)-Avg</th>
<th>Max(KP)-Max</th>
<th>Max(KP)-Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Langdale</td>
<td>$217.91</td>
<td>$1,237.30</td>
<td>$1,088.57</td>
<td>$939.85</td>
<td>$1,959.23</td>
</tr>
<tr>
<td>Red LaSoda</td>
<td>–$588.06</td>
<td>–$334.65</td>
<td>–$241.36</td>
<td>–$148.06</td>
<td>$105.35</td>
</tr>
<tr>
<td>Vivaldi</td>
<td>–$282.65</td>
<td>$281.28</td>
<td>$319.90</td>
<td>$358.52</td>
<td>$922.45</td>
</tr>
</tbody>
</table>

potatoes were categorized as marketable and non-marketable. Marketable potatoes consisted of A1, A2, and A3 with diameters ranging from 1-7/8 to 2-1/2, 2-1/2 to 3-1/3, and 3-1/3 to 4 inches, respectively, as well as smaller sizes called creamers and B-Size. Non-marketable potatoes consisted of those too large (A4) and inedible tubers (green, growth crack, misshapen, and rotten). The sizes associated with C, B, and A4 were 1/2 to 1-1/2, 1-1/2 to 1-7/8, and >4 inches, respectively. Twenty potatoes for each harvested row were cut open to determine internal tuber defects that may be present. These were categorized as hollow heart (HH), brown rot (BR), corky ringspot (CRS), internal heat necrosis (IHNS) and brown center (low, medium, or high).

Economic estimation. While the free market determines prices of potato varieties from season to season, the 2012 season’s market price was used to determine potential economic gain from applying PGPI to these potato varieties. Marketable potatoes sold from this study were creamers, B-size, A1 and A2 sizes and prices varied between each variety. ‘Langdale’ potatoes per 50-lb bag were $24 (C), $8.50 (B), $12.50 (A1), and $6.50 (A2). ‘Vivaldi’ potatoes were $19 (C), $9.50 (B), $15.50 (A1), and $6.50 (A2) per 50 lb. ‘Red LaSoda’ potatoes were unusually low this year with prices of $16 (C), $14.50 (B), $10 (A1), and $4.50 (A2) per 50 lb. These numbers were used to calculate the economic differences between PGPI and non-PGPI treated potatoes per acre.

Statistics. All statistics were run using JMP version 10.0 (SAS Institute, Inc., Cary, NC). Differences in the measured parameters between the PGPI and non-PGPI crops were assessed using two-way analyses of variance (ANOVA) and Tukey’s test (P < 0.05).

Results

Yield and quality. Marketable yield in all three varieties was not significantly altered through the application of PGPI. However, ‘Vivaldi’ potatoes yielded significantly (P < 0.01) more marketable potatoes by weight than ‘Red LaSoda’ and ‘Langdale’ (Fig. 1). Non-marketable potatoes were significantly lower (P < 0.01) in the ‘Langdale’ potatoes treated with PGPI. This decrease in non-marketable ‘Langdale’ potatoes occurred as a result of significantly fewer green potatoes harvested. ‘Langdale’ potatoes also experienced a significant decrease in A3 size potatoes coupled with slight increases in A1 and A2 size potatoes. This increase in smaller sized marketable ‘Langdale’ potatoes suggests PGPI may be impacting marketable yield and further testing should be performed on the ‘Langdale’ variety. No significant differences in internal tuber defects were observed between PGPI and non-PGPI plots (data not shown).

Economic impacts. While yield weights of potatoes are important, the most important factor in determining if PGPI was beneficial for crop production was economic impact differences calculated between PGPI and non-PGPI treatments. There were no significant differences in marketable tuber yield between the PGPI and non-PGPI treatments. These data are summarized in Table 1, which shows the largest and smallest possible impacts of treatment, as well as, the difference between the minimum, average and maximum values of each treatment for each potato variety.

The direct material cost of applying PGPI to potato plants was $20.50 per acre in this particular study performed on Blue Sky Farms in 2012. However, this was only the preliminary results with three potato cultivars: ‘Langdale’, ‘Vivaldi’, and ‘Red LaSoda’. To verify the effects of PGPI application on potato productivity and profitability, more field trials are needed.

In summary, the effectiveness of PGPI in improving profitability of these three potato varieties, at this site location, is remarkable and variety dependent. PGPI application increased potato tuber values by $1,089 and $320 per acre for ‘Langdale’ and ‘Vivaldi’, respectively, due to more valuable potato tubers being produced. However, PGPI had negative impacts on ‘Red LaSoda’, which resulted in $241 loss per acre. In future experiments, the PGPI application schedule could be altered or different potato varieties could be included to determine PGPI effectiveness in enhancing potato crop profitability.

Literature Cited
