Protein Yield of Potato Tuber as Affected by Plant Density and Nitrogen Fertilizer

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ABSTRACT

In order to the study of the effects of plant density and nitrogen fertilizer on yield of protein content in potato tuber (Agria cultivar), a factorial experiment based on randomized complete block design was carried out in Ardabil region in 2009 with three replications. Factors were nitrogen fertilizer levels (0, 80, 160 and 200 kg/ha nitrogen) and plant densities (5.5, 7.5 and 11 plant/m²). Results showed that the highest number, dry weight and yield of tuber and protein yield per unit area and the lowest mean tuber weight and protein percent per plant were achieved in density of 11 plant/m². With increasing nitrogen application up to 80 kg/ha, number, dry weight, yield and protein content of tuber per unit area and mean tuber weight per plant, were increased. So, utilization of 80 kg/ha net nitrogen to achieve highest yield and lowest nitrate accumulation, 11 plant/m² to gain seed tuber according to reducing tuber weight and size and 7.5 plant/m² to eating utilizations, is recommended.

Key words: Tuber protein, Plant density, Potato and Yield.

Introduction

Potato is one of the most important industrial plants is a major role in feeding the world and for very high performance, the amount of energy and protein production per unit area is more than wheat and rice [4]. Nitrogen is essential for plant growth and one of the major components are proteins. When the plant grows in abnormal conditions, decreased protein production and non-protein nitrogen in the form of assembly plant gains [2]. Waddell et al [9] reported that nitrogen fertilizer, increased gland was compared with the controls. The average increase in yield of potato tubers from the use of nitrogen than the control, about 3.34 percent is [6]. Density in potato cultivation, some important characteristics of plants, such as total yield, bulb size distribution and quality affect the gland [8]. Yilma and Alvin [10] in a report, planting density of 624 thousand plants per square meter was recommended for potato. Maher [5] has reported that with increasing culture density, the average weight of tubers increased and low density, number of tubers harvested per unit area was low. Probably due to increased density of food stress and competition occurring within a plant or the number of large tubers that are produced in shoot high density, reduced the average size of lumps is [1]. With increasing plant density on bulb yield per unit area is increased [3].

The purpose of this study, we examined the effect of plant density and nitrogen fertilizer on protein percentage and yield, yield and yield
components of potato tubers, to determine the optimum level of nitrogen fertilizer and plant density was the most desirable in which the potato yield and environmental pollution is to establish minimum.

Materials and Methods

To investigate the effect of plant density and nitrogen fertilizer on yield of potato varieties Agria gland protein, a factorial experiment based on randomized complete block with three replications in 2009 was conducted in Ardabil. The first includes four levels of nitrogen fertilizer (0, 80, 160 and 200 kg N ha) and the second factor in three levels of plant density (5.5, 7.5 and 11 plants per square meter) as nitrogen source urea in two steps (at the time of planting and soil phase-forming plant foot) was to farm. Soil tests conducted according to the depth of 0-30 cm, EC saturated mud, the 3.68 M mhos / cm, and pH of soil 7.09, total N 0.56 percent and soil texture was sandy loam. Distance between rows, 60 cm, respectively. Each sub-plots included six 3-meter lines and the distance between plots to prevent lateral effect of fertilizer to the plot, about 1.5 m were considered. Meanwhile, a row with no additional fertilizer at a distance to avoid not planted marginal effect was planted. In order to maintain uniformity in the experiment, 60 to 70-gram lump of choice and the twenty fourth of May 2009 were planted. About 13-12 cm planting depth was considered. In the final harvest, which was used to determine performance (drying time 50 percent of the shoot) first aerial parts of about 10 days prior to action taken was to remove the skin glands classification is complete [4]. Then, after 10 days, the area of about 2 square meters of each plot sampling to determine the performance and other traits measured was performed. Glands harvested to measure different traits related to the glands were transported to the laboratory. Before measuring the traits associated with roots and tubers Stolon washed thoroughly with water and then rinse with distilled water were. To determine the dry weight, they have separate ventilation of the oven having temperature for 48 hours at 75°C C was placed. After finally passed the long dry samples with sensitive precision balance 0.01 g were weighed and recorded. To determine the protein gland, the gland initially percent nitrogen Kjeldal method measured the percentage of product at a fixed ratio 6.25, tuber protein, respectively. Protein function using the following equation was used (protein yield of tuber = tuber protein percentage × dry weight of tuber).

Results

The results showed that only the affected gland protein interaction of plant density at different levels of nitrogen fertilizer was the average weight of tubers per plant, protein function, number, dry weight and bulb yield per unit area for the simple effect of plant density and nitrogen fertilizer significantly respectively. Gland protein yield per plant increased with increasing plant density and plant density of 11 square meters and the highest value was increased to 160 kg of nitrogen fertilizer use increased and then decreased (Table 1). In combination treatments 160 kg nitrogen per hectare and 5.5 plants m high, and combined treatments in the level of control and 80 kg nitrogen per hectare in the density of 5.5 plants per square meter jointly lowest protein percentage glands were obtained (Figure 1). Increased use of nitrogen fertilizer to a certain extent increased the average tuber weight per plant was the highest so this trait in applying 160 kg N ha respectively. Meanwhile, the control surfaces and application of fertilizer nitrogen 200 kg ha statistically significant effect on the average weight of tubers per plant showed. Also observed that the density of 11 and 7.5 plants per square meter at least jointly Picks 5.5 plants per square meter was the highest rate of this trait (Table 1). Comparison table (Table 1) showed that increased to an optimum level of nitrogen fertilizer increased yield per unit area is the gland. Highest levels of this trait for nitrogen levels jointly for 80 and 160 kg of fertilizer per hectare and the lowest level of fertilizer was seen with increasing plant density and yield per hectare increased gland. Increased to an optimum level of nitrogen fertilizer increased dry weight per unit area is the gland. Maximum dry density of glands per unit area in 11 plants per square meter and the lowest densities of 5.5 and 7.5 plants per square meter was obtained jointly (Table 1). Density per unit area increases the number of tubers per unit area was. So that, densities of 11 and 7.5 plants m the highest density in the joint 5.5 plants per square meter was the next category (Table 1).

Discussion

Percentage and yield of protein

In combination treatments 160 kg nitrogen per hectare and 5.5 plants m high, and combined treatments in the level of control and 80 kg nitrogen per hectare in the density of 5.5 plants per square meter jointly lowest protein percentage glands were obtained (Figure 1). Gland protein yield per plant increased with increasing plant density and plant density of 11 m at the highest level was increased to
Table 1: Simple effects of plant density and Nitrogen level on measured traits. (Average of two years).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Tuber protein (g)</th>
<th>Protein yield of tuber (g m(^{-2}))</th>
<th>Dry weight of tuber (g m(^{-2}))</th>
<th>Mean tuber weight (g per plant)</th>
<th>Number of tuber (m(^2))</th>
<th>Tuber yield (g m(^{-2}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen fertilizer level (kg ha(^{-1}))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7.82a</td>
<td>39.3b</td>
<td>498.79b</td>
<td>23.29b</td>
<td>63.86b</td>
<td>2024.6b</td>
</tr>
<tr>
<td>80</td>
<td>8.27a</td>
<td>54.95a</td>
<td>669.95a</td>
<td>30.21ab</td>
<td>93.35a</td>
<td>2994.1a</td>
</tr>
<tr>
<td>160</td>
<td>8.27a</td>
<td>57.78a</td>
<td>728.18a</td>
<td>33.67a</td>
<td>100.9a</td>
<td>3174.6a</td>
</tr>
<tr>
<td>200</td>
<td>7.94a</td>
<td>39.3b</td>
<td>498.23b</td>
<td>24.85b</td>
<td>80.23ab</td>
<td>2457.0b</td>
</tr>
<tr>
<td>Plant density (plant m(^{-2}))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>8.23a</td>
<td>42.13c</td>
<td>525.35b</td>
<td>30.55a</td>
<td>77.12b</td>
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<tr>
<td>7.5</td>
<td>8.02a</td>
<td>47.55b</td>
<td>580.32b</td>
<td>27.36ab</td>
<td>81.62ab</td>
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</tr>
<tr>
<td>11</td>
<td>7.96a</td>
<td>59.18a</td>
<td>742.45a</td>
<td>26.11ab</td>
<td>95.00a</td>
<td>3167.6a</td>
</tr>
</tbody>
</table>

*Numbers with same words in each column, have no significant differences to each other.

Fig. 1: Interaction effects of plant density × nitrogen on nitrogen percent of tuber.

160 kg N fertilizer application increased the levels of this trait and the level of 160 kg, 80 kg, from a statistical groups were (Table 1). Probably due to reduce tumor weight in high densities and thus reduce the dry bulb, the bulb of protein function is reduced. However, with increasing nitrogen fertilizer application to a certain extent, dry weight of tubers increased so that the expected yield of protein increased. Results by Saeedi [7] this experiment is also quite similar.

Yield and yield components

The higher plant density, dry weight and bulb yield per unit area increased (Table 2). Increasing yield per unit area with increasing plant density by Jagroop et al [3] has also been reported. With increasing nitrogen application to 160 kg, number, dry weight and bulb yield per unit area and average weight of tubers per plant, increased and then decreased. This due to the excessive expansion of aerial application of nitrogen fertilizer Poor (more than 160 kg per hectare), followed by increased competition within a plant to achieve environmental resources like water and food, reduced significantly the performance and its components in 200 kg of fertilizer per hectare, is that this result completely in accordance with previous research results are [7]. The density of 5.5 plants m\(^{-2}\) highest average weight of tubers per plant was obtained. Probably due to increased plant density reduced food availability and competition for every plant within a plant, or in terms of a large number of tubers that are produced in shoot high density, reduced the average size of lumps is [1]. Meanwhile, the plant density increases leading to a significant increase in the number and dry weight per unit surface of the gland was. Saeedi [7] reported that increasing nitrogen intake with tubers, average weight increased but if the bulb will be optimal nitrogen rate of consumption exceeds the average tuber weight will be reduced.

Conclusion

In general observed that fertilizer levels used in this experiment, especially at the level of 80 kg N ha gland and protein levels in the fertilizer, was higher than other levels. The optimal level of fertilizer nitrogen fertilizer to nitrogen protein conversion efficient and well taken. Thus, consumption of 80 kg fertilizer N ha pure form, to achieve maximum performance for cultivar Agria tubers in the Ardabil region is recommended. Considering the average yield of potato tubers in the Ardabil region against 28.7 ha is compared with the functions of the fertilizer treatments 80 and 160 kg in this study (respectively, 29.94 and 31.74 ton ha), fertilizer recommendations can be said that the Ardabil region is used. The density of 11 plants per square meter according to the weight glands and their size is suitable for seed tubers. But if the market-friendly and oral comments to be considered, density 7.5 plants per square meter suitable for this variety is recommended.
References


