Effects of Different Sizes of Mini-tuber on Yield and Yield Components of Potato Variety Agria

Alireza Mahmoudpour 1*

1PhD student of Agronomy, Agricultural University of Tajikistan
*Corresponding author: Email: alirezampour@yahoo.com

ABSTRACT

Given the importance of potato in the economy and people’s nutrition, as well as planting of disease-free seeds, it seems necessary to produce healthy seeds through tissue culture. This study was conducted during 2012-2013 at the Research Center of Agricultural University of Tajikistan aiming to evaluate the effect of different sizes of mini-tuber on yield and yield components of potato crop. Agria variety plantlets derived from tissue culture were grown in pots; the yielded mini-tubers were divided according to size into lighter than 1 g, 1-5 g, 5-10 g, and heavier than 10 g treatments, which then were evaluated in randomized complete block design in four replications. The results showed that tuber weight, the mean of bush yield, and the yield per area unit increased following the increase in mini-tuber weight. The highest mean number of tubers was produced from 5-10 g mini-tubers. Examination of other traits showed that the mean number of eyes and diameter of tubers increased by increasing mini-tuber weight. According to the results, mini-tubers lighter than 1 g are not suitable for planting.

Key words: potato, tissue culture, mini-tuber

Introduction

As one of the most important crops in the world, potato follows wheat and rice in terms of food and production significance. In addition to industrial use, it sometimes substitutes for wheat. Moreover, potato is one of the four basic food materials worldwide after wheat, rice, and maize (FAO, 2008). Potatoes are usually propagated by seed tubers which could be the most important factor in the spread and transmission of disease. The quality of seed tuber not only directly affects the crop grown from seed, but also any possible disease on or inside tuber can spread to adjacent fields or into the soil. Sometimes, attacks of viruses to potatoes may destroy 80% of the product; therefore, the most effective way to fight viral pathogens is the use of disease-free tubers. Given the progress of tissue culture, conducting studies in this regard seems necessary. Mini-tubers are the progeny tubers produced on in vitro derived plantlets (Struik, 2007). Seed potato production involving mini-tuber production systems has found its place all over the world. This system creates a bridge between the in vitro rapid multiplication and the field multiplication of seed tubers and is thus a classical way to multiply or acclimatize in vitro material before its use in the open field. Producing mini-tubers from in vitro plantlets allows a faster rate of multiplication and reduces the number of field generations needed in seed production (Ranalli, 1997) and thus improves the health status over conventional seed potatoes (Haverkort et al., 1991). (Sulotana et al. 2001) studied...
the effect of seed tuber size and planting depth on the growth and yield of potatoes and stated that seed tuber size significantly affect the growth and yield of potatoes. They planted tubers derived from true seeds in 4 weight treatments (5, 7.5, 12.5, and 17.5 g) in 4 different planting depths (shallow planting, 2.5, 5, and 7.5 cm) and found that the highest yield (34.39 t/ha) was from the largest seeds (17.5 g). (Lommen et al. 1995) studied the storage period of tubers and determined that almost all mini-tubers heavier than 0.5 g survived at 2 °C for 1.5 years. The results of this study showed that tubers’ yield was largely affected by seed tubers weight, and lighter tubers had a longer sleep. Plants grown from lighter tubers spend more time for germination and their buds have thinner stems, smaller roots, and higher stem to root ratio; the number and weight of tubers produced was low in plants as well. (Ozkaynak and Samansy, 2004) examined the relationship between yield and yield components by planting two different sizes of mini-tubers (2-4 g and 11-15 g) and reported that number of stems, number of tubers, and tuber weight of plants grown from heavier mini-tubers was higher than that of plants grown from lighter mini-tubers. In general, there is a positive relationship between tuber and other components of the yield. (Tornton and Neundorfer, 1986) stated that the total yield of tuber increases following increase in tuber size. In addition, 2-5 weeks delay in harvest of tubers decreased stem production and tuber yield, but did not affect the number of tubers per plant.

Materials and Methods

This study aimed to choose the best weight of mini-tuber for raising the efficiency of potato yield per unit area. The study was conducted in the Research Center of Agricultural University of Tajikistan in a greenhouse with an area of 240 m2 during 2012-2013. Land preparation included rotavating, collecting weeds, and adding phosphorous and potassium fertilizers to the soil (7.5 kg potassium sulfate and 12.5 kg triple superphosphate). Potato variety used in this experiment was Agria with four mini-tubers sizes including lighter than 1 g, 1-5 g, 5-10 g, and higher than 10 g treatments. They were examined in four replications in a randomized complete block design. According to a culture map, the minitubers were planted with a spacing of 20 cm in rows at a distance of 75 cm from each other. The first irrigation was done immediately after planting. In order to eliminate possible bugs, Diazinon insecticide at a concentration of 1.5 parts per thousand was sprayed 10 days after planting. Moreover, the existing weeds were removed through hand weeding during the growing period. After 45 days, 20 kilograms of urea fertilizer was top-dressed on the land and the product was harvested after 90 days.

Results and Discussion

The results of variance analysis in (Table 1) show that there is a significant difference at 1% level between various weights of mini-tubers in the number of eyes per tuber. No significant difference was observed in the mean number of eyes between treatments lighter than 1 g and 1-5 g; however, the difference in the mean number of eyes between 5-10 g and heavier than 10 g was significant at 1% level. According to the results of comparison of the means, the number of eyes in the treatment heavier than 10 g with a mean of 6.02 was higher than those in the treatment lighter than 1 g with a mean of 4.72 (Fig 1). Comparison of the average yield per plant and yield per hectare shows that increasing mini-tubers weight has increased the yield. However, this increase was not significant in the treatments 5-10 g and heavier than 10 g (Fig 2, 3). The results of this experiment showed that average number tubers of tubers in all treatments had no significant difference and the highest number of tubers (8.46 per plant) was seen in the treatment 5-10 g (Table 2). But generally the number of tubers increased by increasing mini-tubers weight; this can arise from different factors such as genotype, nutrients store of seed tubers, tuber size,
culture spacing, irrigation, weather, and the number of stems per plant (Fig 4). (Bardas, 2004) suggested that the number of tubers is a function of mini-tubers size, i.e. the number of tubers increases by increasing mini-tuber size. The results showed that the average weight of tubers per plant significantly differed at 5% level (Table 1); such that the tubers weight increased following increasing of mini-tubers weight and the highest weight of tubers was observed in the treatment heavier than 10 g with an average of 79.09 g. (Rykbost et al. 2004) stated that the size of mini-tubers has a direct impact on the weight of tubers per plant. In general, small seeds have smaller leaf area index, which result in decreased photosynthetic potential. Moreover, germination percentage is less affected by the size of mini-tubers.

Table 1. Analysis of variance for Mean number of eyes, number of tubers per plant, diameter of tubers and tuber weight.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>Mean number of eyes</th>
<th>Mean number of tubers per plant</th>
<th>Mean diameter of tubers</th>
<th>Mean tuber weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>3</td>
<td>0.74</td>
<td>1.98</td>
<td>8%</td>
<td>2.61 ns</td>
<td>88.97</td>
</tr>
<tr>
<td>Treatment</td>
<td>3</td>
<td>3.79**</td>
<td>2.61</td>
<td>0.92*</td>
<td>3.34</td>
<td>496.3*</td>
</tr>
<tr>
<td>Error</td>
<td>9</td>
<td>0.77</td>
<td>3.34</td>
<td>3.34</td>
<td></td>
<td>81.24</td>
</tr>
</tbody>
</table>

Figure 1. Effect of mini-tuber weight on number of eye
Figure 2. Effect of mini-tuber weight on tuber yield per ha (ton)
Table 2. Mean comparison of different sizes of mini-tuber

<table>
<thead>
<tr>
<th>Mini-tuber weight (g)</th>
<th>Number of eyes</th>
<th>Number of tubers</th>
<th>Diameter of tubers (Cm)</th>
<th>Tuber weight per plant (g)</th>
<th>Tuber diameter per tuber (g)</th>
<th>Tuber yield per ha (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lighter than 1 (g)</td>
<td>4.72</td>
<td>6.55 ab</td>
<td>3.99</td>
<td>53.85</td>
<td>c</td>
<td>21163.05</td>
</tr>
<tr>
<td>1-5(g)</td>
<td>5.01 bc</td>
<td>7.13 a</td>
<td>4.05</td>
<td>64.27</td>
<td>bc</td>
<td>27494.70</td>
</tr>
<tr>
<td>5-10(g)</td>
<td>5.41 b</td>
<td>8.46 a</td>
<td>4.67</td>
<td>72.07</td>
<td>ab</td>
<td>36582.73</td>
</tr>
<tr>
<td>heavier than 10 (g)</td>
<td>6.02 a</td>
<td>7.59 a</td>
<td>4.96</td>
<td>79.09</td>
<td>a</td>
<td>36017.40</td>
</tr>
</tbody>
</table>

Figure 3. Effect of mini-tuber weight on Tuber weight per plant
Figure 4. The effect of mini-tuber weight on number of tubers, diameter of tubers and weight per tuber

The yield increase can be attributed primarily to increased weight of mini-tubers. Moreover, increase in the number of tubers per plant, though not significant in this study, has affected the yield. In a study, (Rykhost et al. 2004) concluded that larger mini-tubers increase the yield through increasing the number and size of tubers.
In general, it can be concluded that by increasing the weight of mini-tubers, the weight treatments of mini-tubers were significantly increased in terms of growth indices, including the number of eyes, the number of tubers, weight, diameter, and yield per unit area; except for the number of tubers in the treatment lighter than 1 g that show no change following weight increment; and in general, yield increase could be the result of increased tuber weight.

Conclusion

According to the results, mini-tubers lighter than 1 g are not suitable for planting. Similar results reported by other researchers (Sulotana et al. 2001) that seed tuber size significantly affect the growth and yield of potatoes.

Acknowledgments

Thanks to, Agricultural University of Tajikistan and Mr. Ahmadreza Mahmoodi Moghaddam, who helped me in this article.

References

