YIELD PERFORMANCE OF TRUE POTATO SEEDS (TPS) HYBRIDS UNDER CLIMATIC CONDITIONS OF NORTHERN AREAS

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ABSTRACT

Four true potato seed (TPS) hybrids were evaluated for tuber yield with a standard variety (Diamont) at Naltar Seed Valley Northern Areas, Gilgit during the 2005 crop season. Various agronomic parameters like number of stems per plant, seedling vigor, number of tubers per m², yield of tubers per hectare and grading weight percentage were assessed. The TPS hybrids Atzimba x TPS-67 and LT-8 x TPS-67 gave greater tuber yield (43 tons/ha) than the standard variety Diamont. Diamont and the TPS hybrid MF-I x TPS-67 did not significantly differ for tuber yield per hectare whereas the TPS hybrid MF-II x TPS produced the lowest number of tubers per m², number of tubers per plant, number of tubers per m² and yield per hectare (29.2 ton). On the basis of this study, it is concluded that TPS parent TPS-67 (male parent) has a better combining ability with TPS parents LT-8 and Atzimba, hence true potato seed (TPS) of these hybrids are recommended for general cultivation in Northern Areas of Pakistan.

Key Words: True potato seed (TPS), Genotypes, Agronomic Parameters, Northern Areas

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INTRODUCTION

Potato (Solanum tuberosum L.) belongs to the family solanaceae and is the fourth biggest crop of the world after wheat, rice and maize (Anonymous, 1995). In Pakistan, this important crop is grown over an area of 109500 hectares with a total production of 1810400 tones. Average yield of potato is 16.5 tones per hectare (Anonymous, 2005). The current yield (19.4 ton/ha) is very low as compared to some developed countries of the world (Anonymous, 2007). Main reason of low yield in Pakistan is non-availability of quality seed at planting season. Imported seed costs 50-60% of the total cost of production, which is beyond the purchasing power of the small farmers (Nizam et al., 2005). To overcome this barrier, an alternative and cheap technology must be developed to produce potatoes with low cost for low income peoples of remote mountainous regions like northern areas of Pakistan. This problem can be solved by the use of an alternative method of potato production like TPS. This could reduce the total production cost for the small farmers. Moreover, TPS is easier to store from one planting season to another and its transportation and management is easier than perishable tuber seeds. In the conventional system 2.5 tons seeds of bulky tubers are needed to plant one hectare of potato crop as compared only 100 grams of TPS fulfills the some requirements. The main objective of this study was to select the suitable TPS hybrids for better tuber yield and other desirable characters for mountainous regions of northern areas of Pakistan.

MATERIALS AND METHODS

The research was conducted at Nalter Valley, 25 kilometers away from Gilgit city during 2005 cropping season. During 2004, one male TPS parent TPS-67 was crossed with four female TPS parents to produce TPS hybrids (1) Atzimba x TPS-67, (2) LT-8 x TPS-67, (3) MF-I x TPS-67 and (4) MF-II x TPS-67. Next year, these four TPS hybrids were evaluated for their performance in comparison with a standard variety, Diamont. Pre basic I category tubers of Diamont were used as local check. True potato seeds (TPS) were sown in wooden crates filled with sterilized peat moss. Germinating seedlings were protected from direct sunlight and were irrigated to keep the peat moss moist. Emergence of TPS was completed in 10-15 days after sowing. Sowing was done in first week of May in a glass house at Gilgit and one month old seedlings were transplanted at Nalter Seed Valley. Field was
prepared by ploughing followed by planking. Ridges were made as recommended for potato crop. 5-10 cm fully grown seedlings were transplanted after sunset to avoid severe sunshine. The distance between the rows was maintained at 75 cm and plant to distance as 20 cm. A randomized complete block design (RCBD) with three replications was used. Full doses of Phosphorous and Potash and 50% Nitrogen fertilizers were applied at the time of transplanting. Rate of fertilizer was 200-150-75 NPK kg/ha as recommended.

First Irrigation was given just after transplanting and subsequent irrigations were given as and when required. The seedlings were transplanted at 5th June 2005 and harvested at 14th September 2005. The remaining cultural practices were applied uniformly. The data were recorded for number of stems plant\(^1\), seedling vigor, number of tubers plant\(^1\), Tuber yield (kg ha\(^{-1}\)). The data were subjected to analysis of variance (Steel and Torrie, 1981). Variables showing significant differences among the treatments were further tested for comparison of significance of means by using Duncan’s multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Number of Stems Plant\(^1\)

Number of Stems Plant\(^1\) is important because it influences the number and size of tubers at harvest. The data presented in Table-I showed that the hybrid Atzimba x TPS-67 produced the maximum number of stems/plant (6.60) whereas the hybrid LT-8 x TPS-67 and MF-I x TPS-67 produced the lowest number of stems/plant (6.00 and 5.73) respectively which are statistically at par with each other. Among TPS, MF-II x TPS-67 produced lower stems per plant (5.40) compared to other genotypes, Diamont (control variety) produced the lowest number of stems per plant (3.53). These results are in accordance with the findings of Rashid et al. (1990) who reported that TPS families produced significantly higher number of stems and better growth than that of standard varieties.

Seedling Vigor

Seedling vigor is essential for seedling performance under the adverse conditions commonly encountered during field development. Current study indicated that seedling derived from TPS had better vigor. The data pertaining to plant vigor presented in Table-I show significant difference between hybrids. Hybrids MF-I x TPS-67 and MF-II x TPS-67 displayed the highest plant vigor with values 3.83 and 3.73 respectively. Hybrids LT-8 x TPS-67 and Atzimba x TPS-67 had plant vigor of 2.85 and 2.80 whereas Diamont (control) showed plant vigor with the value of 2.70 but statistically at par with Atzimba x TPS-67 and LT-8 x TPS-67. Generally, all TPS hybrids including standard variety Diamont responded better for plant vigor and this may be attributed to more conducive temperature during summer season where temperature remains 20-30°C throughout the growing season. However, the differences among genotypes may be due to genetic differences between families. These vigorously growing families can be expected to produce higher tubers per plant and better yield per unit area. Beukema and Zaag (1990) explained that plant vigor is the potential of a family for sprouting, stem length, LAI and total dry matter production per plant.

Table 1

<table>
<thead>
<tr>
<th>Genotype</th>
<th>No. of stems per plant</th>
<th>Seedling Vigor</th>
<th>Total tubers/m²</th>
<th>Yield ton/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamont</td>
<td>3.53 C</td>
<td>2.70 B</td>
<td>99.33 C</td>
<td>38.07 B</td>
</tr>
<tr>
<td>Atzimba x TPS-67</td>
<td>6.60 A</td>
<td>2.80 B</td>
<td>254.66 A</td>
<td>43.07 A</td>
</tr>
<tr>
<td>LT-8 x TPS-67</td>
<td>6.00 AB</td>
<td>2.83 B</td>
<td>246.33 A</td>
<td>43.50 A</td>
</tr>
<tr>
<td>MF-I x TPS-67</td>
<td>5.73 AB</td>
<td>3.83 A</td>
<td>231.33 AB</td>
<td>35.90 B</td>
</tr>
<tr>
<td>MF-II x TPS-67</td>
<td>5.40 B</td>
<td>3.73 A</td>
<td>207.66 B</td>
<td>29.20 C</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>1.194</td>
<td>0.2382</td>
<td>32.33</td>
<td>4.147</td>
</tr>
</tbody>
</table>

Total Tubers/m²

The data presented in Table I showed that the difference in total number of tubers per unit area was highly significant. TPS Genotype Atzimba x TPS-67 and LT-8 x TPS-67 produced more number of tubers/m² (254.66 and 246.37) followed by genotype MF-I x TPS-67 and MF-II x TPS-67 which produced 231.33 and 207.66 tubers/m² respectively. The lowest number of tubers was produced by check Diamont that produced 99.33/m². From this study it appeared that TPS families had better potential and adoptability to flourish and give higher number of tubers/m². The results of the present study agree with the results reported by Madalgeri (1999), Dabas et al. (1994) and Sikka et al. (1994) who reported that potato crop was more economical by growing TPS families.
Yield tons ha$^{-1}$

It is evident from the data presented in Table I that TPS genotypes LT-8xTPS-67 and Atzimba x TPS-67 yielded 43.50 and 43.07 tons/ha, respectively. These two genotypes are statistically at par with each other. Whereas the standard variety, Diamont, yielded 38.07 tons/ha, the TPS genotype, MF-I x TPS-67, produced 35.90 tons/ha. TPS genotype MF-II x TPS-67 produced the lowest tuber yield (29.20 tons/ha). These results indicate that TPS genotypes performed better for final tuber yield. With almost 1/10th seed rate TPS families yielded significantly better than that of Diamont. The results of this study revealed that by the use of TPS one could save 50% expenses of seed.

Grading Weight Percentage (smaller size 1-25 g)

The results in relation to small tubers turned out to be significant between genotypes (Table II). The highest number of small tubers (1-25 g) were recorded in all the four TPS hybrids with values MF-I x TPS-67 48.35%, Atzimba x TPS-67 45.00%, MF-II x TPS-67 40.00% and LT-8 x TPS-67 37.66% which are statistically at par to each other. All the TPS families produced relatively higher percentage of small tubers. These findings are in agreement with results of Taralaua et al. (1998) who evaluated TPS hybrid family MF-I x TPS-67 at three locations and concluded that large medium and small size tubers were observed in the ratio 17:33.3:65. Kadian et al. (1996) also reported that the fraction of the smallest grade of autumn and spring seedlings crop were 36.30 and 40.70%, respectively.

Medium Size Tubers (25-50 g)

The data regarding number of medium size tuber (25-50 gram/m$^2$) are presented in Table II. It indicates significant difference between genotypes. All the hybrids families were at par for production of medium size tubers. No medium sized tubers were produced by check variety Diamont. However, these results are in conformity with the findings of Shivandam et al. (1998) who observed seeds of four TPS progenies which sown in nursery beds in India. The seedlings were harvested after 100 days of sowing and graded for weight and yields. TPS family MF-II x TPS-13 produced the highest number of medium tubers. Kadian et al. (1996) also studied five TPS hybrid families MF-II x TPS-13, MF-II x TPS-67, TPS-7 x TPS-67, TPS-25 x TPS-13 and TPS-25 x TPS-67 in autumn and spring seasons at the central Potato Research Station Madipuram India. They reported that performance of all the families for seedling tubers during the autumn seasons was comparatively better than spring. Verma & Singh and Chaudhry et al. (1991) also reported that TPS-7 x TPS-67 produced highest mean medium tubers followed by MF-I x TPS-67. In their study the performance of MF-I x TPS-67, TPS-7 x TPS-67 and MF-I x TPS-13 was excellent. It is concluded that these families can be used for seedling tubers, production for both the seasons for better results.

Table II: Performance evaluation of TPS hybrids for grading weight yield in comparison with standard variety

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>1-25 g</th>
<th>25-50 g</th>
<th>50-100 g</th>
<th>100 g and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamont</td>
<td>0.00 B</td>
<td>0.00 B</td>
<td>45.00 A</td>
<td>55.00 A</td>
</tr>
<tr>
<td>Atzimba x TPS-67</td>
<td>45.00 A</td>
<td>37.66 A</td>
<td>10.00 B</td>
<td>7.33 B</td>
</tr>
<tr>
<td>LT-8 x TPS-67</td>
<td>37.66 A</td>
<td>41.33 A</td>
<td>13.33 B</td>
<td>7.66 B</td>
</tr>
<tr>
<td>MF-I x TPS-67</td>
<td>48.33 A</td>
<td>28.33 A</td>
<td>15.66 B</td>
<td>7.33 B</td>
</tr>
<tr>
<td>MF-II x TPS-67</td>
<td>40.00 A</td>
<td>33.33 A</td>
<td>20.00 B</td>
<td>6.33 B</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>18.38</td>
<td>14.00</td>
<td>17.37</td>
<td>14.34</td>
</tr>
</tbody>
</table>

Large Tubers (50-100 g)

The data regarding large number of tubers (50-100 g)/m$^2$ presented in Table II showed significant difference between genotypes. The check variety Diamont produced higher percentage (45%) of large sized tubers (50-100 g) than all TPS hybrid families. The TPS F1 hybrids were at par with each other. The difference in the number of large tubers among TPS families might be due to certain genetic factors which favoured TPS hybrid families MF-I x TPS-67, MF-II x TPS-67 to flourish better in climatic conditions. These results are in agreement with the findings of Kadian et al. (1996) who reported that MF-II x TPS-67, MF-II x TPS-13 and TPS-7 x TPS-67 produced the higher percentage of large size tubers per unit area.

Tubers 100g and Above

The perusal of data Table II revealed significant effect of genotypes was observed regarding large number of tuber/m$^2$. Among the genotypes control variety produced the largest number of large size tubers with 55.00%. All the TPS genotypes produced large tubers in less percentage with values ranging from LT-8 x TPS-67 7.66%, Atzimba x TPS-67 7.331, MF-I x TPS-67 7.33% and MF-II x TPS-67 6.331. All the hybrids are statistically at par to each other. The crop planted at Naltar Gilgit received very short period for growth and development i.e. hardly 100 days. In the month of
September temperature falls below the optimum growth allowing only a short period for growth and development. In case of transplanting seedlings the crop took 15-20 days for reestablishment and this gape was not recovered by plants in case of seedlings of the crop planted at early May then the crop receive more than 130 days and more no of large tubers are expected.

CONCLUSION AND RECOMMENDATIONS

On the basis of this study, it is concluded that TPS parent TPS-67 (male parent) has a better combining ability with TPS parents Lt-8 and Atzimba, hence TPS hybrids Atzimba x TPS-67 and LT-8 X TPS-67 produced greater tuber yield than the standard variety Diamont.

It is recommended that more TPS parental lines may be included in the further research programme and suitable parents may be selected that is acceptable to end consumers; Early plantation of TPS lines in hilly areas may be ensured so that maximum seed could be related to seedling tuber production. J. Indian Potato Assoc. 19: 17-20.

REFERENCES