INFLUENCE OF PHOTOPERIOD AND TEMPERATURE ON TRUE POTATO SEED (TPS) GERMINATION AND SEEDLING GROWTH

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ABSTRACT: TPS germination and seedling establishment is very poor if seeds are not sown under proper environmental conditions. To find out the optimum environmental conditions for true potato seed (TPS) germination and seedling growth, a series of experiments were conducted in growth chambers at 20, 22, 24, 26, 28 and 30°C in combination with 12, 14 and 16 h photoperiod. Temperature had the major effect on seed germination and seedling growth followed by interaction of temperature with photoperiod and photoperiod alone. The optimum photoperiod for seed germination and seedling growth was 12 h. The optimum temperature for seed germination was found to be 24-26°C, whereas optimum root and shoot growth occurred at 28-30°C.

Apart from the genotype, temperature and photoperiod are the major environmental factors that influence all morphological growth stages of potato plant, like seed germination, vegetative growth, flowering and tuberization (Steward et al., 1981). Effect of photoperiod and temperature on various characteristics of potato crop have been well documented, e.g. total tuber yield and average number of tubers (Haynes et al., 1988), tuber initiation (Wheeler et al., 1986), tuber dry weight (Synder and Ewing, 1989) and cultivar differences (Lemaga and Caesar, 1990). However, there is little information available on the influence of photoperiod and temperature, individually as well as in combination, on TPS germination and seedling growth. Such information is required to select a suitable period for TPS planting in various regions of the country. A factorial experiment was conducted in growth chambers under controlled temperature and photoperiod. Main effects of six temperature regimes (20, 22, 24, 26, 28 and 30°C) and three photoperiods (12, 14, 16 h) were studied. Seeds were germinated in Petri dishes lined with moistened filter paper. Four replications of 25 seeds each were studied at each combination of temperature and photoperiod. Germination was recorded on 7th day and observations on root length, shoot length, shoot dry weight and leaf formation were recorded on 21st day after sowing. Data was analyzed using MSTAT software.

The main effects of temperature and photoperiod and their interaction with each other on seed germination were high. Maximum TPS germination (94%) and shoot dry weight (43.5 mg) occurred at 26°C under 12 h photoperiod while, minimum germination (29%) and dry shoot weight (9.8 mg) were observed at 20°C under 14 h photoperiod. The results showed that the temperature ranging from 24-26°C generally assured good germination percentage and shoot dry weight, the two most important seedling parameters, in all the three photoperiodic regimes. Temperatures lower than 24°C and higher than 26°C significantly reduced the germination percentage as well as dry shoot weight. In these two parameters also, the maximum trait value occurred under 12 h photoperiod at all the temperature regimes when compared with other two photoperiods (Table 1).

Maximum (24.72 mm) and minimum (10.99 mm) root lengths were observed at 28°C under 12 h photoperiod and at 20°C and 14 h photoperiod, respectively. Root lengths in all the seedlings increased with rise in temperatures from 20-28°C and then it declined at 30°C under all the 3 photoperiodic regimes. Maximum root length occurred under 12 h photoperiod at all the temperatures when compared with other photoperiods, except at 22°C when maximum root length was observed under 16 h photoperiod (Table 1).

The effect of temperature on shoot length was maximum at 30°C at all the three photoperiods. Maximum shoot length (6.20 mm) was observed at 30°C under 12 h photoperiod while, minimum shoot length (3.02 mm) was observed at 20°C under 14 h photoperiod. Like root length, maximum shoot length occurred under 12 h photoperiod and then it decreased with increasing photoperiodic regimes (Table 1).

Germinated seedlings showed no leaf formation at 20°C under all the 3 photoperiod regimes and at 30°C under 16 h photoperiod, however, very few seedlings showed leaf formation (11.11%) at 30°C under 12 and 14 h (5.88%) photoperiods. Maximum seedlings showed leaf formation at 28°C and 12 h photoperiod. Like other seedling parameters, percent seedlings with leaf formation was maximum at 12 h and minimum at 16 h photoperiodic regimes in all the temperatures (Table 1).
Table 1. Effect of day length and temperature on seed germination and seedling characteristics

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Photoperiod (h)</th>
<th>Root length (mm)</th>
<th>Shoot length (mm)</th>
<th>Germination (%)</th>
<th>Shoot dry weight (mg)</th>
<th>Leaf formation (%)</th>
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<tbody>
<tr>
<td>20</td>
<td>12</td>
<td>12.45</td>
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<tr>
<td>20</td>
<td>14</td>
<td>10.99</td>
<td>3.02</td>
<td>29</td>
<td>9.80</td>
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<tr>
<td>20</td>
<td>16</td>
<td>10.95</td>
<td>3.11</td>
<td>45</td>
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<td>0.00</td>
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<tr>
<td>22</td>
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<td>14.49</td>
<td>3.48</td>
<td>49</td>
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<td>49.07</td>
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<td>3.32</td>
<td>45</td>
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<td>16</td>
<td>16.63</td>
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<td>66</td>
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<tr>
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<td>15.35</td>
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<td>2.13</td>
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<td>1.58</td>
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</table>

The temperature effect was relatively greater for all the seedling traits studied followed by its interaction with photoperiod and least effects were of photoperiod. The analysis of variance revealed that temperature (20-30°C) had the strongest effect on various seedling parameters like root length, shoot length, final germination percentage, seedling dry weight and leaf formation (%). Photoperiod (12-16 h) as well as its interactions with temperature had significant effects on final germination percentage, seedling dry weight and leaf formation (%), it had non-significant effects on shoot and root lengths. There was no significant main effect of photoperiod and its interaction with temperature on shoot length and root length. The optimum photoperiod for seed germination and all seedling parameters was 12 h and longer photoperiods were inhibitory. This can be explained by the fact that potato evolved in the highlands of Andes near the equator where photoperiod is around 12 h and appears to have been conserved evolutionarily. Optimum temperature for seed germination was found to be 24-26°C and for seedling growth it was 28-30°C.

Literature cited:


