GERMINATION OF PELLETIZED AND NATURAL PETUNIA X HYBRIDA SEEDS AFTER LONG TERM STORAGE

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Abstract: Pelleting is used by seed companies to improve the sowability of small and unevenly shaped seeds that could not be sown by a sowing machine. Petunia x hybrida is among the most popular annuals worldwide. The seeds are relatively small so young plants producers request pelleted seeds. The only drawback of pellets could be lowering the germination rate after 3 years of guaranteed shelf live. Natural seeds keep high germination longer, usually for 3–5 years. In this experiment was tested germination rate of 14 F1 Petunia varieties from 2000 till 2014. In 2006 the seeds were pelleted. According to this experiment the natural seeds kept high germination after 13 years if stored in optimal conditions. The germination rate after harvesting and in 2014 was not statistically different on p = 0.05. The germination of pelleted seeds and natural seeds stored in room temperature decreased over the years.

Key Words: seeds, Petunia, pelleting, long term storage, germination

INTRODUCTION

Pelleting is a technology nowadays widely used by seed companies. It does not influence the physiological attributes of the seeds, like priming or pregermination, but improves the sowability of the seeds (Halmer 1994). The layer of inert material significantly increases the size and weight of small seeds and also changes their irregular shape. This enables mechanical sowing with a sowing machine which is essential in cost-effective industrial production of young plants (McDonald and Kwong 2005).

Pellets differ in many attributes – size, shape, colour, material, but the pelleting process is always the same. The seeds are placed in the rotation drum and sprayed with a glue so the pelleting material could stick to the seeds’ surface. Multiple layers of pelleting material (usually clay or silicates) and glue are applied until the specific size of the pellet is reached (Adkins et al. 2007, Baskin and Baskin 2014). Afterwards the pelleted seeds are slowly (2–3 hours) desiccated in a special drying unit where circulates hot air (24–26 °C). If not desiccated properly, shelf life of the seeds is very limited (Job et al. 1999).

If pelleting material as well as the glue are inert and the pellets are dried properly, then pelleting has limited impact on germination. The seed companies develop and constantly improve their own glues and materials and test if pellets have required characteristics. The pellet has to dissolve easily after sawing so the seed can start germinating. This technology also can’t dramatically lower the germination rate, right after the application as well as in longer term (Styer and Koranski 1997). Seed companies guarantee 3-years shelf life of pellets, if packed in three-layer bag (plastic foil, paper and aluminium layer) the germination remains high.

Petunia x hybrida is among the worlds’ top-selling annuals (Ball 1991). It is due to the big variability - different sizes and colours of flowers, upright or spreading habitus (Anderson 2007). The seeds are small, 0.6–0.7 mm in length and 0.5–0.6 mm in diameter (Gerats and Strommer 2008, Sink 1984) so young plants producers demand pelleted seeds. Petunia pellet is round, 1.0–1.2 mm in diameter (McDonald and Kwong 2005) so it can be sown by a sowing machine.

Seeds remain the germination level for at least two years if held in dry and cool place (Sink 1984). Key role in germination rate of the seeds play conditions after harvesting, esp. temperature and relative moisture level (Sajjan et al. 2013).
The aim of this paper is to examine the declination of germination rate of Petunia x hybrida seeds if stored in optimal conditions and determine if the pelletization decreases the germination rate of seeds in short term (right after pelletization) and in long term if stored in room temperature. This simulates the conditions under which the seeds in pictorial packages are sold and stored in the shops.

MATERIAL AND METHODS

Characterization of material, experimental design and germination testing

In the experiment were tested seeds of 14 varieties of Petunia x hybrida. The seeds were harvested in 2000 and 2001, all varieties were F1 hybrid, represented original Czech breeding (company Černý-BioPro Ltd.), 6 varieties were grandiflora type (big flower) and 8 were multiflora type (small flower). The plants were planted in the greenhouse and throughout the whole cultivation had good growing conditions and were pest and disease free (except 1 component). Seed samples for the experiments were collected from the standard seed production of the company that was sold in the Czech Republic as well as exported. Every year is produced just a part of assortment due to extensive costs and space requirements. This is a reason why seeds were harvested in 2 years – some varieties in 2000, other in 2001.

After harvesting, the seeds were dried for 3 months (20 °C) until the constant balance of 35% of relative humidity was reached. Then the seeds were placed in the glass container with a metallic lid and rubber seal. The containers were stored in dark in air conditioned storage where was maintained constant temperature of 5 °C.

The germination of these 14 varieties was tested every year in March. The germination test of natural seeds was according to ISTA methodics - Jacobsen germinator, filtration paper, 4 x 50 seeds, 21 days, 22 °C.

Second part of the experiment was to determine if the pelletization decreases germination rate – right after pelleting and in the longer term. In the seed shops are sold pelleted seeds wrapped in 3-layer bag. These are stored in the room temperature for 3 years. Seed companies guarantee the same germination for this time period. In order to do so, freshly harvested seeds with high germination are used for pelleting.

In 2006 the seed sample of the examined varieties was pelleted. The same seeds as in the first part of experiment were used. Seeds were harvested in year 2000 or 2001 and stored in dark and temperature 5 °C. Pelletizing glue BioPro Coat SuperFine (starches and modified starches) and pelleting material BioPro Powder Sili (silicates) were used. Pellets were dried properly in the drying unit (26 °C, 3 hours). Samples of pelleted and natural seeds were stored in the 2 ml freezer Epruvet with seal lid and silicon gasket. Samples were stored in air conditioned room with maintained temperature 20 °C. The diameter of the pellet was 1.0–1.2 mm.

The germination of pellets was tested immediately after pelleting and then every 2 years in March. The germination of pellets was tested in the soil test according to ISTA methodics. The pellets samples (4 x 50 pellets) were tested in the germinating chamber (24 °C, relative humidity 90–100%, above the shelves are special fluorescent tubes with modified spectrum Osram Biolux, light intensity 2750 lux, 16 hours light, 8 hours dark). Natural seeds were tested also every 2 years but on the Jacobsen germinator.

Seed companies test the germination of seeds according to ISTA methodics. Natural seeds are tested on the filtration paper on the Jacobsen germinator placed on the Jacobsen table. Germination of pellets is tested in the soil. Jacobsen germinator is not optimal for this purpose because the pellets are not dissolved properly and the seed can’t start germinating. On the other hand, natural seeds tend to float to the lower levels of soil after irrigation and the germination rate is significantly influenced.

This experiment consists of 2 parts:

1) What is the decline of germination rate in a long term, if the seeds are dried properly and stored in optimal conditions in 5 °C.

2) Examine if the pelleting glue and material (BioPro Coat SuperFine and BioPro Powder Sili) are suitable also for older seeds (seeds harvested in 2000 and 2001) and if the pelleting don’t negatively influence germination for at least 3 years if stored in the room temperature.
The results were evaluated in program STATISTICS with the t-test.

**RESULTS AND DISCUSSION**

**Long term storage of natural seeds – optimal conditions (5 °C)**

If the natural seeds were stored in optimal conditions and the temperature 5 °C was maintained, the germination level of all 14 tested varieties remained high and did not statistically differ (on p = 0.05). Seed companies usually don’t sell seeds with germination lower than 85% because it is uneasy to guarantee the minimal germination 85% for the 3 years which is a usual shelf life of seeds packed in the 3-layer packages. Only one variety – Láska F1 had low germination level, right after harvesting and also during the whole duration of the experiment. The difference between the germination right after harvesting in 2001 (79%) and in 2014 (77%) is not statistically significant (p = 0.003839). Low germination of variety Láska F1 could be a result of worse health conditions of the maternal component due to Oidium spp. The germination of *Petunia x hybrida* seeds according to scientific research papers maintains for 3–5 years (Sink 1984, Gerats and Strommer 2008, McDonald and Kwong 2005). But according to our experiment the seeds remained their high germination rate much longer, more than 10 years (Table 1).

**Table 1 Germination rate of natural seeds Petunia x hybrida – stored in optimal conditions**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Grandiflora (G), Multiflora (M)</th>
<th>Germination rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angelika F1</td>
<td>M</td>
<td>90 92 90 94 88 93 97 93 95 95 92 94 93 92 91</td>
</tr>
<tr>
<td>Belinda F1</td>
<td>M</td>
<td>94 95 92 92 92 94 98 95 95 95 97 97 93 94 94</td>
</tr>
<tr>
<td>Lucie F1</td>
<td>M</td>
<td>96 98 97 96 94 95 97 100 98 99 96 97 94 98 97</td>
</tr>
<tr>
<td>Marika F1</td>
<td>M</td>
<td>97 97 96 97 99 95 98 97 96 96 95 95 96 96 96</td>
</tr>
<tr>
<td>Rita F1</td>
<td>M</td>
<td>97 98 95 95 97 97 96 92 95 95 92 96 96 96 97</td>
</tr>
<tr>
<td>Simona F1</td>
<td>M</td>
<td>96 97 96 96 95 94 96 97 96 97 97 97 96 96 95 97</td>
</tr>
<tr>
<td>Brigitta F1</td>
<td>M</td>
<td>96 95 96 96 96 94 96 94 95 95 96 96 94 96 94 96</td>
</tr>
<tr>
<td>Sylvie F1</td>
<td>M</td>
<td>98 96 96 96 95 98 95 97 97 99 97 96 97 95 96</td>
</tr>
<tr>
<td>Přátelství F1</td>
<td>G</td>
<td>92 93 91 92 91 91 93 91 93 93 93 91 92 91 92 91</td>
</tr>
<tr>
<td>Radost F1</td>
<td>G</td>
<td>94 92 92 93 89 92 94 94 93 93 94 92 93 92 92 92</td>
</tr>
<tr>
<td>Láska F1</td>
<td>G</td>
<td>79 78 80 77 80 80 82 77 83 87 87 80 79 79 77</td>
</tr>
<tr>
<td>Půvab F1</td>
<td>G</td>
<td>94 93 94 93 94 94 93 93 92 94 94 93 93 93 93 93</td>
</tr>
<tr>
<td>Touha F1</td>
<td>G</td>
<td>93 94 93 92 94 92 93 93 94 93 94 94 93 94 93 94</td>
</tr>
<tr>
<td>Úsměv F1</td>
<td>G</td>
<td>97 96 93 92 93 93 96 96 98 94 94 94 98 94 98 98</td>
</tr>
</tbody>
</table>

**Figure 1 Germination rate of natural seeds Petunia x hybrida – stored in 20 °C**
The pelleting process decreases the germination rate right after the process. This could be explained by existence of a barrier of an inert material (Figure 2). The seed has to have bigger vigour to start germinating. This is also the reason why the seed companies pellet only the seeds from new crop with high germination rate. In this experiment the seeds were pelleted 5 years after harvesting. T-test was not performed for the germination rate before and after pelleting due to different methodology of germination test. Natural seeds (before pelleting) are tested using Jacobsen germinator, pellets are tested in soil.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Results of t-test (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pellets</td>
</tr>
<tr>
<td>Angelika F1</td>
<td>0.620220</td>
</tr>
<tr>
<td>Belinda F1</td>
<td>0.386704</td>
</tr>
<tr>
<td>Lucie F1</td>
<td>0.087080</td>
</tr>
<tr>
<td>Marika F1</td>
<td>0.266570</td>
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<tr>
<td>Rita F1</td>
<td>0.382175</td>
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<tr>
<td>Simona F1</td>
<td>0.270829</td>
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<tr>
<td>Brigitta F1</td>
<td>1.000000</td>
</tr>
<tr>
<td>Sylvie F1</td>
<td>0.190116</td>
</tr>
<tr>
<td>Přátelství F1</td>
<td>0.320206</td>
</tr>
<tr>
<td>Radost F1</td>
<td>0.142800</td>
</tr>
<tr>
<td>Láska F1</td>
<td>0.779559</td>
</tr>
<tr>
<td>Půvab F1</td>
<td>0.190116</td>
</tr>
<tr>
<td>Touha F1</td>
<td>0.779559</td>
</tr>
<tr>
<td>Úsměv F1</td>
<td>0.647967</td>
</tr>
</tbody>
</table>

Four years after pelletization pellets remain the same germination rate as right after pelleting (Table 2). The same conclusions were obtained for natural seeds. The differences in germination rate are not statistically significant, all p-values are higher than 0.05.
Germination rate statistically significantly drops according to t-test on the significance level $p = 0.05$ after more than four years of storage in room temperature $20 \, ^\circ C$. This drop is not only significant in pelleted seeds but also the same trend is by natural seeds (Figure 1). After 8 years of storage in these conditions natural seeds as well as pellets are not usable for professional purposes. The producers of young plants request the germination at least 90%, by Petunia seeds even above 95%. The results correspond with the conclusions in the literature (Sink 1984, McDonald and Kwong 2005, Sajjan et al. 2013). The storage conditions, especially the temperature play the main role in determination of germination rate over the storage time.

CONCLUSION

Seed pelleting has many positives. According to our experiment the pelleting glue BioPro Coat SuperFine (starches and modified starches) and pelleting material BioPro Powder Sili don’t influence the germination in long term. The drop in germination is significant right after the pelleting, because the pellet is a barrier in germination. The gradual decrease of germination over longer period of time is the same for pelleted seeds as well as natural seeds. If the natural seeds are dried properly and stored in optimal conditions where temperature $5 \, ^\circ C$ is maintained, the germination level does not change over more than 10 years. Pellets as well natural seeds remain the guaranteed germination level even if they are stored in room temperature.

ACKNOWLEDGEMENTS

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REFERENCES


