The effects of different concentrations of gibberellic acid (GA3) on seed germination of *Helianthus annuus* and *H. petiolaris*

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ABSTRACT

Germination tests were conducted by soaking native, wild *Helianthus annuus* and *H. petiolaris* seeds in various concentrations of gibberellic acid (GA3) for 1 week, 4°C. For *H. annuus*, the most effective concentrations of GA3 were 1000 ppm (61.7%) and 500 ppm (58.3%). Lower concentrations of GA3 were less effective. For *H. petiolaris*, the most effective concentrations of GA3 were 1000 ppm (56.1%), 500 ppm (65.0%), and 250 ppm (62.2%) and, again, lower concentrations of GA3 were less effective. Transplanting the germinated seeds of *H. annuus* to soil in pots, resulted in nearly 100% success, indicating no apparent long-term effects from the GA3 treatment. Published on-line www.phytologia.org *Phytologia 99(1): 32-35 (Jan 19, 2017).* ISSN 030319430.

KEY WORDS: *Helianthus annuus*, *H. petiolaris*, seed germination, dormancy, gibberellic acid (GA3).

Native, wild sunflowers (Helianthus spp.) are known to be difficult to germinate (Seiler, 1993). Recently, Adams and TeBeest (2016) reported on various stratification treatment effects on germination of *Helianthus petiolaris*. We found a moderate concentration of GA3 (500 ppm) with one week stratification at 4°C was very effective in increasing the germination rate of recalcitrant native sunflower seeds (80% vs. 30% control). Stratification (1 wk at 4°C) increased germination, regardless of the seed treatment. Ethrel (25 ppm) treatment was effective, but not as much as GA3 (500 ppm). Soaking sunflower seed in water for 12 or 16 hr resulted in no seed germination.

The literature on pre-treatment methods for sunflower seed germination has been recently reviewed (Adams and TeBeest, 2016).

The purpose of the present paper is extend the tests on pre-treatment using GA3 at different concentrations to determine the concentration of GA3 that produces highest seed germination in *H. annuus* and *H. petiolaris*, native, wild collected seed.

MATERIALS AND METHODS

Seeds of *H. petiolaris*, PI451978-NC7, Ellsworth, KS were obtained from GRIN (Germplasm Resources Information Network), USDA.
Seeds of *H. annuus*: were collected 16 July 2016, from a natural population, 1 mi. south of Gruver, TX (*Adams 14952*).

All seeds were surface sterilized by:
1. Washing with soap/tap water;
2. Dipping in 70% ethanol, 30 sec;
3. Sterilizing by soaking in 20% Chlorox (8.25% sodium hypochlorite) for 30 min.;
4. Thoroughly rinsing in sterilized ddwater (Protocol from Singhung Park, Kansas State University).

Germination tests: Effects of various concentrations of gibberellic acid (GA3, PlantHarmones.net, 90%) stored at 4°C, 1 week (7 days) in GA3 solutions.
1000 ppm GA3 stock solution: dissolved 1.0 g GA3 in 5 ml ethanol, added to 995 ml DI water to produce 1000 ppm stock. Diluted with DI water to make: 500 ppm, 250 ppm, 125 ppm, and 62.5 ppm stocks.
Control: soaked in DI water, 4°C, 1 week.
20 seeds were used in each of 3 replicates (60 seeds total). The seeds were soaked in DI, or various GA3 solutions in beakers, 4°C, 1 week. In addition, for both *H. annuus* and *H. petiolaris*, 60 seeds were placed in sterilized filter paper, pre-wetted with 500 ppm GA3, then placed in sealed plastic bags at 4°C, 1 week. Seeds were germinated at RT (21°C), in normal lab fluorescent lighting. Seeds were examined for fungal contamination daily and contaminated seeds removed. After 14 days, the seeds with emergent roots were scored as germinated.

RESULTS

Table 1 shows that for *H. annuus*, the most effective concentrations of GA3 were 1000 ppm (61.7%) and 500 ppm (58.3%). Lower concentrations of GA3 were less effective. This is shown in figure 1, where 1000 and 500 ppm were much more effective than lower concentration of GA3.

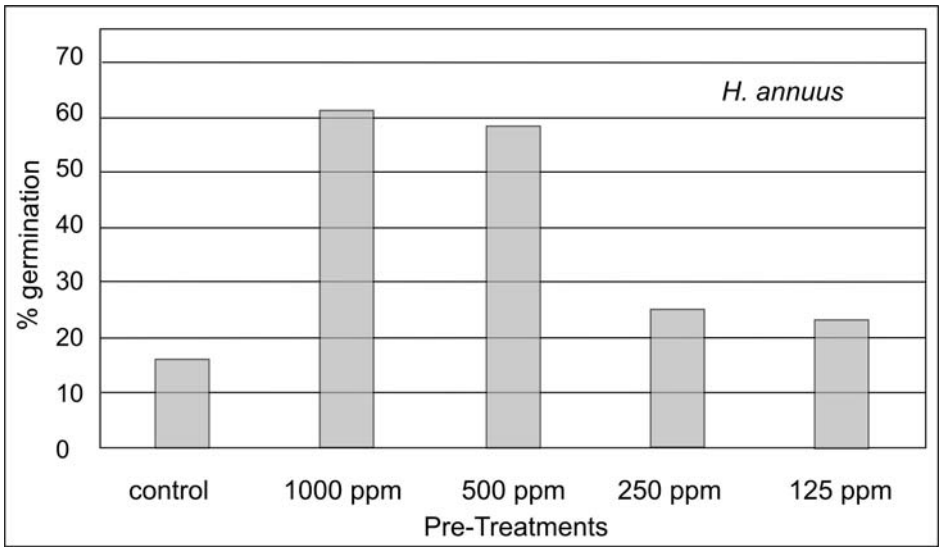

Figure 1. Germination of *H. annuus* at various concentrations of GA3, soaked 1 week, 4°C. Control: soaked in DI water, 1 week, 4°C.

For *H. petiolaris*, the most effective concentrations of GA3 were 1000 ppm (56.1%), 500 ppm (65.0%), and 250 ppm (62.2%).

In contrast to the results for *H. annuus*, lower concentration of GA3 were somewhat effective in seed germination for *H. petiolaris* (Fig. 2), with considerable enhanced germination at 250 and 125 ppm GA3.

Comparing soaking seeds in a beaker of 500 ppm GA3 vs. storage in filter paper saturated with 500 ppm GA3 resulted 58.3% vs 51.7% (*H. annuus*, Table 1) and 65.0% vs. 44.8% (*H. petiolaris*, Table 2). This seems to indicate that there is a small advantage in soaking the seeds in a beaker.

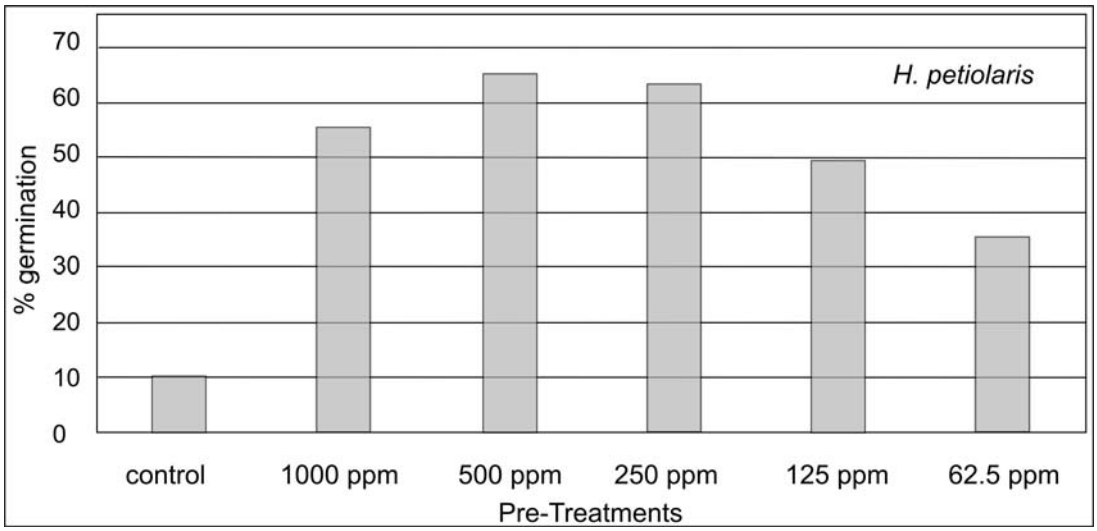

Figure 1. Germination of *H. petiolaris* at various concentrations of GA3, soaked 1 week, 4°C. Control soaked in DI water, 1 week, 4°C.

In summary, this study found an effective pre-treatment to enhance seed germination of *H. annuus* and *H. petiolaris* is soaking in GA3 for 1 week, 4°C. It should be noted that transplanting germinated seeds of *H. annuus* to soil in pots, resulted in nearly 100% success, indicating no apparent long-term effects from the GA3 treatment.

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Table 1. Germination tests of *H. annuus*, native, Gruver, TX. References: Kumari and Singh (2000) Maiti et al. 2006.

Pre-Treatment, all soaked 1 wk, 4°C	germination rates
1. control: seeds soaked in DI water	9/60 = 16.7%
2. 1000 ppm GA3	37/60 = 61.7%
3. 500 ppm GA3	35/60 = 58.3%
3a. 500 ppm GA3 on filter paper	31/60 = 51.7%
4. 250ppm GA3	15/60 = 25.0%
5. 125ppm GA3	14/60 = 23.2%

Table 1. Germination tests of *H. petiolaris*, native, Ellsworth, KS. References: Kumari and Singh (2000) Maiti et al. 2006.

Pre-Treatment, all soaked 1 wk, 4°C	germination rates
1. control: seeds soaked in DI water	6/59 = 10.2%
2. 1000 ppm GA3	32/57 = 56.1%
3. 500 ppm GA3	39/60 = 65.0%
3a. 500 ppm GA3 on filter paper	26/58 = 44.8%
4. 250 ppm GA3	33/53 = 62.8%
5. 125 ppm GA3	28/57 = 49.1%
6. 62.5 ppm GA3	21/58 = 36.2%