Seed Size and Pre-treatment: Effect on Germination and Seedling Emergence

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ASA-CSSA-SSSA International Annual Meeting, Nov. 2-5, 2014, Long Beach CA

Abstract

Soybean (*Glycine max*) is an important source of protein and oil, and has nutriceutical and pharmaceutical benefits. Soyfood consumption in the U.S. has dramatically increased as more people became aware of soyfood containing highly digestible protein, all essential amino acids and a high concentration of isoflavones. Popular soyfood, soymilk and tofu, and the miracle "super-food", edamame, are all produced from large-seeded soybeans. However, germination rate and seedling vigor of large seeds is usually lower than medium and small seeds. The objectives of this study is to; 1) Determine difference in germination of soybean seeds in various seed size groups, 2) Determine effect of pre-treatment (soaking and or fertilizer application) on germination and emergence, and 3) Explore the effect of germination and emergence on food-type soybean yield and quality. Six soybean varieties varied in seed size (<10g/ 100 seeds, between 12 and 16 g/100 seeds, and >20g/ 100 seeds). Seed germination and emergence were tested under laboratory and field conditions. Preliminary results showed that small seeded varieties have better germination under both field and laboratory conditions. Also under laboratory conditions, N fertilizer treatment delayed and resulted in low germination. Pre-soaking in water for more than 5 hours reduced germination and seedling emergence especially in the large seeded varieties.

Introduction

Soybean is an important source of protein and oil, and is also consumed worldwide for its nutriceutical and pharmaceutical benefits. Global demand of food-grade soybeans for human consumption has been increasing due to the proven and publicized health benefits and nutritional values from soy products. In 2011, 37% of Americans consume soyfoods or soy beverages at least once per month and about 31% of U.S. consumers look for food products containing soybean (Soyfoods.org, 2012).

The expanding soybean-based food market in Japan and the U.S. has generated considerable interest among American soybean producers in recent years. The current U.S. market for soyfoods is approximately $4 billion per year and $5.2 billion in 2011, and the total exported U.S. food-grade soybeans is about $8 billion annually (Johnson, 2000; Soyfoods. org, 2012; Zhang and Kyei-Boahen, 2007). The most popular soyfood, soymilk and tofu, and the miracle "super-food", edamame, are all produced from large-seeded soybeans. Soymilk has dominated about 20% of entire soyfood sales since 2008; tofu as a traditional soyfood has very stable sales of approximately $250 million from 2008 to 2011 (Soyfoods.org, 2011); an emerging soyfood that needs least processing is edamame that is consumed as vegetable with a sale increase of 18% each year in the U.S. (personal communication). All of above soyfoods require conventional soybeans with large seeds of more than 20 g/100 seeds. However, large-seeded soybeans tend to have lower germination rate, slower emergence and low seedling vigor than medium and small seeds.

Study Objectives

- Determine differences in germination of soybean seeds of various size groups
- Determine whether seed pre-treatment like water-soaking or N-fertilizer application affect germination rate and emergence
- To determine the effect pre-treatment on soybean seed yield and quality

Materials and Methods

Materials

Six varieties belonging to three size groups were used. Small- (*MFS-561 and V08-4773*), medium- (*Glenn and V03-4705*), and large- (*MFL-159 and V07-1897*) seeded varieties were used in this study.

Methods

Test germination rate and emergence (germination index) of each variety by planting them in germination paper in the lab and directly sowing in the field.
The experimental design is randomized complete block design
Seed treatment prior to planting includes soaking, fertilizer application, and combination of soaking and fertilizer application.

In the laboratory, the number of seeds with emerged radicle were determined everyday beginning 24 hours after experiment began. In field plots, number of emerged seedlings were determined daily.

Preliminary Results

Laboratory Study

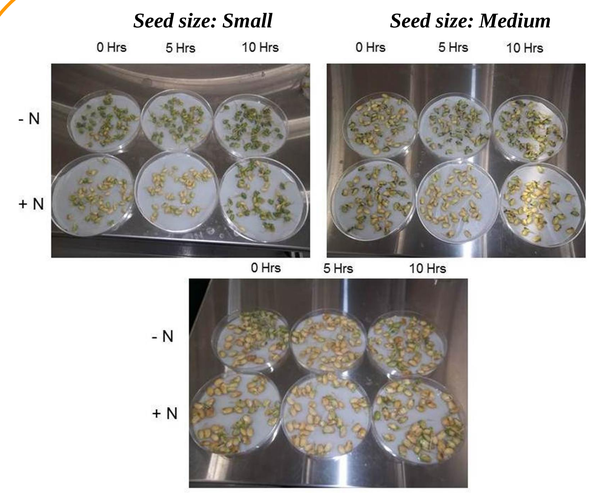

Figure 1. Effect of seed size, nitrogen fertilizer and presoaking in water for 0, 5 and 10 hours on germination of soybean seed during the first 24 hours under laboratory conditions.

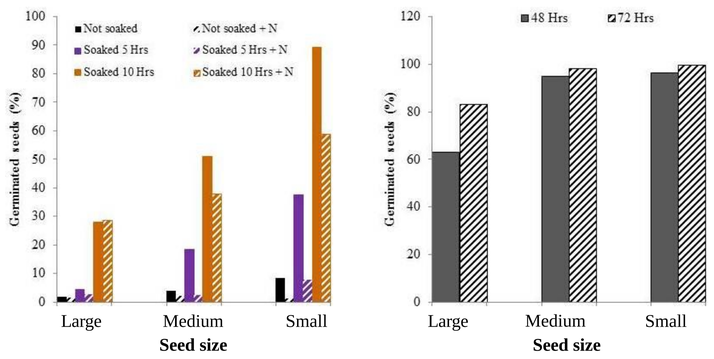

Figure 2. Effect of seed size, and pre-treatment on seed radicle emergence 24 hours (a) and 48 and 72 hours (b) after start of experiment under laboratory conditions

Field Grown Seeds

Seedling Emergence

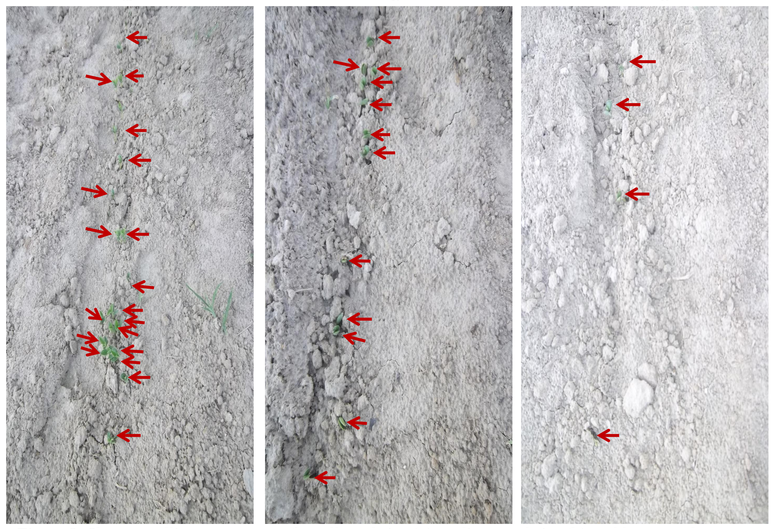

Figure 3. Shows seedling emergence of small seed size (a) medium seed size (b) and large seed size (c) a week after planting

Plant growth in the field

Figure 4. Plant density of field grown seeds of different seed size classes.

Preliminary Conclusion

- Effect of nitrogen fertilizer more significant during first 24 hours especially for small and medium sized seeds
- Medium and small seed varieties achieved higher germination than large seeded under each treatment
- Soaking seeds increased germination rate
- Large seed varieties had lower germination percent 72 hours after start of experiment
- Small and medium seed varieties had higher germination and early emergency in the field compared to large seeded varieties

Acknowledge

The project is funded by Virginia Agricultural Council