



HUMA GRO® Seed Treatment Study

Research on Effects of BLEND™, BREAKOUT®, START-L™ and VITOL®
Seed Treatments for Carrot, Okra and Radish

Research Report

Summary

Experiment conducted to determine the effectiveness of several products as seed treatments to accelerate the processes of germination and growth of the radicle (embryonic root) and hypocotyl (embryonic shoot) of several crop species.

Purpose

Bio Huma Netics®, Inc. (BHN) seeks to promote healthy and vigorous growth of crops with its products. BHN's HUMA GRO® sales representatives have noticed that germination and early growth of crops in infertile soils were not as vigorous as in more fertile soils. An experiment was conducted to determine the effectiveness of several products as seed treatments to accelerate the processes of germination and growth of the radicle (embryonic root) and hypocotyl (embryonic shoot) of several crop species. BHN Research & Development (R&D) staff tested four HUMA GRO® products: BLEND™, BREAKOUT®, START-L™, and VITOL®, diluted 1:100 (v/v) with three commercially valuable vascular plant species. The economically valuable parts of two of the plant species, carrot (*Daucus carota* L.) and radish (*Raphanus sativus* L.) are the roots, and the economically valuable part of the third plant species, okra (*Abelmoschus esculentus* (L.) Moench) is its fruit.

Description

An untreated control of distilled water was used for reference, and the HUMA GRO® product treatments of BLEND™, BREAKOUT®, START-L™, and VITOL® used were singly applied at a dilution of 1:100. This dilution rate was chosen, because in previous experimentation, the BHN R&D team demonstrated with pea, cotton, and onion that the dilution of 1:100, or more dilute solutions, generally resulted in more rapid growth of radicles and hypocotyls than did more concentrated solutions of HUMA GRO® products tested. Carrot, okra, and radish were used as the plant species in the present experiment. Four seeds of each plant species were used per replicate (pot), and four replicates per treatment were used in order to do simple statistical analyses of the data. Seeds of the distilled water control and the other four treatments were immersed for 15 seconds, dried overnight (Fig. 1) and then placed four to a coffee filter which was then placed in a plastic bag (Fig. 2).

The seeds were observed daily, and the length of the radicle and hypocotyl of each seed was measured and recorded daily once they had emerged from the seed (Fig. 3). Distilled water was used to keep the seeds moist. Measurements were terminated ten days after seed treatment for carrot, eleven days after seed treatment for okra, and nine days after seed treatment for radish. Statistical analysis of the maximum, minimum, mean, standard deviation and coefficient of variation was performed. Graphs were drawn using the means. Ratios of some means were calculated to depict increases in growth of radicles and hypocotyls in reference to the distilled water control. Other calculations were done to depict ratios of radicle to hypocotyl as affected by all the treatments and genetic factors.

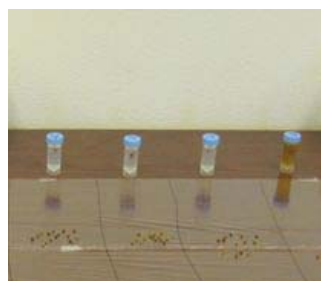


Figure 1. Drying Seeds



Figure 2. Seeds in Filter Paper



Figure 3. Daily Measurement

Results

Germination and Survival

BLEND™, BREAKOUT®, START-L™, and VITOL® increased the germination of carrot (Fig. 4a) and okra (Fig. 4b) compared to the untreated control, but there was 100 percent germination for all five treatments of radish (Fig. 4c). These data indicate that the greatest range of percent germination of the HUMA GRO® seed treatments occurred for carrot, but none of the carrot treatments achieved 100 percent germination. Germination of okra appears to have benefitted by HUMA GRO® treatments of seeds, achieving 94 percent germination with START-L and BREAKOUT® and 100 percent germination with BLEND™ and VITOL®. Germination of radish in this experiment indicates a strong genetic tendency to germinate, regardless of seed treatment. Thus, genetic factors were more dominant than environmental factors affecting germination of radish under the controlled conditions of the experiment. Survival on the date when measurements were terminated for each of the plant species was increased by HUMA GRO® products as seed treatments in all cases (Figs. 4a, b, & c), except in the case of radish for which START-L™ resulted in the same percentage of survival as the distilled water control (Fig. 4c). Plants that did not survive were either attacked by fungus or some other pathogen such as bacteria or a virus, or the plant was so brittle that it broke when being manipulated to be measured.

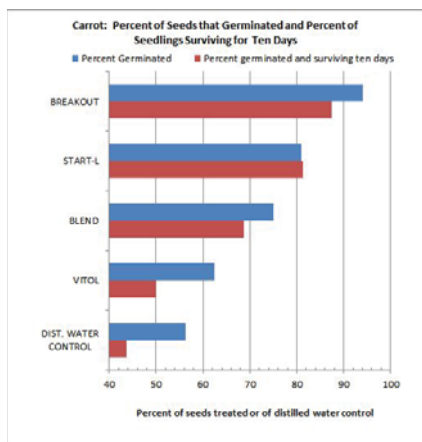


Figure 4a. Carrot: Germination & Survival

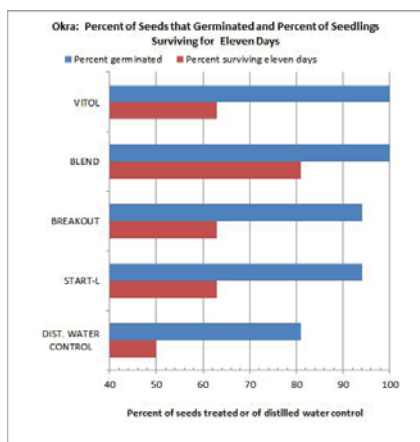


Figure 4b. Okra: Germination and Survival

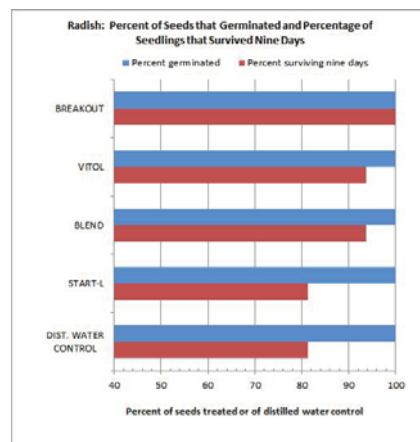


Figure 4c. Radish: Germination and Survival

Ratio of Radicle+Hypocotyl Length, Comparing HUMA GRO® Treatments to Distilled Water

One measure of the effectiveness of the HUMA GRO® treatments is to compare the sum of the average length of the radicle plus the average length of the hypocotyl for each HUMA GRO® treatment to the corresponding sum for the distilled water treatment. As with germination and survival, carrot displays the greatest range of response to the HUMA GRO® treatments compared to the distilled water control (Fig. 5a). Therefore, BREAKOUT® is the most effective treatment to increase growth during the first ten days of growth of carrot (Fig. 5a) and of the first eleven days of growth of okra (Fig. 5b) after seed treatment. On the other hand, seed treatment with the four HUMA GRO® products under the conditions of this experiment made little or no difference in growth of radish, when compared to growth resulting from the distilled water treatment.

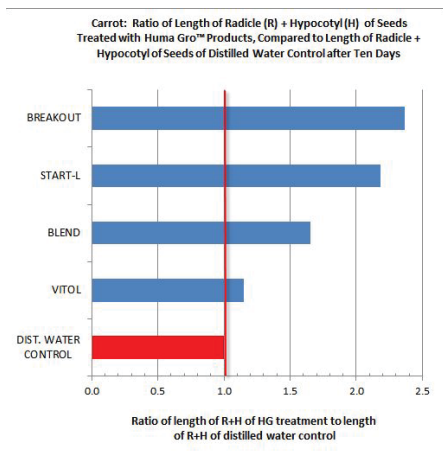


Figure 5a. Carrot: Ratio of HG R+H to Distilled Water R+H

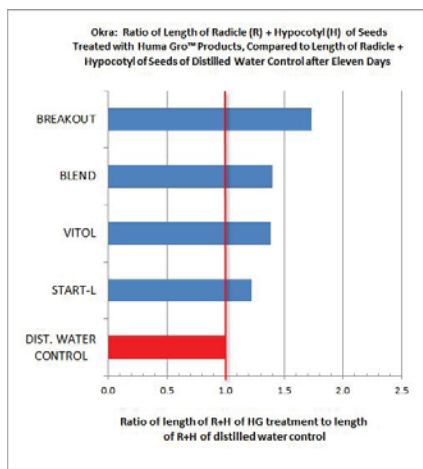


Figure 5b. Okra: Ratio of HG R+H to Distilled Water R+H

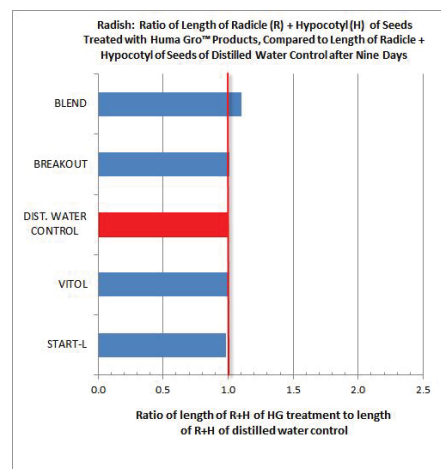


Figure 5c. Radish: Ratio of HG R+H to Distilled Water R+H

Temporal Effects of HUMA GRO® Seed Treatments on Length of Hypocotyl and Radicle

During the experiment, three of the four HUMA GRO® seed treatments increased the development of the hypocotyl (Fig. 6a), and all four HUMA GRO® treatments increased the development of the radicle (Fig. 6b) of carrot compared to the distilled water control. All four HUMA GRO® treatments increased the growth of the hypocotyl (Fig. 6c) and radicle (Fig. 6d) of okra more than the distilled water treatment. Differences in the lengths of hypocotyl (Fig. 6e) and radicle (Fig. 6f) of radish among the HUMA GRO® treatments and the distilled water treatment were less notable compared to those of carrot and okra, yet still showed some benefit.

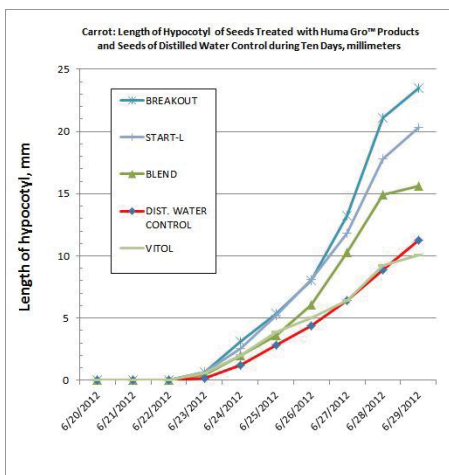
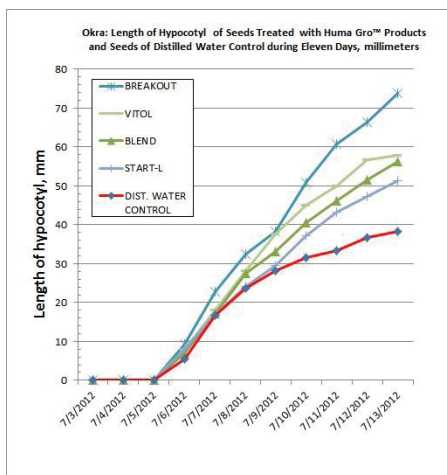
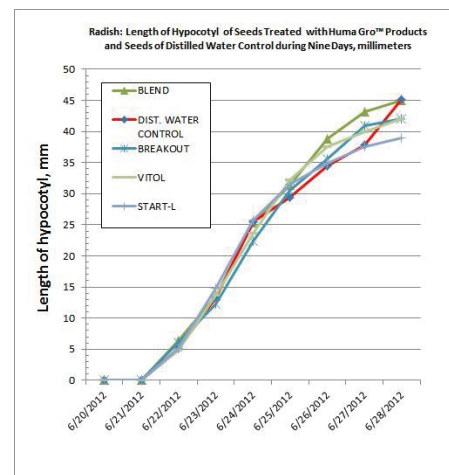


Figure 6a. Carrot: Length of Hypocotyl Figure



6c. Okra: Length of Hypocotyl Figure



6e. Radish: Length of Hypocotyl

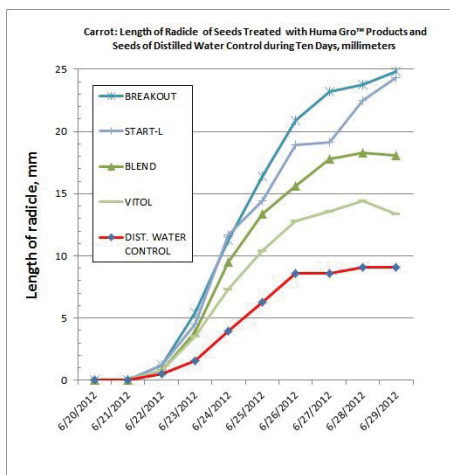


Figure 6b. Carrot: Length of Radicle

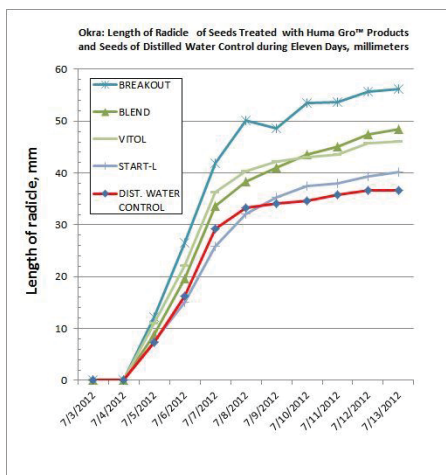


Figure 6d. Okra: Length of Radicle

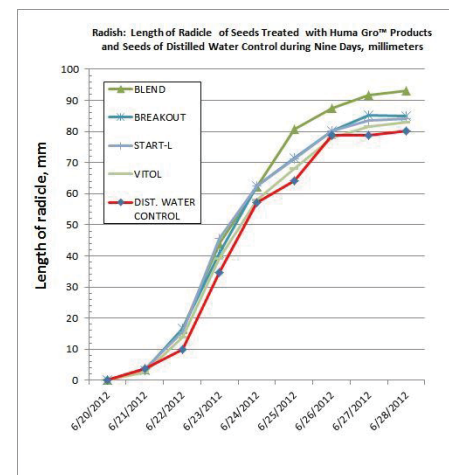


Figure 6f. Radish: Length of Radicle

Discussion & Conclusion

The differences in growth responses (length of radicle and length of hypocotyl) of carrot, okra and radish to the five treatments among the three crops, carrot, okra and radish indicate that seed treatment effects involve both genetic and environmental factors. The results of this experiment indicate BREAKOUT® is a strong candidate to be marketed as a seed treatment for immersion of seeds for 15 seconds and drying before sowing.

All four HUMA GRO® products tested increased percent germination, survival, and the length of both hypocotyl and radicle of carrot and okra compared to the distilled water control. This is evidence that for some crops and in some soils, particularly infertile soils, an immersion of the seeds for 15 seconds in a 1:100 dilution of one of the four HUMA GRO® products and then drying, can result in:

- 1) A greater proportion of the seeds germinating,**
- 2) Increased survival of the new plants, and**
- 3) Increased growth rate of both hypocotyl and radicle.**

The data for radish in this study are a reminder that some plant species may respond relatively little to seed treatment such as was tested in the present study. Field research with one or more of the four HUMA GRO® products tested can be done by distributors and dealers to determine crop specific application rates as well as economic viability.

**If you would like to learn more about these top quality products, contact us directly at
480-423-6805 or visit our website at www.humagro.com.**

**Our HUMA GRO® Products Are
Highly Efficient and Effective Due to Our Unique Delivery System**



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