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Effect of Lettuce Seed Treatment with Seed Power® on Germination, Crop Growth, and Fungicide Interaction

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Abstract
Lettuce emergence rate, seedling growth, and head size has been shown to positively correlate with seed vigor. Seed treatment practices in lettuce that increase seedling shoot mass can significantly influence lettuce growth, development, and final yield. This study investigated effects of lettuce seed treatment with Seed Power® (a nutrient solution containing cobalt and other proprietary compounds; Stoller USA) on lettuce seed germination, crop growth, yield, and potential interaction of Seed Power® with commonly used conventional fungicides.

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Effect of Lettuce Seed Treatment with Seed Power® on Germination, Crop Growth, and Fungicide Interaction

RFR-A1242

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Introduction

Lettuce emergence rate, seedling growth, and head size has been shown to positively correlate with seed vigor. Seed treatment practices in lettuce that increase seedling shoot mass can significantly influence lettuce growth, development, and final yield. This study investigated effects of lettuce seed treatment with Seed Power® (a nutrient solution containing cobalt and other proprietary compounds; Stoller USA) on lettuce seed germination, crop growth, yield, and potential interaction of Seed Power® with commonly used conventional fungicides.

Materials and Methods

On August 6, 2012, non-pelleted butter head lettuce seeds (cv. Ermosa; Johnny's Seeds, Winslow, ME) were subjected to the following treatments: a) Soak in 1 percent Seed Power® solution for 10 minutes, b) soak in 2 percent Seed Power® solution for 10 minutes, or 3) Soak in DI water for 10 minutes.

After soaking, seeds were air dried and seeded into a soil-less greenhouse medium (Sunshine LC1 Mix; 75% sphagnum peat moss and 25% perlite) in 98-celled flats (Figure 2). Each of the three treatments had four 98-celled flats. Germination data was collected (percentage germination) from each 98 celled flat four days after seeding. Seedlings were grown in the greenhouse for four weeks and then moved to the Horticulture Research Station, Ames, Iowa and placed underneath a lath house for hardening. The study was conducted on a Clarion Loam soil with 2-5 percent slope. On September 12, 2012, ground was tilled and raised beds were constructed using a plastic mulch layer. Beds were 6 in. high and were covered with black plastic mulch. Beds were spaced 6 ft center to center. Each treatment comprised of a 15-ft section of raised bed with two rows of plants. Each row had 10 plants with 12-in. spacing between rows and 10-in. spacing between plants. Each treatment had 20 plants. The experiment was a randomized complete block design with four replications.

Fungicide treatments consisted of two conventional fungicides, Revus® and Quadris®. Fungicides tested belong to two different groups and have different active ingredients. Revus® (active ingredient mandipropamid) is a carboxylic acid amide whereas Quadris (active ingredient azoxystrobin) is a methoxy acrylate.

Fungicides were sprayed four times at 2, 3, 4, and 6 weeks after transplanting (Figure 3). A combination of fungicides and seed treatments led to a total of seven treatments (Table 1).

Standard production practices for lettuce were employed. Crop was drip irrigated. During the growing season, data was collected on plant area and leaf chlorophyll content. Crop was harvested on November 9, 2012. Data collected included marketable weight and number, nonmarketable weight and number, leaf number, leaf area, and plant dry weight. To calculate leaf area, plants were completely stripped of leaves and leaves were passed through leaf area meter (L3100, LICOR Leaf Area Meter). Leaves were then oven dried until there was no change in weight. All data

were analyzed using PROC MIXED function of SAS 9.2.

Results and Discussion

Seeds treated with Seed Power® germinated earlier than the untreated controls (Table 2). There were statistically significant differences between untreated controls (56.1% germination) and seeds treated with Seed Power®. Final germination percentages, four weeks after seeding, ranged from 93-96 percent. Although germination percentages did not show any significant differences four weeks after seeding, earliness in germination could be an important aspect for growers who grow crops on a tight schedule. The quicker a grower can move plants out of the greenhouse, the better it is to lower the cost of production in the greenhouse.

Seed Power® treatments significantly improved transplant biomass. Transplants treated with Seed Power® had higher shoot and total biomass as compared with untreated controls. Shoot biomass in the Seed Power® treatments was almost three times the untreated controls (Table 3). There were no statistical differences in root biomass indicating that Seed Power® has greater effects on the shoot system of the plant than the roots.

Differences in transplant dry weight did not reflect in the field. There were no statistical differences in plant growth and development indices. Indirect measurement of chlorophyll using SPAD did not reveal differences (Table 4). Also, measurement of plant size by calculating its area did not show any significant difference.

At the end of the growing season there were no statistical differences in marketable or non-marketable number or weight of lettuce plants (Table 5). There was large variability in the data set, which could be attributed to growing conditions. Growing conditions were stable in the month of September but October was cold and windy affecting the growth and development of lettuce plants. Although lettuce is adapted to cool growing conditions, for optimum growth it requires 60 to 65^0F daytime temperatures. Fluctuating temperatures in October coupled with high velocity winds created adverse growing conditions for the plants. Blowing wind carries sand particles, which cause injury and reduce marketability of the plant. With respect to the interaction of Seed Power® and fungicides, there was a reduction in lettuce marketable weight when 2 percent Seed Power® treatment was used in combination with Quadris. Due to large variability in data, this difference did not lead to any statistically significant difference. Total number of leaver per plant, leaf area, and leaf dry weight did not show statistical differences (Table 6). Number of leaves per plant ranged from 10 to 23.

Seed Power® significantly affected seed germination in lettuce and shortened emergence time. It also improved shoot and total plant biomass. This is probably due to the positive effect of growth promoting compounds in Seed Power®. When plants were taken to the field and sprayed with different fungicides for possible interactions, we did not observe any statistical differences between treatments tested. One of the primary objectives of this study was to study and document any detrimental effect on plant growth caused due to the combination of Seed Power® with a commonly used fungicide (in this case Quadris and Revus). Based on results obtained, there was no such effect. Marketable yields were statistically the same between Seed Power® treatments and the untreated control. This study highlighted positive effects of Seed Power® on seed emergence. An extension of this study would be to test the effect of Seed Power® on seed germination, growth, and quality of transplants in

commonly grown vegetable crops that are started using transplants.

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Table 1. Lettuce seed treatment in combination with fungicide treatments.

Treatment	Seed treatment	Fungicide
1	Untreated Control	-
2	1% Seed Power	-
3	2% Seed Power	-
4	1% Seed Power	Quadris
5	2% Seed Power	Quadris
6	1% Seed Power	Revus
7	2% Seed Power	Revus

Table 2. Germination percentages 4 days after seeding[†].

Treatment	Germination (%)
Untreated	56.1 b
1% Seed Power	80.3 a
2% Seed Power	86.7 a

[†]Means are average of values collected from four 98-celled flats.
[x]Mean separation within columns; means followed by same letter(s) are not statistically significant ($P \leq 0.05$).

Table 3. Biomass (dry weight) of lettuce transplants four weeks after seeding[†].

Treatment	Shoot biomass (g)	Root biomass (g)	Total biomass (g)
Untreated	0.52 b[x]	0.44 a	0.96 b
1% Seed Power	1.34 a	0.36 a	1.70 a
2% Seed Power	1.34 a	0.35 a	1.69 a

[†]Means are average of values from four transplants collected randomly from inner area of flats.
[x]Mean separation within columns; means followed by same letter(s) are not statistically significant ($P \leq 0.05$).

Table 4. Lettuce leaf chlorophyll content and plant area four weeks after transplanting.

Treatment	SPAD[†]	Plant area* (square in.)
Untreated	35.7[NS]	29.8[NS]
1% Seed Power	34.8	31.2
2% Seed Power	33.6	30.1
1% Seed Power + Quadris	35.7	29.6
1% Seed Power + Revus	35.0	28.4
2% Seed Power + Quadris	35.6	27.5
2% Seed Power + Revus	35.3	33.1

[†]Means are average of readings from eight plants per treatment per replication.
[*]Means are average of values from eight plants per treatment per replication ($Area = \pi r^2$).
[NS]No statistically significant difference between means within columns ($P \leq 0.05$).

Table 5. Marketable and non-marketable number and weight of lettuce plants.

	Marketable		Non-marketable	
Treatment	**Number[NS]**	**Weight[NS] (g)**	**Number[NS]**	**Weight[NS] (g)**
Untreated	10	695	10	470
1% Seed Power	10	835	8	345
2% Seed Power	10	880	9	470
1% Seed Power + Quadris	13	843	7	345
1% Seed Power + Revus	9	795	8	355
2% Seed Power + Quadris	9	488	10	570
2% Seed Power + Revus	10	940	9	370

[NS]No statistically significant difference between means within columns ($P \leq 0.05$).

Table 6. Lettuce leaf area, total number, and dry weight per plant at the time of harvest[†].

Treatment	**Number[NS]**	**Area[NS] (sq cm)**	**Dry weight[NS] (g)**
Untreated	20	910	11.7
1% Seed Power	19	923	12.2
2% Seed Power	23	1175	12.4
1% Seed Power + Quadris	22	1004	15.4
1% Seed Power + Revus	23	985	13.0
2% Seed Power + Quadris	22	904	11.4
2% Seed Power + Revus	22	973	13.3

[†]Means are average of values from two plants per treatment per replication.

[NS]No statistically significant difference between means within columns ($P \leq 0.05$).