

**Assessing Biocontrols for Pink Root Mitigation and Yield Impact in Onions  
Onion Research and Development Program  
2018-2019 Progress Report**

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Thanks to the generous support of the members of the New York Onion Research and Development Program (ORDP) board, Ethan Grundberg and Amara Dunn began evaluating commercially available plant growth regulators, biostimulants, and biofungicides for potential suppression of pink root and impact on yield in transplanted bare root ‘Highlander’ onions during the 2018 growing season. As discussed in the proposal for “Assessing Biocontrols for Pink Root Mitigation and Yield Impact in Onions,” few conventional fungicides are labeled for pink root management in New York and even fewer are labeled for use as pre-plant dips for bare root transplanted onions. The goal for the first year of research on this project was to screen a large number of what were broadly defined as biological products, many of which are already being used by onion growers, in order to narrow the focus of future research efforts to find solutions for managing pink root in transplanted onions.

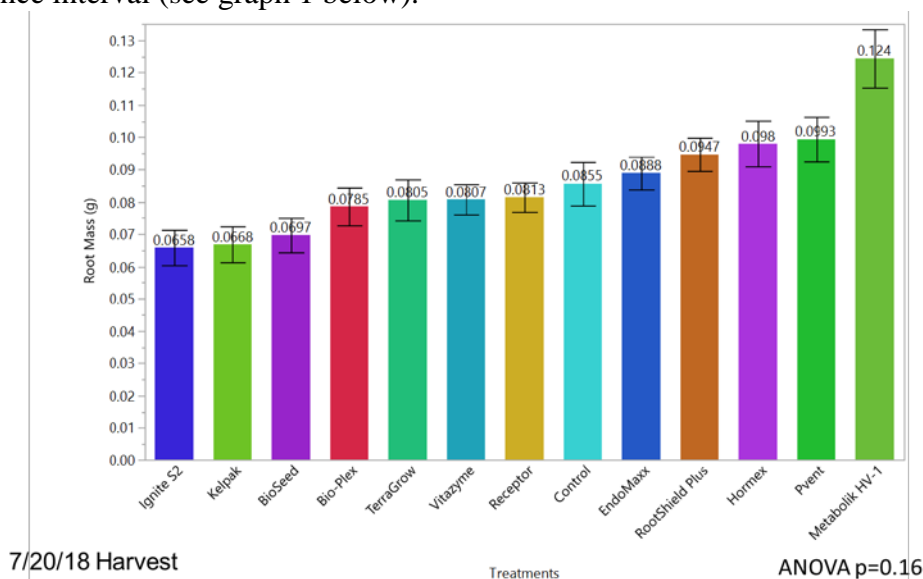
The proposal that was selected for funding by the ORDP outlined five primary objectives for the research on biocontrols during the 2018-2019 funding period. This progress report will address each of those five objectives in order. Since outreach efforts were not included in the primary objectives below, a review of both past and planned presentations of the trial results will be provided at the conclusion of the report.

***Objective 1:** Measure the impact of root growth and development of 5 commercially available biopesticides and biostimulants labeled for pre-plant root dip on onions.*

Given the interest of growers and support from private industry in including a wider array of biological products in the initial screening, the decision was made to increase the number of products from five to twelve plus an untreated control for a total of thirteen total treatments. The treatments that were included fall into three broad categories:

- 1) EPA Registered Plant Growth Regulators:
  - a. Receptor by Helena Chemical
  - b. Vitamin B1 and Hormones Concentrate by Hormex
- 2) EPA Registered Biofungicides
  - a. RootShield Plus by BioWorks Inc
  - b. PVent by BioSafe Systems
- 3) Biostimulants
  - a. Metabolik HV-1 by ISP Technologies
  - b. TerraGrow by BioSafe Systems
  - c. Ignite S2 by Agrigo
  - d. 123 Bareroot Dip Gel by Bio-Plex
  - e. Kelpak Bioregulator by Kelpak
  - f. Vitazyme by Vital Earth Resources
  - g. BioSeed by Vital Earth Resources
  - h. MycoApply EndoMaxx by Valent USA

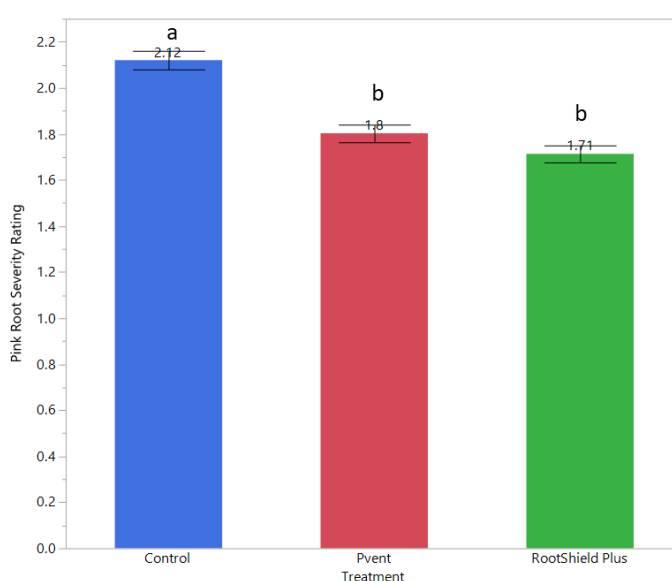
Given the increase in the number of treatments included in the trial, a decision was made to eliminate the proposed root mass measurement one-month after transplant. Instead, a sub-sample of 15 onions per replicate (60 per treatment) harvested on July 20, 2018 were selected for root removal and weighing. Unfortunately, the roots were already mostly desiccated by the harvest date making complete removal of root mass from the field difficult, thus compromising the accuracy and consistency of the data collected. That said, Dunn analyzed the root mass data using a one-way ANOVA and found no statistically significant difference in the mean root mass by treatment at the  $p \leq .05$  confidence interval (see graph 1 below).



Graph 1: Mean at-harvest root mass in grams for all 13 treatments; there was no statistically significant difference found in this trial

**Objective 2:** Assess the difference in pink root severity between biostimulant and biopesticide treatments and the untreated control.

The roots of 50 onions per replicate (200 per treatment) were evaluated within one week after harvest for visual pink root symptoms. The estimated percentage of the total root mass with visual pink root systems was used to rank pink root severity on Dr. Mike Thornton’s 0-3 scale (0 = no roots pink; 1 = <10% of roots pink; 2 = 10-50% of roots pink; 3 = >50% of roots pink). Since neither registered plant growth regulators nor biostimulants products can legally be used to manage plant pests and diseases, Grundberg and Dunn elected not to publicize the impact on at-harvest pink root severity of these groups of products to a grower audience. However, statistically significant differences between the 13 treatments



Graph 2: Pink root severity on onion roots from biofungicide treatments and the untreated control

were found using a Kruskal-Wallis analysis. The mean pink root severity for all 13 treatments can be viewed in table 1 presented in the section on Objective 3. However, the pink root severity for just the untreated control and the two registered biofungicides, RootShield Plus (*Trichoderma harzianum* Rifai strain T-22 + *Trichoderma virens* strain G-41) and PVent (*Gliocladium catenulatum* strain J1446) is shown in graph 2.

**Objective 3:** Measure fresh harvest weights and bulb diameters to determine if there is any yield or size impact from the treatments.

50 onions per replicate (200 per treatment) were weighed on a precision balance and measured with a bulb diameter caliper from Dixondale Farms within a week after being harvested and field-topped on July 20, 2018. The bulb weight of each onion was recorded in grams while the diameter reading was used to classify bulbs by size category (>3.75”= Colossal, 3-3.75”= Jumbo, 2-3”=Medium, 1-2”= Boiler). Though no statistically significant difference was found between treatments for either mean bulb weight or size class distribution using a Kruskal-Wallis analysis, it should be noted that the outlier numeric difference in the Ignite S2 treatment is due to the stand reduction suffered as a result of phytotoxicity of the treatment after transplant and stunting of the remaining treated bulbs.

Treatment and rate/5 gal	Disease severity <sup>z</sup>		Yield (lb) <sup>y</sup>		Percent jumbo <sup>x</sup>		Canopy cover <sup>w</sup>					
	Mean	SE	Mean	SE	Mean	SE	Mean	SE				
Ignite S2 50% v/v	1.51	e	0.05	22.00	a	1.17	29.5	a	4.0	4.19	b	1.17
TerraGrow 0.5 oz	1.66	ef	0.04	25.78	a	1.46	58.0	a	8.8	12.41	ab	0.50
RootShield PLUS 0.375 lb	1.71	def	0.04	27.03	a	0.40	65.3	a	3.2	14.26	a	1.08
Kelpak 6.4 fl oz	1.78	bcdef	0.04	25.51	a	2.11	50.5	a	13.6	11.27	ab	1.12
PVent 0.5 oz	1.80	abcdef	0.04	25.85	a	0.90	60.9	a	7.1	14.10	ab	1.55
BioSeed 50 g	1.88	abcd	0.04	25.00	a	0.84	47.5	a	6.8	13.08	ab	0.82
EndoMaxx 0.033 g	1.88	abcd	0.04	27.15	a	0.86	58.0	a	0.8	12.64	ab	0.23
Vitazyme 5 fl oz	1.94	abc	0.04	27.29	a	0.96	58.0	a	2.7	12.74	ab	0.55
BioPlex 15 oz	1.95	abc	0.04	24.87	a	0.71	59.7	a	1.3	12.00	ab	0.76
Metabolik 4 fl oz	1.96	abc	0.03	26.97	a	0.47	59.5	a	2.9	11.44	ab	0.34
Hormex 5 fl oz	2.00	abc	0.04	26.74	a	0.78	60.0	a	6.8	12.38	ab	0.51
Receptor 0.5 fl oz	2.00	abc	0.04	26.10	a	0.91	65.0	a	6.0	12.83	ab	0.88
Control	2.12	c	0.04	25.77	a	0.41	51.5	a	4.3	14.26	a	0.74
<i>P</i> -value	<0.001			0.104			0.109			0.037		

<sup>z</sup> Disease was rated on a scale of 0-3 (0 = no roots pink; 1 = <10% of roots pink; 2 = 10-50% of roots pink; 3 = >50% of roots pink). Means were calculated from 191-200 bulbs per treatment and significance was tested using a Kruskal-Wallis test.

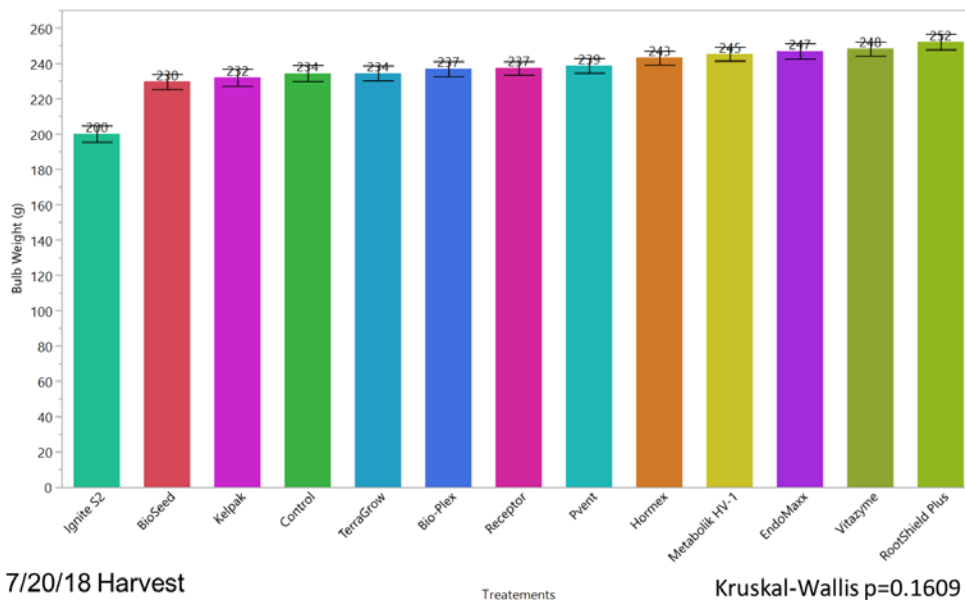
<sup>y</sup> Total bulb weight per plot averaged over 4 plots per treatment. Significance was tested using a Kruskal-Wallis test.

<sup>x</sup> Percent of bulbs harvested per plot that were classified as Jumbo size (3” to 3.75”). Means were calculated from 4 plots and significance was tested using a Kruskal-Wallis test.

<sup>w</sup> Percent of plot covered by foliage on 25 May as assessed using the Canopeo app, averaged over 4 plots. Significance was tested using a Kruskal-Wallis test.

<sup>v</sup> Only PVent and RootShield PLUS are registered as pesticides for disease control.

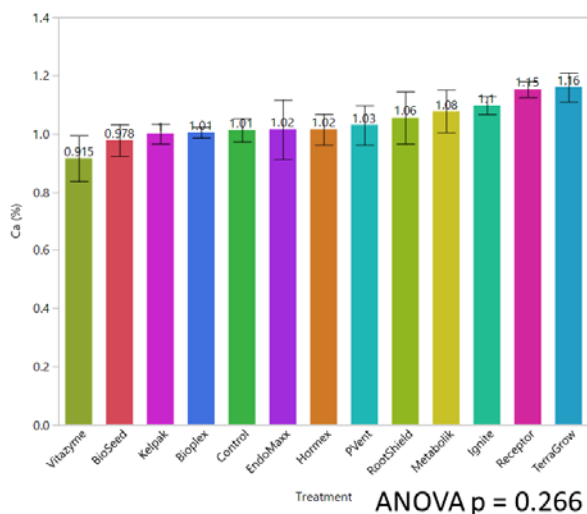
<sup>u</sup> Means followed by the same letter are not significantly different from each other at *P* = 0.05 based on Dunn’s test with a Bonferroni correction.



Graph 3: Mean bulb weight at harvest in grams by treatment; no statistically significant difference was observed

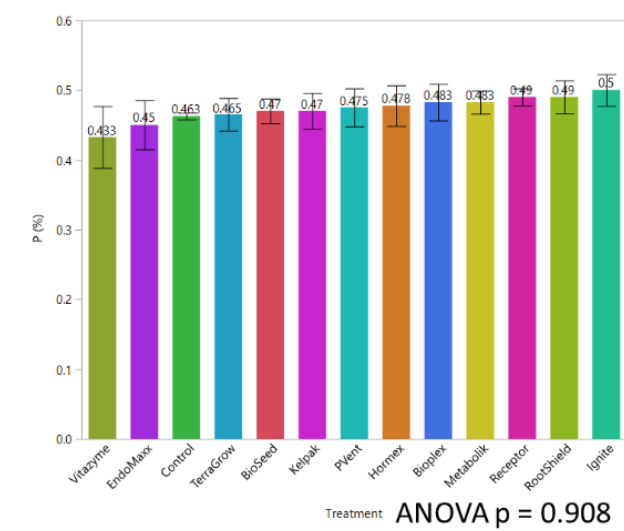
**Objective 4:** Analyze the nutrient uptake of onions in each replicate to assess the impact of products on fertility management.

A representative sample of 45 randomly selected leaves from each replicate were collected and submitted according to the protocol established by Waters Agricultural Laboratory in Warsaw, North Carolina for a foliar nutrient analysis on June 19, 2018. The samples were received by Waters on June 22 and held for processing until June 25, 2018. Foliar concentrations of 11 macro- and micro-nutrients were measured by the private lab and shared with the researchers. Given resource constraints, Grundberg and Dunn selected just three of the eleven nutrients for further analysis: calcium based on grower preference given the believed influence on onion storage quality,

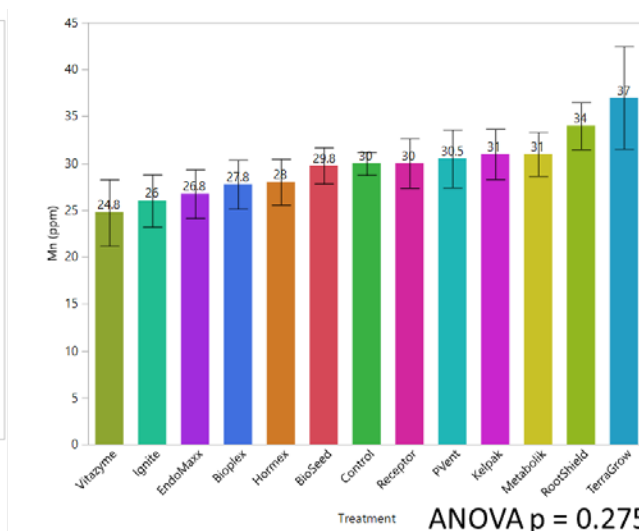


Graph 4: Calcium foliar analysis mean percent concentration in leaf tissue by treatment

phosphorous given the relatively low availability in muck soils and advertised capacity of mycohrrizal fungi species included in several of the products to increase uptake, and manganese due to the relatively low soil availability in shallower muck soils with higher pH. Dunn found no statistically significant difference using a one-way ANOVA analysis between the thirteen treatments for the three nutrients mentioned (see graphs 4, 5, and 6). It is possible that submitting foliar samples for lab analysis earlier in the season could better capture possible influences of dip products on nutrient access and uptake, thus the protocol for foliar nutrient testing has been modified in the proposal for continued funding from ORDP in 2019-2020.



Graph 5: Phosphorous foliar analysis mean percent concentration in leaf tissue by treatment



Graph 6: Manganese foliar analysis mean concentration in ppm in leaf tissue by treatment

**Objective 5:** Quantify the presence of *Trichoderma* spp. on plants treated with RootShield Plus and TerraGrow, and the presence of *Gliocladium catenulatum* on plants treated with PVent.

Thanks to the support and cooperation of BioWorks Inc, BioSafe Systems, and Valent USA, samples from those manufacturers’ products were sent to affiliated private labs in an effort to measure the populations of the beneficial microbial species on treated roots. There was some concern from both industry representatives and growers that the use of pre-plant applications of Dithane (mancozeb), Ridomil Gold (mefenoxam), and Lorsban (chlorpyrifos) may interfere with the efficacy of biological products. Though no statistical analysis was conducted, the data collected is included below and shows promising preliminary results for the compatibility of *Trichoderma* spp. and mycohrrizal fungi species with commonly used pesticides in New York onion production.

Table 1. Root Colonization Results-Untreated Control, PVent or TerraGrow-Field Samples

Treatment	Total # of Root Sections Plated	# of Positives for <i>Trichoderma</i> or <i>Gliocladium</i> *	% Positive for <i>Trichoderma</i> or <i>Gliocladium</i> *
Untreated Control (No PVent; No TerraGrow)	16	0	0
PVent Treated	16	0	0
TerraGrow Treated	16	3	19%

\*Evaluated for *Trichoderma* spp. in TerraGrow Treated and *Gliocladium catenulatum* in PVent Treated Samples

Sr No	Sample number	Percent root colonization	Total <i>Trichoderma</i> Recovered from Onion Roots and Plot Soil				
			Treatment	Mean Log CFU/g dwt	MSE (Log CFU/g dwt)	Mean Log CFU/g dwt	MSE (Log CFU/g dwt)
1	Untreated control 1	0			04.24.18 sampling	06.20.18 sampling	
2	Untreated control 1	0					
3	Untreated control 1	0					
4	Untreated control 1	0	UTC Soil	5.57	0.19	2.65	1.53
5	Endomaxx 1	30.76	RSPlus Soil	5.55	0.13	5.47	0.38
6	Endomaxx 2	0					
7	Endomaxx 3	25	UTC Roots			1.29	1.29
8	Endomaxx 4	23.07	RSPlus Roots			7.29	0.32

**Outreach:** Grundberg presented preliminary results to 75 industry representatives at the Biocontrols East Conference in Rochester, NY on October 12, 2018 and to 25 extension personnel and faculty at Ag In-service in Ithaca, NY on November 13, 2018.

Grundberg will present results to 45 onion growers at Orange County Onion School on March 5, 2019. Dunn is submitting a report to the Plant Disease Management Reports online database.