

2008 IPM MINIGRANT – FINAL REPORT

Production of disease-free onion bare root transplant seedlings

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Nontechnical Summary:

The first recommendation in an Integrated Pest Management strategy for controlling the neck rot disease of onion, caused by *Botrytis allii*, is to start with clean seed and transplant seedlings. In New York, major outbreaks of Botrytis neck rot of up to 80% loss in some varieties have occurred in association with the increase in growing onions from imported bare root transplants from Arizona over the last 6-7 years. A study conducted by Hoepting *et al.* in 2005 and 2006 revealed that 78% of 56 imported bare root onion transplant seedling samples (variety by grower) had some level (range: 1 to 66% of seedlings) of *B. allii* infection prior to their being transplanted into the ground in New York. Comparatively, no *B. allii* was detected in plug transplants or in seedlings of similar age and size as transplant seedlings that were direct seeded in local onion fields. These results confirmed that bare root transplant seedlings produced in Arizona are not produced free of the neck rot pathogen and serve as an important source of inoculum for this potentially devastating disease. The focus of this project was to determine why bare root transplant production in Arizona is conducive to producing transplant seedlings that are infected with *B. allii*, and to evaluate potential management strategies including seed treatments and timely fungicide sprays in order to produce bare root transplants free of disease. Growing onions from clean transplants has the potential to save the onion industry in the Northeast U.S. thousands of dollars.

Objectives:

- 1) To elucidate why onion transplant production in Arizona is conducive to transplant seedlings being infected with *B. allii*. Specifically, whether their production from raw or

minimally treated seed makes the transplant seedlings vulnerable to infection via soil or infected seeds, and whether the typical process of mowing transplants prior to pulling and shipping spreads *B. allii* from plant to plant.

This objective was partially met – see results.

- 2) To develop control strategies, such as seed treatments and/or fungicide treatments following mowing, in order to produce bare root transplants that are free of *B. allii*.

This objective was not met, because *B.allii* was not detected in the seed lot that was supposedly infected - see results.

This project was a collaborative effort among an Extension Vegetable Specialist (the project director), a Plant Pathologist and a Seed Scientist from Cornell University, an Extension Plant Pathologist from the University of Arizona, a bare root onion transplant producer in Arizona, and Bejo Seed Company. It included trials in Arizona on a commercial onion transplant farm and in New York at a research farm.

Approach:

One difference among bare root transplants grown in Arizona, plug transplants and direct seeded onions is that the former is often produced from raw or minimally treated seed (i.e. thiram), while the latter two are typically grown from treated seed. Thus, seed treatments with efficacy against *B. allii* could effectively prevent germinating onion seedlings from becoming infected during transplant production. Tebuconazole has shown efficacy against *B. allii* in laboratory studies and is currently in the IR-4 system for registration as a seed treatment for onion smut control in onions. Two seed lots of the same variety, Sedona, one with approximately 35% *B. allii* infection and the other with none were obtained from Bejo Seeds. Seed treatments, thiram (188 mg a.i./100 g of seed) and tebuconazole (250 mg a.i./100 g of seed), were applied to each lot by Cornell Seed Scientist, Alan Taylor. An untreated control was included in both infested and clean lots for a total of 6 treatments. Two thousand seeds per treatment, enough to produce approximately 20 bundles of 100 plants, were seeded in January and grown at the Sunbelt transplant farm in Arizona using commercial-scale production techniques. Transplants were harvested by hand on April 18 and shipped to New York for analysis by Hoepting, Klotzbach and Lorbeer using a bioassay technique adapted from du Toit et al. 2004, which was initially used by this group to identify *B. allii* in transplant seedlings in 2005 and 2006. In New York, a replicated trial with each of the treatments was conducted at a private research facility in north Rose, NY. The trial consisted of a randomized complete block design with 4 replications with 500 seeds per replicate, enough to produce approximately 5 bundles of 100 plants. Onions were planted into sandy soil by hand 1 1/8” deep on May 1 at a rate of 90 seeds per foot and 30 inch row spacing to represent transplant production culture in Arizona. The trial was irrigated using trickle up to 1 inch per week, as needed. Plants were harvested on Aug 14 when the plants were 15 weeks old, the approximate age of an Arizona grown transplant, and assayed for *B. allii* as described previously.

The typical practice of mowing transplants prior to harvesting may be spreading *B. allii* from plant to plant. First, it is important to determine whether this is the case, and second, to

determine whether such spread can be remedied by application of fungicides with known efficacy against *B. allii*, including Rovral (a.i. iprodione) and Pristine (a.i. pyraclostrobin + boscalid) immediately after mowing. Experiments in Arizona were cancelled because, for the first time ever, the transplant grower did not mow transplant seedlings that were shipped to New York, due to a very cool growing season, which kept the growth of the plants in check. In New York, Rovral (1.5 pt/A) and Pristine (18.5 fl oz/A) were applied immediately after mowing using a CO₂ backpack sprayer with a single 8003 flat fan nozzle and 50 gpa. The trial was set up as a randomized complete block design with 4 replications with clean and infested seed, mowed and not mowed treatments. The trial was carried out in the same manner as described for the seed treatment study. Treatments included: 1) clean seed - not mowed, 2) clean seed - mowed, 3) clean seed – mowed + Rovral, 4) clean seed – mowed + Pristine, 5) infested seed – not mowed, 6) infested seed – mowed, 7) infested seed – mowed + Rovral, 8) infested seed – mowed + Pristine.

Results:

Seed treatment study, AZ: The percent of transplant seedlings returned to New York from the amount of seed sent to Arizona for bare root transplant production was extremely low with an average of only 18.3% (range: 4.1 – 30.4%, Table 1). No latent *B. allii* infections were detected using the bioassays in any of the seed treatments. Although the sample size was disappointingly small, it was surprising to not detect any *B. allii*, especially in the untreated seed lot that that was supposedly infected with the pathogen. It is unknown why the % return of transplants on seed was so low. For future studies, at least twice as much seed should be sent to AZ for bare root transplant production.

Seed treatment study, NY: The percent of transplant seedlings produced in New York from the amount of seed planted was much higher than the return on seed from Arizona with an average of 61.4% (range: 32.8 to 90.4%, Table 2). No latent *B. allii* infections were detected with the bioassays in any of the treatments. This result was surprising, especially from the untreated seed lot that was supposedly infected with the pathogen. Also, the sample size (not including rep 3 & 4) was 2 times larger than it was for the plants returned from Arizona (avg. 604 plants vs. 333 plants assayed). Previously, *B. allii* had been detected using the bioassay technique on samples of this size (Hoepting et al. 2006). Bioassays of replicates 3 and 4 were abandoned in light of finding no *B. allii* in the first two replicates or in the plants returned from AZ.

Mowing and fungicide study, NY: The average percent of transplant seedlings produced from the amount of seed planted in the mowing study was 47.8% (range: 27 – 60.8%; Table 3). No latent *B. allii* infections were detected using the bioassays in any of the treatments. Again, this was a surprising result for the same reasons as discussed above in the seed treatment study. It is noteworthy that we were able to successfully produce bare root onion transplants in New York with a decent rate of return on seed, a technique which can be used in future studies.

Discussion: The failure to detect *B. allii* in this study led to further assaying of the supposedly infected seed lot which was provided by, and originally assayed for *B. allii* by Bejo Seed, by Dr. Lorbeer, Plant Pathologist, Cornell University. When 200 seeds each were assayed using three different techniques, 0% *B. allii* was detected in each assay. Perhaps, *B. allii* become inactive in

storage of this once infected seed lot. In future studies, infested seed lots should be confirmed for the presence of *B. allii* prior to seed treatment and trial set up. Previous laboratory studies conducted by Lorbeer et al. have demonstrated that onion seed infected with *B. allii* can produce seedlings that are infected with *B. allii*. The fact that *B. allii* could not be detected in the treatments with untreated supposedly infected seed, most likely explains why no *B. allii* was detected in this study. The fact that *B. allii* was not detected in any of the transplant seedlings that were grown from untreated clean seed suggests that infection via soilborne *B. allii* did not occur in the sandy soils of AZ or NY in this study. Further study is warranted to elucidate the source (seed or soil) of *B. allii* contamination in bare root onion transplant seedlings in AZ. Unfortunately, management of *B. allii* in bare root onion transplant seedlings with seed treatments and fungicide applications immediately following mowing could not be evaluated due to the absence of *B. allii* in the supposedly infected seed lot used in this study.

Table 1. Evaluation of seed treatments for control of *B. allii* infections in onion bare root transplant seedlings produced commercially in Sunbelt, AZ, 2008.

Lot	Seed Treatment (mg per 100 g seed)	<i>B. allii</i> bioassay results (# plants)			% return on seed
		Bundle #	clean	<i>B. allii</i>	
Clean	Untreated	1	82	0	4.1
Clean	Thiran @ 188	1	55	0	26.8
		2	144	0	
		3	176	0	
		4	162	0	
Clean	Tebuconazole @ 250	1	64	0	6.8
		2	73	0	
35% <i>B. allii</i>	Untreated	1	92	0	26.5
		2	78	0	
		3	60	0	
		4	80	0	
		5	88	0	
		6	132	0	
35% <i>B. allii</i>	Thiran @ 188	1	96	0	30.4
		2	102	0	
		3	62	0	
		4	115	0	
		5	122	0	
		6	111	0	
35% <i>B. allii</i>	Tebuconazole @ 250	1	103	0	15.4
		2	45	0	
		3	75	0	
		4	85	0	
Trial average:					18.3

Table 2. Evaluation of seed treatments for control of *B. allii* infections in onion bare root transplant seedlings produced at a research farm in North Rose, NY, 2008.

Lot	Seed Treatment (mg per 100 g seed)	<i>B. allii</i> bioassay results (# plants)			% return on seed	
		Bundle #*	clean	<i>B. allii</i>		
Clean	Untreated	Rep 1- 1	60	0	71.6	
		- 2	60	0		
		- 3	65	0		
		- 4	50	0		
		- 5	123	0		
Clean	Thiran @ 188	Rep 2- 1	247	0	75.6	
		- 2	131	0		
Clean	Thiran @ 188	Rep 1- 1	60	0	79.8	
		- 2	75	0		
		- 3	60	0		
		- 4	124	0		
		- 5	80	0		
Clean	Tebuconazole @ 250	Rep 2- 1	312	0	90.4	
		- 2	140	0		
Clean	Tebuconazole @ 250	Rep 1- 1	75	0	35.0	
		- 2	45	0		
		- 3	55	0		
		Rep 2- 1	110	0		41.4
		- 2	97	0		
35% <i>B. allii</i>	Untreated	Rep 1- 1	60	0	49.0	
		- 2	65	0		
		- 3	70	0		
		- 4	50	0		
		Rep 2- 1	128	0		52.0
- 2	132	0				
35% <i>B. allii</i>	Thiran @ 188	Rep 1- 1	135	0	62.2	
		- 2	76	0		
		- 3	100	0		
		Rep 2- 1	297	0		85.4
		- 2	130	0		
35% <i>B. allii</i>	Tebuconazole @ 250	Rep 1- 1	90	0	32.8	
		- 2	74	0		
		Rep 2- 1	136	0		50.2
		- 2	115	0		
Trial average:				61.4		

*bioassays on rep 3 & 4 were not conducted after no *B. allii* was detected in reps 1 & 2.

Table 3. Evaluation of mowing and fungicide treatment after mowing to manage *B. allii* in bare root onion transplant seedlings produced in North Rose, NY, 2008.

Treatment			<i>B. allii</i> bioassay results (# plants)			% return on seed
Lot	mowed	Fungicide (rate per acre)	Bundle #*	clean	<i>B. allii</i>	
Clean	No	--	Rep 1- 1	110	0	42.6
			- 2	103	0	
			Rep 2- 1	194	0	60.8
			- 2	110	0	
Clean	Yes	--	Rep 1- 1	143	0	50.6
			- 2	110	0	
			Rep 2- 1	135	0	27.0
			- 2	110	0	
Clean	Yes	Rovral @ 1.5 pts	Rep 1- 1	61	0	36.2
			- 2	120	0	
			Rep 2- 1	230	0	46.0
			- 2	110	0	
Clean	Yes	Pristine @ 18.5 oz	Rep 1- 1	77	0	43.4
			- 2	140	0	
			Rep 2- 1	85	0	53.6
			- 2	183	0	
35% <i>B. allii</i>	No	--	Rep 1- 1	183	0	58.6
			- 2	110	0	
			Rep 2- 1	137	0	49.4
			- 2	110	0	
35% <i>B. allii</i>	Yes	--	Rep 1- 1	185	0	60.0
			- 2	115	0	
			Rep 2- 1	81	0	55.4
			- 2	89	0	
35% <i>B. allii</i>	Yes	Rovral @ 1.5 pts	Rep 1- 1	108	0	43.6
			- 2	110	0	
			Rep 2- 1	121	0	56.6
			- 2	162	0	
35% <i>B. allii</i>	Yes	Pristine @ 18.5 oz	Rep 1- 1	93	0	46.8
			- 2	141	0	
			Rep 2- 1	174	0	34.8
			- 2	110	0	
Trial average:						47.8

*bioassays on rep 3 & 4 were not conducted after no *B. allii* was detected in reps 1 & 2.

Impacts:

This project enhanced the collaboration among Cornell Cooperative Extension, Cornell University, Bejo Seeds, a transplant producer in Arizona and an Extension Plant Pathologist at the University of Arizona. Together, this group is working towards the common goal of the production of bare root onion transplant seedlings that are free of *B. allii* contamination, which could save onion growers in New York and beyond, several thousands of dollars in losses from neck rot, caused by *B. allii*.

Complimentary work to this study is being conducted by Hoepting et al., which investigates the economic feasibility of using locally grown plug onion transplants as an alternative to importing bare root transplants from AZ.

A repeat of this study using seed that has been confirmed to be infected with *B. allii* by Cornell and larger sample sizes is warranted, because the potential impacts of onion growers planting onions from transplants that are free of disease is considerable.

Appendices:



Figure 1. **Left:** neck rot of onion, caused by *Botrytis allii*. (photo: Hoepting, 2007). **Right:** *B. allii* sporulation of leaf tips and leaf sheaths of bare root onion transplant seedlings in bioassay, Hoepting et al. 2006.



Figure 2. Bare root onion transplant production on sandy soil with drip irrigation in North Rose, NY, 2008 (photo: Hoepting, 2008).



Figure 3. Bundles of bare root onion transplant seedlings grown in New York (left) and Arizona (right). Photos by Hoepting, 2008, 2006.



Figure 4. Bare root onion transplants before (back row) and after (front row) mowing, IPM mini-grant research project, NY, 2008.