CASE STUDY:

Evaluation of Disease Management Strategies for the Control of Pink Root on Sweet Onion in Maui, Hawaii

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Location: Kula, Maui

Situation

The Hawaii sweet onion industry is valued at $4.05 million with 300 harvested acres per year (2001 Statistics of Hawaiian Agriculture). In the tropics, the most important diseases of onions are pink root, *Phoma terrestris,* and fusarium basal plate rot, *Fusaruim oxysporum f.sp. cepae.* These diseases are most severe in areas where monoculture is present. Plants infected at seedling stage may be killed or severely stunted showing symptoms of nutritional deficiencies or drought stress. Infected plants produce unmarketable bulbs that are either shriveled or undersized. On Maui, these diseases have caused an estimated reduction in yield of 10% to 40% and in some cases 100% crop loss. Based on the 2001 Statistics of Hawaiian Agriculture, this loss can be translated into an estimated dollar loss of $199,300 to $797,200 to the onion industry per year. This loss assessment is conservative since it does not take into account other indirect costs such as the increased labor for harvesting, sorting and cull removal. Based on grower estimates, the increased labor for grading the onions adds 25% to the production cost of the onions. Furthermore, the presence of these diseases delay the harvest period up to one month, which increases crop maintenance including labor, water, pesticide, and other inputs.

Method

An experiment was conducted in the spring of 2001 to evaluate the effect of several disease management strategies on disease incidence and marketable yield. The experiment consisted of a split plot design with 4 replications per treatment. The only exception was the rape 2x + liquid compost treatment. The main treatments consisted of fumigated plots of Metam sodium, two green manure crops - sudangrass 'Sordan 79', and rape 'Humus' and a control (fallow treatment). The sub-treatments included, a commercial liquid inoculant, EM1 (Ecoyo, Inc.) and a control (non-treatment). Due to the lack of rape seed for the 2x treatment, liquid compost was added to this treatment. At harvest, individual bulbs were individu-

Overview of Sustainable Techniques Used

Soil Fumigation

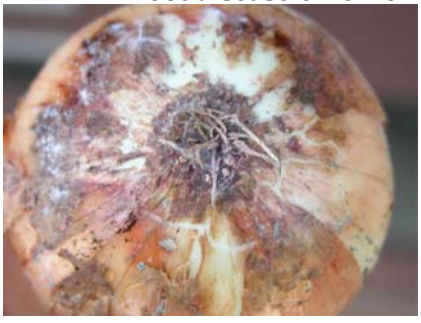
Green Manures

Biological Inoculants

Normal onion bulb

Fusarium basal plate rot

Pink root disease on onion



ally graded and weighed. Disease incidence and severity ratings were conducted at harvest, by visual observations. The yields from this experiment were low due to the inability to control heavy thrips infestations on foliage.

Results and Discussion

The results showed significant greater bulb weight in the vapam, vapam + EM, and rape + liquid compost treatments with 0.28 lbs, 0.31 lbs, and 0.34 lbs, respectively (refer to Table 1. Overall Mean Bulb Weight). The treatments with highest percentage of grade A's were the rape + liquid compost, liquid compost and rape 1x treatments with 98%, 99%, 87.5%, respectively. The control treatment had 84% grade A bulbs.

The treatments with the lowest pink root disease severity rating were the rape 1x, sorghum 1x, and vapam treatments with 1.56, 1.6, and 1.67, respectively. The control had an average pink root severity rating of 1.8. The pink root severity ratings are as follows: 0= no disease, 1 £ 25% infected roots, 2 = 26-50%, and 3= ³51%. The treatments with the lowest bacterial bulb rot incidence were rape + liquid compost, liquid compost, and rape 1x with 2%, 5%,and 8%, respectively. The control and vapam treatments had 12% and 14% of the bulbs infected with bacterial rots. The treatments with the lowest fusarium basal

Green Manure crop at six weeks.

Table 1. Overall Mean Bulb Weight

Treatment	Bulb Weight (lbs)	N
Rape 2x + LC (liquid compost)	**0.34A**	52
Vapam + EM	**0.31A**	200
Vapam	**0.28A**	200
Sorghum 2x	0.26B	200
Sorghum 1x + EM	0.25BC	200
Rape 1x	0.24BC	200
Rape 2x + LC	0.23BC	200
Rape 1x + EM	0.22BCD	200
Sorghum 1x	0.22BCD	200
Control	0.21BCD	200
Sorghum 2x	0.21CD	200
Liquid compost	0.20D	200
Liquid compost	0.19D	200

Note: Numbers in **bold** are best treatments
Note: Rape 2x + LC= only 1 replication, thus data may not be as reliable.

Mowed rape

Mowed sudangrass

Table 2. Treatments with least Fusarium Incidence

Treatment	**Total Number of Points** (= no. plants infected) (1= yes; 0= no disease)
Sorghum 1x (least)	**0**
Vapam	**1**
Rape 1x	**1**
Control	2
Liquid compost	2.6 equivalent
Sorghum 2x	3
Rape 2x + LC (most)	7.7 equivalent

In descending order.
Best treatments in **bold**.

Table 3. Treatments with best Grades (Grade A, and least off-grades and culls).

Treatment	Cumulative Points (with 200 bulbs) (1=grade A, 2=offgrade, 3=culls)	Total No. of Grade A bulbs.	% Grade A Bulbs
Rape 2x + LC (best)	**207**	**197 equivalent.**	98.5
Liquid Compost	**232**	**176 equivalent**	88.0
Rape 1x	**237**	**175**	87.5
Sorghum 1x	251	170	85.0
Control	253	168	84.0
Vapam	261	165	82.5
Sorghum 2x (worst)	261	161	80.5

Best Treatments in **bold**.

plate rot incidence were sorghum 1x, vapam, and rape 1x with 0, 0.5%, and 0.5%, respectively. The control had 1% of the bulbs infected with fusarium basal plate rot at harvest. The rape + liquid compost treatment had the highest incidence of fusarium basal plate rot with 7%. The EM1 treatments had no effect on the mean bulb weight. The EM1 treatments also had a lower percentage of grade A bulbs as compared to the non-EM1 treatments. There were no differences in the pink root severity in EM1 vs. non-EM1 treatments. In regards to the incidence of fusarium basal plate rot, the EM1 treatments had a higher incidence of disease. It is interesting to note that the EM1 treatments reduced the incidence of bacterial bulb rots by approximately 50%. Results of the field experiment suggest that green manure cover crops such as rape can be used as an effective biofumigant comparable to the soil fumigant (Metam Sodium). The data also suggest the use of bioinoculants such (EM1) and liquid compost may improve yields, bulb quality and reduce the disease incidence and severity of bacterial rot diseases on bulb onions.

Participants

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Table 4. Treatments with least Bacteria infection.

Treatment	Total Number of Points (= total number infected bulbs) (1= yes; 0= no infection) Number of bulbs (200)
Rape 2x + LC (least)	**3.8 equivalent**
Liquid Compost	**9.3 equivalent**
Rape 1x	**16**
Sorghum 1x	23
Control	23
Sorghum 2x	24
Vapam (most)	28

Best treatments in **bold.** Lower numbers are better.

Table 5. Treatments with least Pink Root infection.

Treatment	Total No. of points	Total No. infected bulbs, with index 2 or 3 (N)
Rape 1x (least)	**313**	**92**
Sorghum 1x	**321**	**101**
Vapam	**335**	**110**
Rape 2x + LC	342 equivalents	127
Liquid compost	350 equivalents	119 equiv.
Control	361	117
Sorghum 2x (most)	365	129

Best Treatments in **bold**. Lower numbers are better.
Point System: 0= none; 1 = <25% infected roots, 2 =25-50% infected roots, 3 = >51% infected roots

Tank mix of EM1

EM1 Application

Table 6.
Mean Bulb Weight as affected by EM treatments

Treatment	**Mean Bulb Weight** (lbs/bulb)	**N** (no bulbs)
None	0.25 A	600
EM	0.23 B	602

Table 7. Effect of EM on number of Grade A, and diseased onions.

Grade (best treatment on top) EM (best)= 710 total None (worst)= 783
Fusarium incidence None (best)= 2.3 points EM (worst)= 14.7 points
Pink Root Incidence EM and None= equal effect
Bacterial incidence EM (best)= 45.6 points None (worst)= 81.7

Table 8. Effect of EM treatments on yield and disease incidence of individual treatments.

Treatment	Weight (total)	Grade[1] (total points, index)	Pink Root[2] # of bulbs infected / 200 bulb sample	Fusarium	Bacteria
Control + EM	21.5W	**117**	**164**	2	**8**
Control - EM	**24**	136	197W	**0**	15W
Liq compost + EM	19.7W	125	**172**	1.3	6.6
Liq compost - EM	20.3	**107**	178	1.3	**2.7****
Rape 1x + EM	**24.2**	**112**	**150****	**0**	**6**
Rape 1x - EM	21.8	125	163	1	10
R2x + LC + EM	23.1	**100****	211	7.4W	**0****
R2x + LC - EM	**34****	108**	**140****	**0**	4**
Sorghum 1x + EM	22.1	**119**	161	0	**9**
Sorghum 1x- EM	**25.0**	132	160	0	14
Sorghum 2x + EM	20.7W	**123**	186	3W	**8**
Sorghum 2x - EM	**25.9**	140W	**179**	**0**	16
Vapam + EM	28.9	**118**	**163**	1	**8**
Vapam - EM	**30.9****	143W	172	0	20W

** = Best Treatment W = Worst Treatment
(Note: numbers in bold are best, within +/- EM treatments)
[1] = Grade ratings (1=grade A, 2=offgrade, 3=culls)
[2] = pink root severity ratings (0= no disease, 1= <25% infected roots, 2= 26-50%, and 3= >51%)

Table 9. Mean bulb weight of Grade A bulbs, number of Grade A bulbs, and mean bulb weight of off-grade and culls.

Treatment	Grade A (lbs)	Grade A (No)	Off-Grade/Culls (lbs)	Off-Grade/Culls (No)
Vapam	.29A	165	.32A	35
Rape 2x + LC	.28A	196eq	0.3A	4 eq
Sorghum 1x	.23B	170	.29A	30
Control	.22BC	168	.26A	32
Rape 1x	.22BC	175	.31A	25
Sorghum 2x	.21BC	161	.32A	32
Liq comp	.19C	178eq	.21A	21eq
EM	.22B	531	.27A	71
None	.24A	493	.30A	107

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