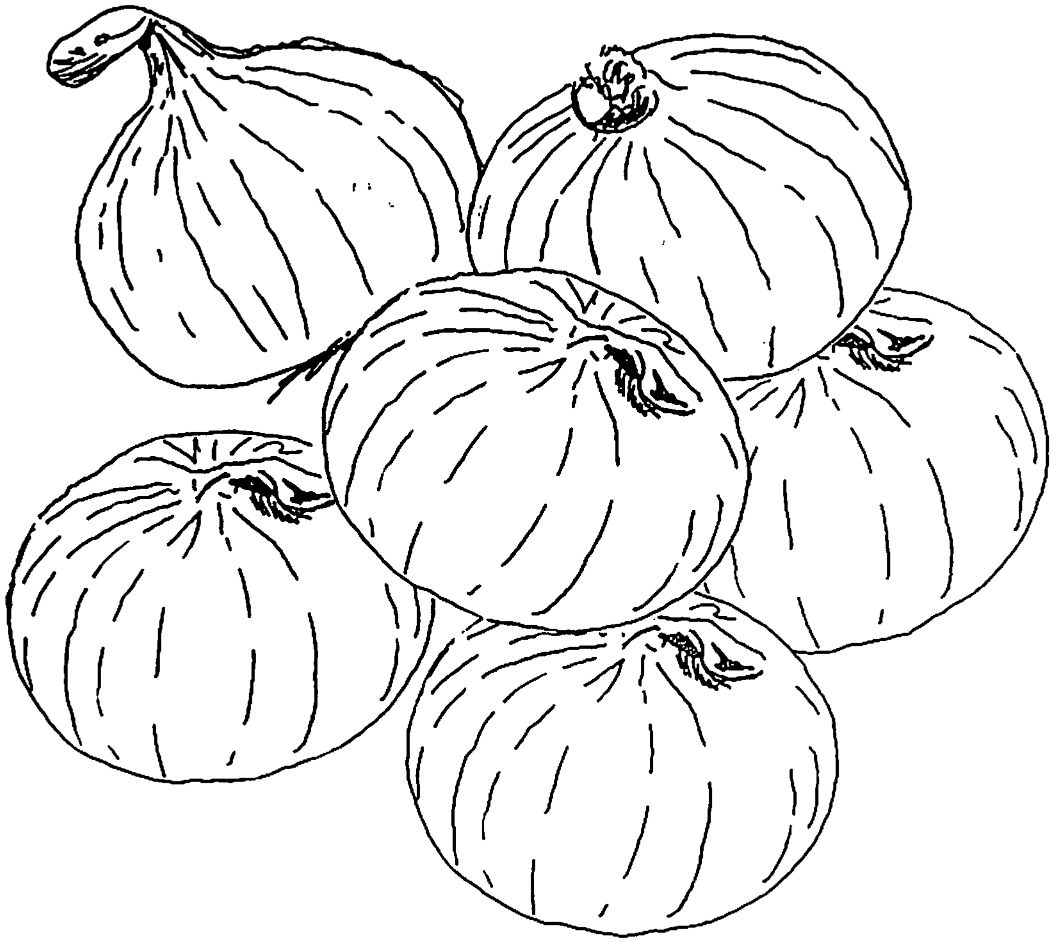

1992 Georgia Onion Research - Extension Report

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THE 1992 RESEARCH-EXTENSION REPORT

Georgia's onion industry is primarily based upon the production of sweet onions, so called because of a mild pungency level of the varieties grown. Georgia's sweet onion industry originated on a farm two miles east of Vidalia, more than 60 years ago. During 1992, approximately 250 growers harvested over 8,000 acres of onions. The industry has an annual farm value of approximately $30 million and contributes approximately $100 million to the economy of Georgia.

The University of Georgia and USDA/ARS provide information on many aspects of production and handling to the onion industry through research and extension programs. This first Onion Research-Extension Report is a compilation of current information.This information may be progress reports of research underway or reports of conditions in the field. This Onion Research-Extension Report is intended to convey the status of present information and should not be considered as the final authority.

SUMMARY OF CHANGES IN EXTENSION RECOMMENDATIONS FOR VIDALIA ONIONS COMING OUT OF ON-FARM RESEARCH AND DEMONSTRATION PLOTS

Willie O. Chance, III, Extension Horticulturalist

The Vidalia onion industry in Georgia is in the middle of a time of change. The creation of the Vidalia Onion Committee in 1989 and the introduction of controlled atmosphere storage for onions has changed the way growers and buyers look at the onion. There is also much change going on in the way onions are grown as growers try to produce a sweeter onion that will last longer in storage. Research and demonstration plots have been established by the Georgia Extension Service to guide and direct some of these changes.

Pop-Up and Plant beds

Pop up fertilizers are recommended when planting the transplant onion crop. These fertilizers contain high percentages of highly soluble phosphorus. Examples include 18-46-0 and 10-34-0. This phosphorus is important to the young plants as they establish a new root system after transplanting.

Based on field observations, several county extension agents were recommending the use of pop-up fertilizers on plantbeds. The pop-up would be incorporated at planting or scattered over the top soon after planting or as the first side-dress nitrogen application. A field demonstration showed the benefit of this practice. Extension now recommends 100 to 150 lb. per acre of dry material be scattered over the top after seeding or at first side-dress (before the plants are half grown). Further work will probably be done to confirm these findings and to learn more about why this application works so well.

Cultivar, Pungency, and C. A. Storage

A project funded by the Vidalia Onion Committee looked at the effect of cultivar on pungency (hotness) and controlled atmosphere (C.A.) storability.

This research has not yet been completed, so results are preliminary. For this reason they will be quickly summarized here as opposed to giving much hard data.

Onions were grown as per extension recommendations. This means lower sulfur rates (40-50 lb/acre) and split fertilizer applications. It was found that, using this fertilizer regime, many onion varieties did tend to have a significantly higher pungency level but this had not been consistent year to year. In general, if onions were grown as per extension recommendations, most varieties will be fairly mild. If, however, growers use high sulfur rates than recommended, certain varieties may get hot faster than others. This is being investigated further.

As far as C. A. storability, a few varieties have appeared to have better storability. However, only one year's data is available at this time, so few recommendations have been made. Several of the traditional varieties grown look good for C. A. More information is available from Willie Chance in Statesboro.

One of the most important things learned over the years is that culture is important to storability. For best storability onions should be mature (necks soft or fallen over) and onions should not be over-fertilized. Best storage was obtained on onions that were grown following extension recommendations.

Sulfur rates for Vidalia Onion

Although no work has been done on this subject, it has become apparent that sulfur rates for Vidalia onion need to be linked to soil type. Extension recommendations in 1990 were 30 lb/acre. On some sandy sites, this has been seen to be too low. On sites with more clay (which keeps sulfur from leaching), 30 lb/acre is adequate. Sulfur deficiency has become more prevalent in the last few years.

The recommendation for now is 35 to 60 lb/acre.

Sandy sites should use the higher rates. Soils that are sandy with a clay base (these soils will have pebbles on the surface) should use intermediate rates. The lowest rates are used on soils where there is some clay visible.

This is not a tested recommendation, but one that is based on observation. It has worked well on farms where it has been tried. One thing is certain though, rates of sulfur above these will cause onions to be hot at harvest.

The recommendations for sulfur fertilization to prevent deficiencies (from too little sulfur) and hot onions (from too much sulfur).

- Use sulfur rates from 35-60 lb/acre.

- Split sulfur applications. Sulfur is usually put out in the complete fertilizers early in the season (5-10-15, 6-12-12, etc.). These fertilizers should be split into several applications, perhaps like this:

At planting	600 lb/acre 5-10-15
30 days after planting	300 lb/acre 5-10-15
45-60 days after planting	300 lb/acre 5-10-15

If all the sulfur is applied at planting, it is more likely to leach and cause deficiency problems.

Finish all sulfur applications by mid to late January. Later applications cause onions to be hot.

If a sulfur deficiency is discovered late in the season, apply 5-7 lb/acre of epsom salts as a foliar spray. This will supply sulfur without making the onions hot.

More work should be done in this area.

1993 CROP CONDITIONS

Danny Gay, Extension Plant Pathologist

The 1993 onion crop appears to be in relatively good condition following extremely warm weather. The weather did not cooperate with plant production as beds were seeded a little later and then cold weather followed, which caused many growers to utilize smaller than normal plants. These early plantings with small transplants resulted in poor stands in some locations. The extreme warm, wet weather that occurred in December and January has allowed Alternaria (purple blotch) to develop. In most cases, a couple of days of sunshine dries up the infection. We have suggested to growers that Maneb + Copper should be applied where physical damage occurs, whether it is caused by insects, hail, disease or other mechanical factors.

We have identified bacterial streak and bulb rot in one sample thus far. It is our hope that this disease does not occur widespread over the onion belt. We recently received permission to use Streptomycin for this disease for one more year. The label expires June 30, 1993.

We expect to develop some opinions about soil fumigation as the second fumigation plots are underway in Tattnall and Tift Counties. We have a good arsenal of fungicides to combat foliage diseases and do not anticipate any major difficulty in controlling them as they develop. Growers are aware of the timely application of fungicides along with good coverage.

POPULATION DYNAMICS OF PSEUDOMONAS VIRIDIFLAVA

R. D. Gitaitis, Research Plant Pathologist

Senusekectuve Medium/Isolation Methodology Developed

A semiselective medium, T-5, (Table 1) was developed for isolation of Pseudomonas viridiflava, the causal bacterium of bacterial streak and bulb rot. Strains of P. viridiflava were isolated from onions in Georgia; Florida (original hosts were tomato and parsnip); or obtained from the American Type Culture Collection (original host was bean in 1930). Cultures of each strain were maintained in 15% glycerol at - 100 F. Strains were cultured on a standard medium (King's medium B (KMB)) prior to all tests. Plating efficiencies were determined by preparing bacterial suspensions from shake cultures in nutrient broth. Bacteria were harvested by centrifugation, suspended in phosphate-buffered saline, serially (1:9) diluted and 0.1 ml aliquots were spread on test media. Numbers of colonies were counted after plates were incubated 3-5 days at 80 F and were compared to growth and development on KMB. Recovery from soil was evaluated by adding 1 ml of a suspension (1×10^5 cfu/ml) of P. viridiflava to 10 g of nonsterile soil suspended in 100 ml of PBS. Efficiency of recovery was evaluated on plates of KMB and T-5 (Table 2.). The test originally was conducted in four soil samples that had no history of onion production and later in soil samples that had a 16-yr history of onion production. When incubated at 80 F, plating efficiencies on T-5 for four strains of P. viridiflava ranged from 67 to 120% (avg. = 87.8%). In the soil recovery assay, P. viridiflava was recovered (avg. of actual value = 2.6×10^3 cfu/ml, whereas the expected value was 1×10^3 cfu/ml) on T-5 from all replications of all four soil samples that had no history of onion production. Two representative colonies from each plate (n=48) tested negative for oxidase and arginine dihydrolase activity, and were identified as the target organism, P. viridiflava. High populations of saprophytic bacteria and fungi prevented recovery of the target organism from KMB. However, when soil samples came from areas with a long history (up to 16-yr) of onion production, there were considerable numbers of nontarget bacteria and fungi on T-5 plates which made recovery of P. viridiflava more difficult. Low temperature incubation was developed and fine-tuned for the recovery of this organism (Table 3). When incubated at approximately 80 degrees F (typical for many bacteria) plating efficiencies on T-5 for four strains of P. viridiflava ranged from 67 to 120% (avg. = 87.8%). In soil recovery assays, P. viridiflava was recovered at 100% of the expected value (1×10^3 cfu/ml) on T-5 from all replications of all four soil samples that had no history of onion production (the organism was purposely added to the soil to evaluate the medium's ability). Representative colonies from each plate were tested and were identified as the target organism, P. viridiflava. High populations of saprophytic bacteria and fungi interfered with and prevented recovery of the target organism from standard medium, KMB. However, when soil samples came from areas with a long history (up to 16-yr) of onion production, there were considerable numbers of nontarget bacteria and fungi on T-5 plates which made recovery of P. viridiflava more difficult. An observation of refrigerated onions that continued to rot led us to the use of medium T-5 in conjunction with incubation at 40 degrees F for enhanced isolation of P. viridiflava. This appears to be a useful and reliable method for recovery of this organism. When recovery of bacteria from eight soil and three irrigation water samples (three replications each) was evaluated, there was an approximate 1000 fold reduction of nontarget microorganisms on T-5 incubated at 40 F compared to the same samples incubated at 80 F (Table 4). We concluded that the semi-selective medium T-5 supports adequate growth of P. viridiflava and can be useful in the recovery of the bacterium from various sources, especially in conjunction with low temperature incubation.

Survey of the Onion-Growing Region

From October, 1991 to August, 1992, hundreds of soil, soybean, and irrigation water samples from Toombs, Montgomery, and Tattnall counties were assayed, and 11 seed samples were processed and plated on selective media. Soil samples were suspended in buffer (10 g/100 ml), and the 10^0, 10^{-1}, and 10^{-2} dilutions spread on appropriate media. Soybean leaves were either washed in buffer in bulk samples with 0.1 ml aliquots being spread from the three appropriate dilutions, or individual lesions were crushed and expressed sap streaked on appropriate media. Aliquots of the three dilutions of the various samples were directly spotted on to T-5 (for P. viridiflava), KMB (for slippery skin), TB-T (for sourskin), and CVP (for Erwinia, P. marginalis, and other soft rotters) and incubated. Suspect colonies were picked from the plates and tested for identity by either traditional biochemical and physiological tests or by fatty acid analysis and gas chromatography. P. viridiflava was not detected in any of the soil, water, or soybean samples, however, P. cepacia, the sourskin pathogen, was detected in low frequency in some soil samples, and numerous and high concentrations of pectinolytic bacteria (which are potential softrot postharvest pathogens) were recovered in pond water (Table 5.). The only time that P. viridiflava was detected naturally before symptoms were evident was as an epiphyte (surface dweller on the epidermis) in association with frost on onion leaves in January, 1992. Once symptoms became evident in February, the bacterium was routinely recovered from diseased tissues.

Although soybeans were shown to be a host based on inoculations in the greenhouse, and soybeans that had been inoculated in field plots at Tifton developed symptoms in the field, with the bacterium being recovered late in the season, there was no demonstrated carry over to the next season. In addition, there was no recovery of the bacterium from soybean volunteers in the 1992 onion crop (Toombs, Co.) nor from a survey of several soybean fields in the Vidalia, onion-growing region in August, 1992 prior to the planting of the 1993 crop.

Fumigation Studies

Regardless of location (Toombs or Montgomery Co.) in the fumigation study (methods given elsewhere), there was an increase in populations of pectinolytic bacteria (possible postharvest pathogens) recovered on CVP media over time. Average pectinolytic, soilborne, bacterial populations were 1.4×10^3, 6.3×10^3, 3.9×10^4, and 5.0×10^4 cfu/g of soil in October, November, January and March, respectively. In the heavier soils (site A), populations of total bacteria at 80 and 40 F, and fluorescent pseudomonads at 40 F declined from October through March, whereas fluorescent pseudomonads growing at 80 F increased from January to March (Figure 1). In a loamy sand soil (site B), populations of total bacteria and fluorescent pseudomonads declined from October to January at both 80 and 40 F, then all increased significantly from January to March (Figure 2). None of the soil fumigation treatments affected foliar (Table 6) or bulb (Tables 7 & 8) disease severity (in terms of bacterial rots) at any time during the growing season or at harvest. There were significantly higher numbers of endophytic, nonpathogenic bacteria in bulbs grown in soils treated with the higher rate of chloropicrin compared to other treatments or the untreated control (Tables 7 & 8). Soils treated with higher rates of chloropicrin, either alone or in combination with methyl bromide, produced higher yields of onions (Table 9). There was a significant decrease in the amount of bolting (production of seedscapes) which resulted in higher yields in plots treated with the higher rate of chloropicrin.

Fertility Studies

In Tifton, an application of excessive amounts of fertilizer increased bacterial streak and rot severity compared with what was observed in onions receiving the standard, recommended levels of fertilizer (Figure 3). Although disease levels in onions treated with excessive levels of fertilizer were higher in all months, the logistic transformation of the disease progress curves for both treatments indicated a very similar rate (r) of disease development, r= 0.049 for excessive, and r=

0.057 for standard fertilizer rates (Figure 4). This indicates that the main effect of the standard fertilization practice delayed the onset of the epidemic. Thus, if the delay is sufficiently long and the weather conditions become less favorable, it may result in less disease. In contrast, if favorable weather conditions (cool and wet) persist late into the spring, then disease may continue to develop and be severe. Additional work under different climatic conditions is required to fully assess the benefits of using this cultural practice to control this disease.

Early in the epidemic (February), P. viridiflava was recovered 100% of the time from both typical symptoms and from necrotic tips (dieback) of leaves, a symptom not previously associated with this disease, in plants receiving excessive amounts of fertilizer (Table 10). However plants treated with standard levels of fertilizer displayed no typical symptoms but did exhibit the tip dieback. Attempts to recover P. viridiflava from 20 such samples failed to produce the bacterium. In March, however, P. viridiflava was again isolated in 100% of the samples displaying both symptom types in plants receiving excessive fertilizer levels, in 100% of the samples displaying typical symptoms in plants receiving standard fertilizer levels, and in 60% of samples with tip dieback in plants receiving the standard fertilizer treatment, however these latter samples from the standard fertility treatment yielded very low numbers of bacteria compared to the numbers recovered from the high fertility treatment.

Chemical Control

In both 1991 and 1992, there was no significant control of bacterial streak and rot in replicated field trials at Tifton with the use of either copper or streptomycin when these products were tested alone or in combination with a spreader-sticker. It should be noted however, that in 1991 the disease levels were so low that a fair assessment could not be made. The data for 1992, however, is more reliable. A high number of isolates of P. viridiflava were found to be tolerant to copper at levels normally used for disease control. However, in laboratory assays it was found that the copper tolerance is negated when the fixed coppers are used in combination with mancozeb.

Postharvest Studies

Identification of nearly 2000 bacteria recovered from onion bulbs at harvest, healthy onion bulbs, and from rotted bulbs in storage is still in progress. Isolations have been made from discolored zones of onion bulbs held under various storage conditions from a couple of weeks to 4 months. Isolations were made on TB-T, T-5, Nutrient Agar, and KMB media. KMB and T-5 have been incubated at 40 F and Nutrient Agar and TB-T have been incubated at 80 F. Suspects from these plates have been placed on CVP, KMB, and KMA to determine their pectinolytic, fluorescent, and pyocyanine capabilities. Representative strains have been stored for identification by fatty acid analysis by gas chromatography (GC). Identification by GC analysis requires a loopful of bacteria cultured on trypticase soy agar to be added to 1 ml of 1.2 N NaOH in 50% aqueous methanol in a screw cap tube and saponified for 30 min at 212 F. Samples then were acidified with 0.5 ml of 6 M HCl (final pH 2) and incubated at 176 F for 4 min. After cooling, FAMES were extracted with 1 ml of a hexane and diethyl ether mixture (1:1). After gentle mixing (3 min), the lower aqueous phase was removed. The organic phase was washed by gentle agitation (end-over-end five times) with 3 ml of 0.3 N NaOH. After separation of phases, the upper organic phase was removed for analysis. FAMES were analyzed by gas-liquid chromatography with a Hewlett-Packard Model 5890A gas chromatograph equipped with a 30 m by 0.25 mm phenyl methyl silicone fused silica capillary column. Prior to analysis of samples, the gas chromatograph was calibrated with a commercial FAMES mix. Most recently, an enrichment technique using "sterile" onion slices as a food source has shown promise in isolating other soft rotting bacteria that are associated with the deterioration of onions in storage. Bacteria isolated in this manner were also identified by gas chromatography for their fatty acid composition. An up-to-date list of different kinds of bacteria recovered from onion bulbs so far is listed in Table 11.

Summary

We concluded that the semi-selective medium T-5 supports adequate growth of P. viridiflava and can be useful in the recovery of the bacterium from various sources. It was interesting that when first evaluated, the medium was nearly 100% selective when known populations of P. viridiflava were added to soil. Unfortunately, the soils used in the first tests had a different cropping history than those for which the medium was intended and samples were taken in mid-winter when soil populations were lower than most sample periods. When used in epidemiologic studies in onion-growing areas, the medium was not as efficient as we desired in eliminating nontarget microorganisms. An observation of refrigerated onions that continued to rot led us to the use of medium T-5 in conjunction with incubation at 40 F for enhanced isolation of P. viridiflava. This appears to be a useful and reliable method for recovery of this organism.

In spite of our best efforts, we failed to detect P. viridiflava in soil, irrigation water, volunteer soybean plants in onion fields or in soybeans preceding onion planting. It is possible that the bacterium survives in association with weeds or other plants outside of the area and then is disseminated in to onion fields, the bacterium may be seedborne, or finally, the source of inoculum may be in the soil or irrigation water at levels below which we could detect or in isolated pockets that our sampling methods missed.

It is interesting to note that several other pathogenic bacteria, including Pseudomonas cepacia, Pseudomonas gladioli pv. alliicola, Pseudomonas marginalis, Erwinia chrysanthemi, and other potential secondary pathogens were recovered from diseased onions, soil and irrigation water, but did not cause significant disease problems in the field. Postharvest studies, including the effect of maturity at harvest, are still in progress. Certainly the high frequency of isolating "gut" bacteria, including Salmonella, many of which are potential human pathogens is interesting and may be some cause for concern. The characterization of the total microflora of soils, irrigation water, foliage, and onion bulbs is incomplete. The interaction of these organisms may be affecting bulb quality and duration of shelf-life. This type of work remains in progress.

Fumigation with any of the chemicals tested had little effect on bacterial streak and rot, other bacterial diseases, or on total bacterial populations in the soil. This could be due to either the lack of bactericidal activity by the products, an ineffective method of application (water was used to seal the surface as no plastic cover was used), or because the microorganisms re-entered (possibly in irrigation water) and rapidly recolonized the soil.

The best hope of managing this disease may be the use of good cultural practices. In particular, the use of standard, recommended levels of fertilizer appear to offer some disease control (Figure 5.). Often, onion growers apply excessive levels of fertilizer during winter months to promote rapid growth in order to achieve an early harvest. Onions harvested and sold early command the highest prices. Unfortunately, this practice also appears to predispose the plant to disease problems. In 1992, disease severity and incidence has not been as great as in 1990 or 1991. However, losses may have been more subtle. Rather than colonizing and eventually rotting the interior of the bulb, in many instances the bacterium simply destroyed outer leaves, which resulted in smaller onions in 1992.

Table 1. T-5 Medium for *Pseudomonas viridiflava*

Item	g/L
Sodium Chloride	5.00
Monobasic Ammonium Phosphate	1.00
Dibasic Potassium Phosphate	1.00
Magnesium Sulfate Septahydrate	0.20
Agar	20.00
D-tartaric acid	3.00
Phenol Red	0.01
Deionized water	920 ml[1]
Bacitracin[2]	10 mg
Vancomycin	6 mg
Cycloheximide	75 mg
Novobiocin	45 mg
Penicillin G	50 mg

[1] Adjust pH (- 7.2) with 35-40 ml 1 N NaOH and autoclave.

[2] Cool to 100 F and then aseptically add antibiotics.

Table 2. Recovery of Pseudomonas viridiflava on T-5 and KMB media when known concentrations of bacteria were added to nonsterile, Tifton loamy-sand.

Soil	Medium	Mean # Colonies per Dilution[1] 10^0	Mean # Colonies per Dilution[1] 10^{-1}
A	KMB	BTNTC[2]	BTNTC
B	KMB	BTNTC	BTNTC
C	KMB	BTNTC	BTNTC
A	T-5	149	25
B	T-5	156	30
C	T-5	149	23
Mean	KMB	BTNTC	BTNTC
Mean	T-5	151	26

[1] Values represent the mean of three replications.

[2] BTNTC = background bacteria too numerous to count.

Table 3 . Effect of incubation temperatures on growth of <u>Pseudomonas viridiflava</u> on KMB and Basal Tartrate Media.

	Mean # Colonies per Dilution[1]									
	86 F		77 F		59 F		50 F		40 F	
Strain-Medium	10^{-6}	10^{-7}	10^{-6}	10^{-7}	10^{-6}	10^{-7}	10^{-6}	10^{-7}	10^{-6}	10^{-7}
DD2-KMB	87	7	64	10	63	7	63	7	69	7
DD2-T-5	45	4	51	7	47	5	53	5	46	7
R2-KMB	42	5	55	6	56	7	57	6	65	8
R2-T-5	55	6	58	8	50	5	52	7	58	4
91-1-KMB	87	7	94	5	97	9	93	7	98	9
91-1-T-5	51	7	68	10	76	8	77	6	66	7

[1] Values are based on the mean of three replications.

Table 4. Recovery of bacteria similar to Pseudomonas viridiflava (i.e. utilize tartrate, are insensitive to 5 antibiotics, and raise the pH to create pink zones in medium T-5) vs total bacteria at 40 F and 80 F. Sample site was commercial soils prior to fumigation in the Vidalia, GA region.

	Mean Population (cfu)/g of soil			
	40 F		80 F	
Soil	Pink Zone	Total	Pink Zone	Total
A-1	1×10^3	2.8×10^4	1×10^4	1×10^7
A-2	0	0	1×10^4	5.6×10^6
A-3	0	0	3×10^3	6.5×10^6
A-4	0	9×10^2	3×10^4	1.1×10^7
A-5	0	1×10^2	2×10^4	1.2×10^7
A-6	0	0	2×10^4	6.6×10^6
A-7	0	0	1×10^4	9.5×10^6
A-8	0	0	2×10^3	5.6×10^6
S-1	4×10^2	5.1×10^3	2×10^6	2.2×10^6
S-2	0	7.2×10^3	4×10^5	1.2×10^6
S-1	2×10^2	1.3×10^3	8×10^4	4.1×10^5
Mean	1.5×10^2	3.9×10^3	2.4×10^5	6.4×10^6

Table 5. Recovery of pectinolytic[1] bacteria on CVP medium from various commercial ponds in the Vidalia Onion growing region.

Pond	cfu of pectinolytic bacteria per ml of pond water
A[2]	5×10^{0}
B	1×10^{4}
C	3×10^{1}
D	2×10^{3}
E	3×10^{1}
F	1×10^{2}
G	0
H	0

[1] Pectinolytic bacteria are potential soft rot pathogens.

[2] Samples collected 10/22/91.

Table 6. Ratings of total quality of onion foliage over a period from November, 1991 to April, 1992 at two locations in the Vidalia Onion-growing region of Georgia.

		Foliar Necrosis (0 - 11)			
Treatment[1]	Rate	Site A Time[2]4	Site A Time 5	Site B Time 4	Site B Time 5
6733	low	1.9 a[3]	4.3 a	1.7 a	2.7 a
6733	high	2.0 a	4.9 a	2.1 a	2.9 a
HD Pic	low	3.1 a	4.5 a	2.0 a	2.7 a
HD Pic	high	2.5 a	4.6 a	2.3 a	2.6 a
MBC	low	2.3 a	4.1 a	2.1 a	2.5 a
MBC	high	2.4 a	4.0 a	1.7 a	2.7 a
Telone C-17	-	2.5 a	4.0 a	2.6 a	3.3 a
Check	-	3.0 a	4.0 a	3.1 a	2.7 a

1 Treatments: HD Pic= chloropicrin, 6733= 67% methyl bromide and 33% chloropicrin, MBC= methyl bromide, Telone C-17= 77.9% 1,3-dichloropropene and 16.5% chloropicrin.

2 No disease detected in rating periods 1-3 (Nov.- Jan.). No rating made in Feb.

3 Data analyzed by ANOVA, Means compared by Duncan/Waller K-ratio T test. Values within columns designated by the same letter are not significantly different, $P = 0.05$.

Table 7. Recovery of endophytic bacteria from onion bulbs (n= 30/trt) sampled two weeks prior to harvest and at harvest at site A in the Vidalia Onion-growing region of Georgia.

		# Bulbs Colonized				% Bulbs Rot Symptoms
		Fluor. Ps		Total Bacteria		
Treatment[1]	Rate	Time 1	Time 2	Time 1	Time 2	Time 2
6733	low	1.3 a[3]	1.3 b	3.7 a	2.0 b	2.3 a
6733	high	0.3 a	0.7 b	3.3 a	1.3 b	0.0 a
HD Pic	low	1.7 a	0.3 b	2.7 a	1.0 b	0.97 a
HD Pic	high	2.3 a	4.0 a	2.3 a	4.3 a	0.80 a
MBC	low	1.0 a	1.3 b	1.0 a	1.7 b	0.73[2]a
MBC	high	2.7 a	0.7 b	4.7 a	0.7 b	0.0 a
Telone C-17	-	2.3 a	1.7 b	3.7 a	1.7 b	1.50[2]a
Check	-	0.3 a	1.0 b	2.7 a	1.7 b	0.87 a

[1] Treatments: HD Pic= chloropicrin, 6733= 67% methyl bromide and 33% chloropicrin, MBC= methyl bromide, Telone C-17= 77.9% 1,3-dichloropropene and 16.5% chloropicrin.

[2] Pseudomonas viridiflava recovered.

[3] Data analyzed by ANOVA, Means compared by Duncan/Waller K-ratio T test. Values within columns designated by the same letter are not significantly different, P= 0.05.

Table 8. Recovery of endophytic bacteria from onion bulbs (n= 30/trt) sampled 3 weeks prior to harvest and at harvest at site B in the Vidalia Onion-growing region of Georgia.

		# Bulbs Colonized				% Bulbs
		Fluor. Ps		Total Bacteria		Rot Symptoms
Treatment[1]	Rate	Time 1	Time 2	Time 1	Time 2	Time 2
6733	low	3.7 a[2]	3.7 a	5.3 a	4.3 a	0.63 ab
6733	high	5.0 a	5.3 a	6.3 a	6.0 a	0.61 ab
HD Pic	low	3.0 a	4.7 a	5.0 a	5.7 a	1.26 ab
HD Pic	high	3.0 a	4.0 a	5.7 a	4.7 a	0 b
MBC	low	4.3 a	3.0 a	4.7 a	5.7 a	0.61 ab
MBC	high	1.7 a	5.0 a[3]	4.3 a	6.7 a	0 b
Telone C-17	-	5.0 a	3.3 a	7.0 a	4.0 a	1.91 a
Check	-	2.7 a	4.7 a	4.7 a	6.0 a	1.31 ab

1 Treatments: HD Pic= chloropicrin, 6733= 67% methyl bromide and 33% chloropicrin, MBC= methyl bromide, Telone C-17= 77.9% 1,3-dichloropropene and 16.5% chloropicrin.

2 Data analyzed by ANOVA, Means compared by Duncan/Waller K-ratio T test. Values within columns designated by the same letter are not significantly different, $\underline{P}$= 0.05.

3 Pseudomonas viridiflava recovered.

Table 9. Effect of fumigation treatments on onion yields at two locations in the Vidalia Onion-growing region of Georgia.

	Kg x 1000/Ha		# of Jumbos[1]		% Bolt
Treatment[2](Kg/Ha)	Site A	Site B	Site A	Site B	Site A
6733 (88)	26.9 b[3]	39.1 a	7.7 a	48.7 a	21.3 a
6733 (127)	35.9 a	38.0 a	5.0 a	48.3 a	2.7 b
HD Pic (85)	27.8 b	38.1 a	7.0 a	45.7 a	11.7 ab
HD Pic (124)	36.0 a	37.1 a	6.3 a	47.7 a	9.3 ab
MBC (162)	30.8 ab	35.5 a	5.3 a	43.0 a	10.7 ab
MBC (258)	29.5 b	35.4 a	3.0 a	47.0 a	18.0 ab
Telone C-17	31.9 ab	34.4 a	7.3 a	42.0 a	10.3 ab
Check	27.3 b	37.0 a	5.0 a	44.3 a	16.3 ab

[1] Onions were immature at site A at time of harvest.

[2] Treatments: HD Pic= chloropicrin, 6733= 67% methyl bromide and 33% chloropicrin, MBC= methyl bromide, Telone C-17= 77.9% 1,3-dichloropropene and 16.5% chloropicrin.

[3] Data analyzed by ANOVA, Means compared by Duncan/Waller K-ratio T test. Values within columns designated by the same letter are not significantly different, $P = 0.05$.

Table 10. Recovery of Pseudomonas viridiflava from typical and atypical symptoms in onion leaves from plots receiving high or low levels of fertilizer through the winter of 1992.

Fertility Treatment	Symptom-type	Recovery of P. viridiflava Feb.	Mar.
High	Mid-leaf, base[1]	20/20[2]	10/10
High	Tip dieback	20/20	10/10
Low	Mid-leaf, base	0/0[3]	10/10
Low	Tip dieback	0/20	6/10[4]

[1] Typical symptoms were water-soaked streaks in mid to base of leaves as opposed to atypical dry, necrotic streaks extending from the tip.

[2] Bacteria were recovered in massive numbers on KMB.

[3] No plants with symptoms in this treatment in Feb.

[4] Only one sample contained bacteria in massive numbers; of the remaining five, less than 10 cfu were recovered per plate of KMB.

Table 11. Identity of bacterial species recovered from onion bulb interiors.

Identification	Comment
Bacillus sphaericus	saprophyte
Bacillus pabuli	saprophyte
Pseudomonas marginalis	soft rot pathogen (primary)
Pseudomonas syringae	foliar pathogen (primary)
Pseudomonas cepacia	soft rot / sourskin pathogen (primary)
Pseudomonas putida	saprophyte
Pseudomonas corrugata	tomato stem pathogen (secondary)
Pseudomonas chloroaphis	saprophyte
Pseudomonas gladioli pv alliicola	soft rot / slippery skin pathogen (primary)
Pseudomonas fluorescens	possible secondary rot organism
Pseudomonas viridiflava	plant pathogen
Xenorhabdus nematophilus	biocontrol of insects vectored by nematodes
[1]Cedecea davisae	potential opportunistic human pathogen
[1]Citrobacter freundii	"
[1]Enterobacter agglomerans	"
[1]Erwinia herbicola	potential opportunistic plant pathogen
[1]Erwinia chrysanthemi	soft rot pathogen (primary plant pathogen)
[1]Erwinia uredovora	biocontrol pathogen of rust fungi
[1]Erwinia carnegieana	opportunistic plant pathogen
[1]Erwinia cypripedii	soft rot pathogen (secondary plant pathogen)
[1]Escherichia coli	fecal inhabitant, opportunistic human pathogen
[1]Hafnia alvei	"
[1]Klebsiella planticola	potential human pathogen
[1]Kluyvera cryocrescens	fecal inhabitant, opportunistic human pathogen
[1]Morganella morganii	fecal inhabitant, opportunistic human pathogen
[1]Salmonella choleraesuis	potential food poisoning pathogen
[1]Serratia odorifera	potential opportunistic human pathogen
[1]Serratia plymuthica	
[1]Serratia marcescens	" " " "
[1]Shigella sonnei	potential human pathogen
[1]Yersinia frederiksenii	potential human pathogen
[1]Yersinia enterocolitica	" " "

[1] Members of the Enterobacteriaceae family (majority of species are known as the gut microflora, i.e. bacteria that are often associated with fecal matter, contaminated water etc., although Erwinia, a plant pathogealso belongs to this family) were found frequently in onion bulbs.

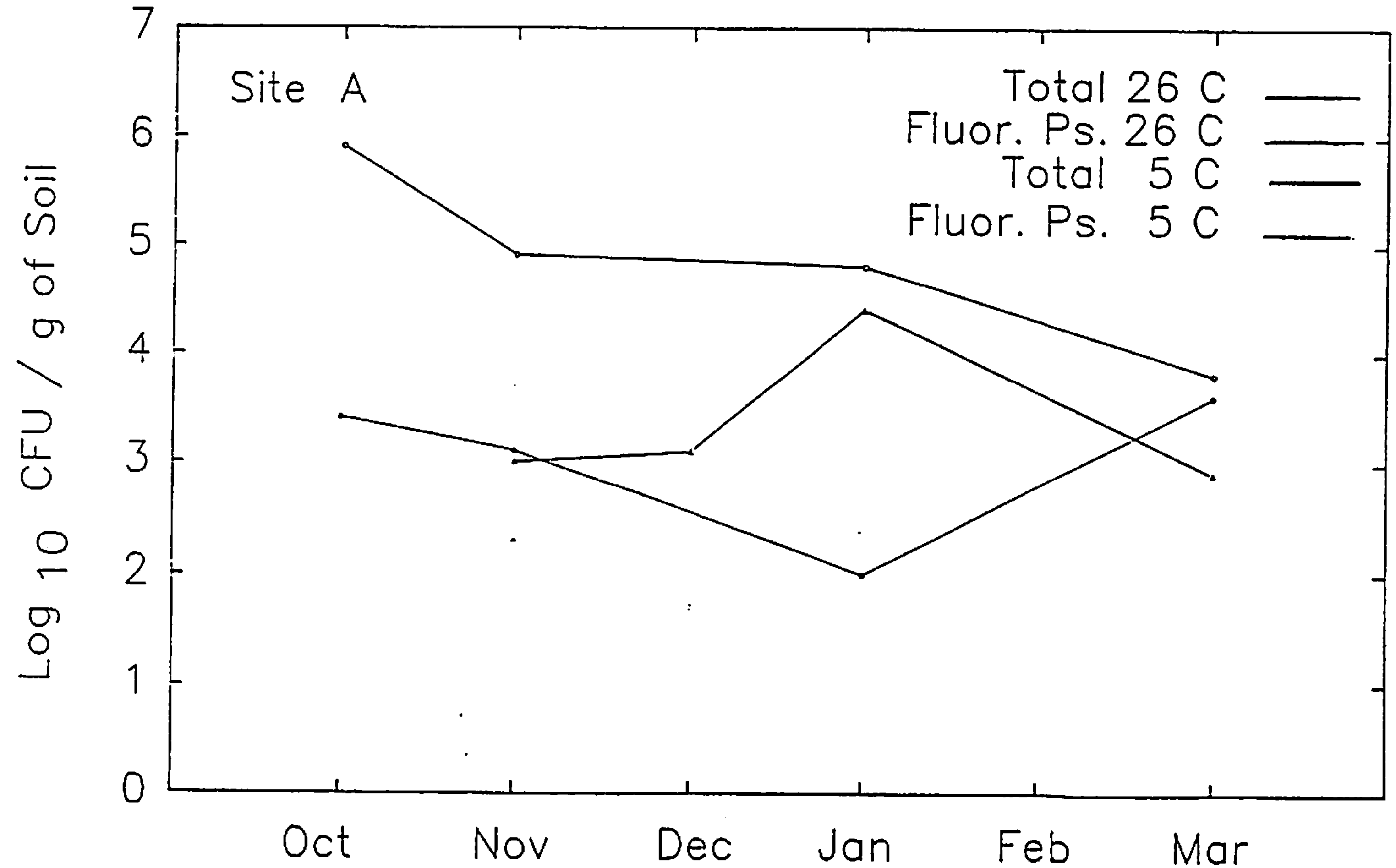

Figure 1. Bacterial Populations in Soil at Fumigation Site A.

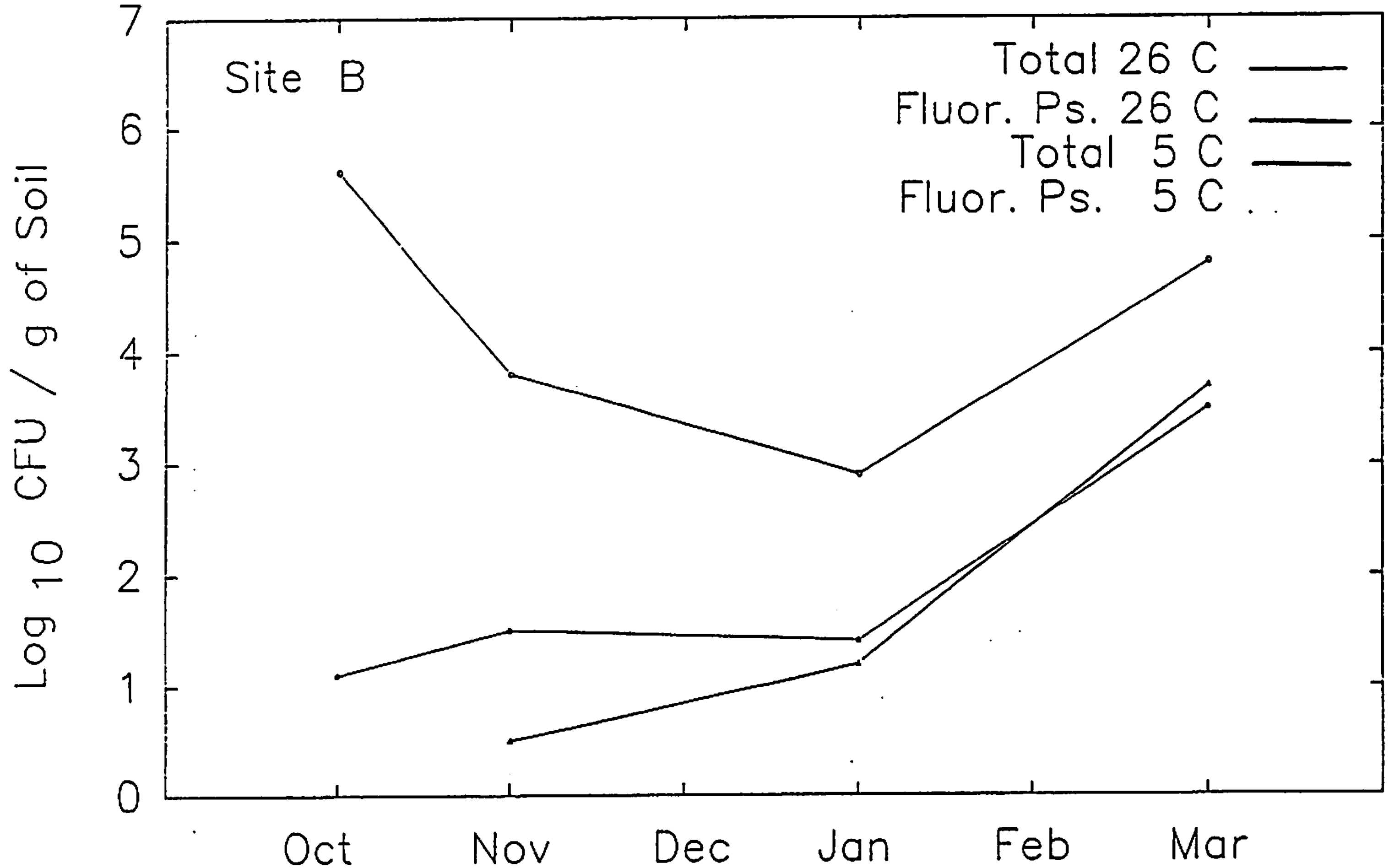

Figure 2. Bacterial Populations in Soil at Fumigation Site B.

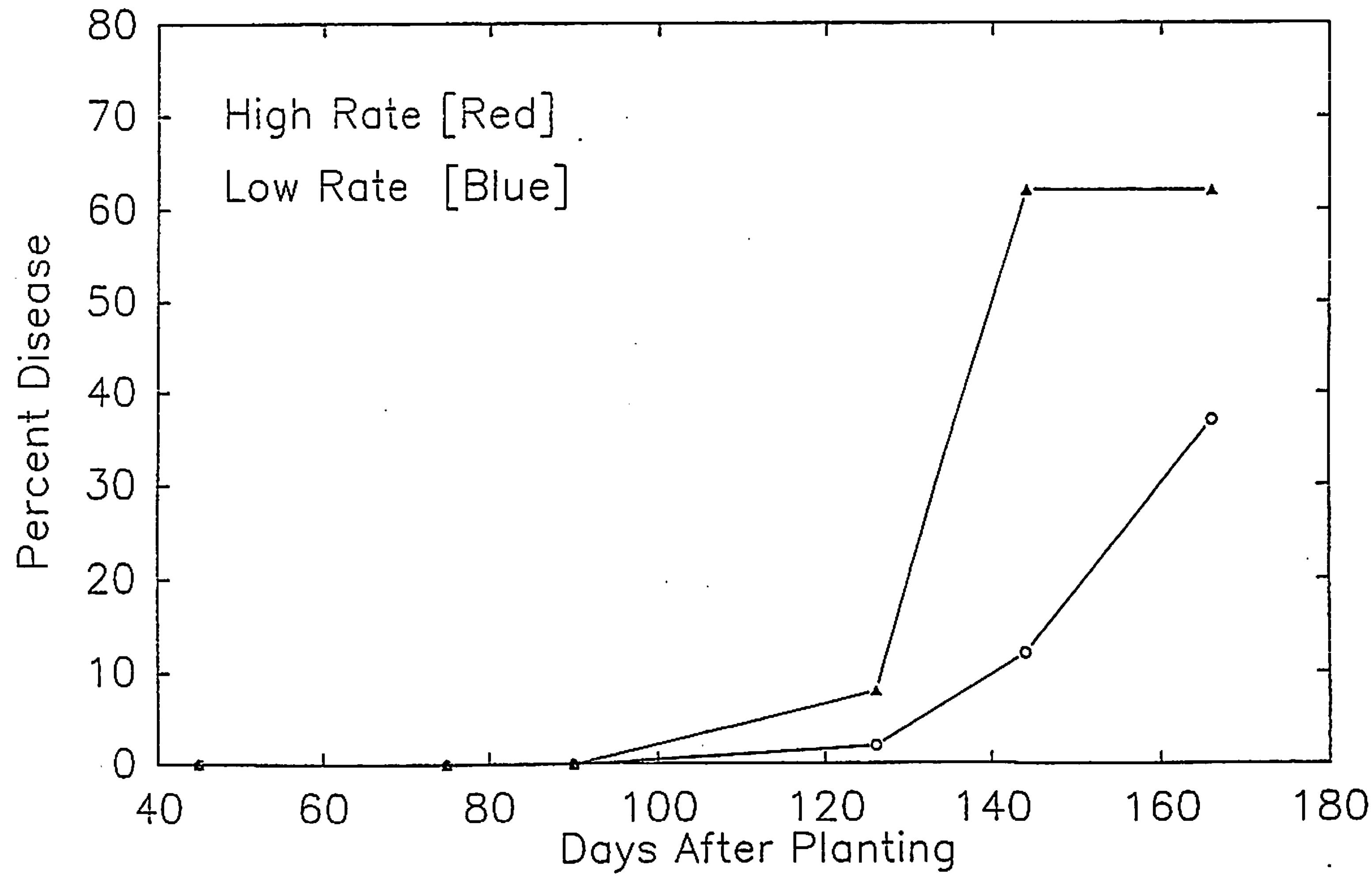

Figure 3. Amount of Bacterial Streak & Bulb Rot in Onions Receiving High or Low Fertilizer Rates

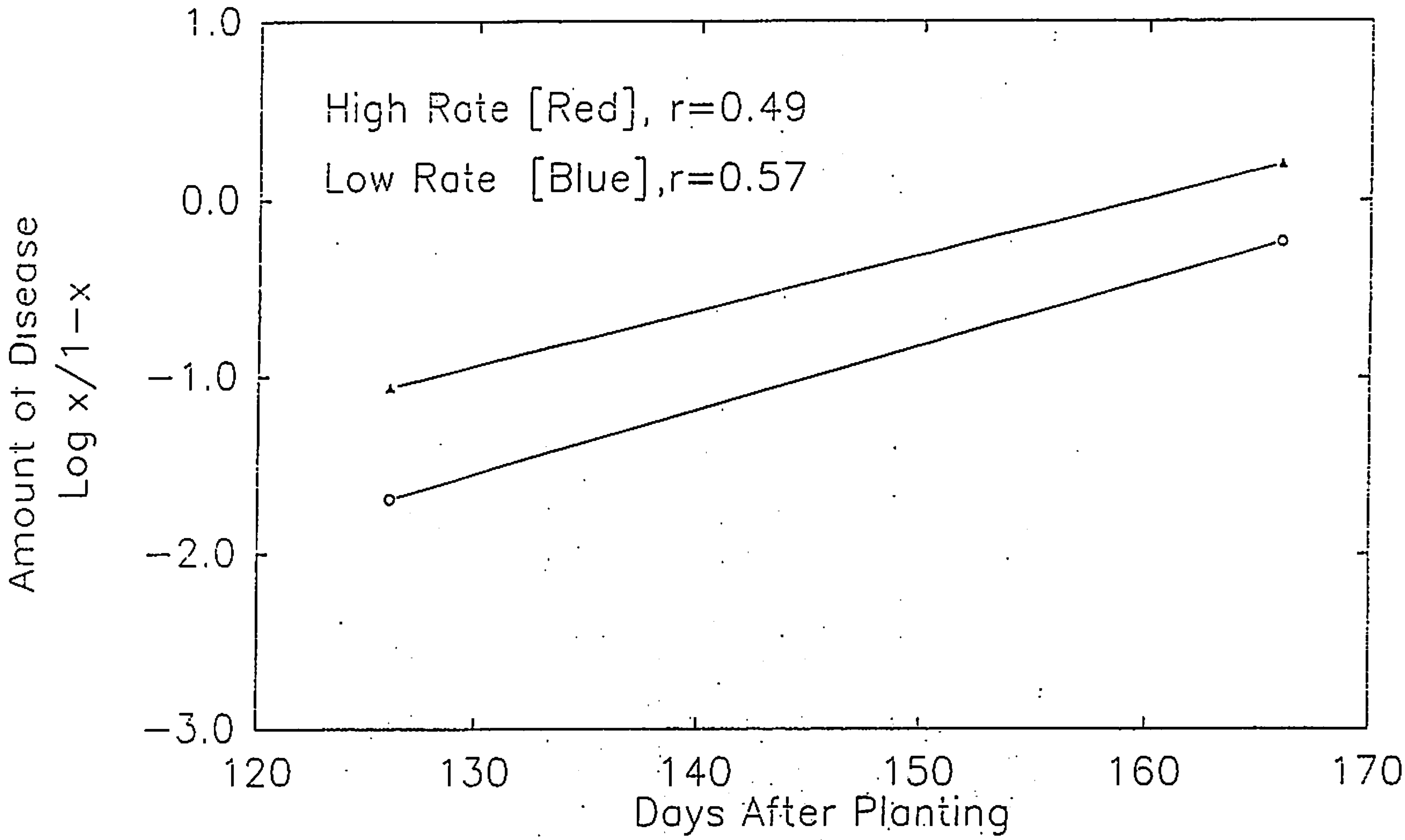

Figure 4. Logit Transformation of Disease in Onions Receiving High or Low Fertilizer Rates

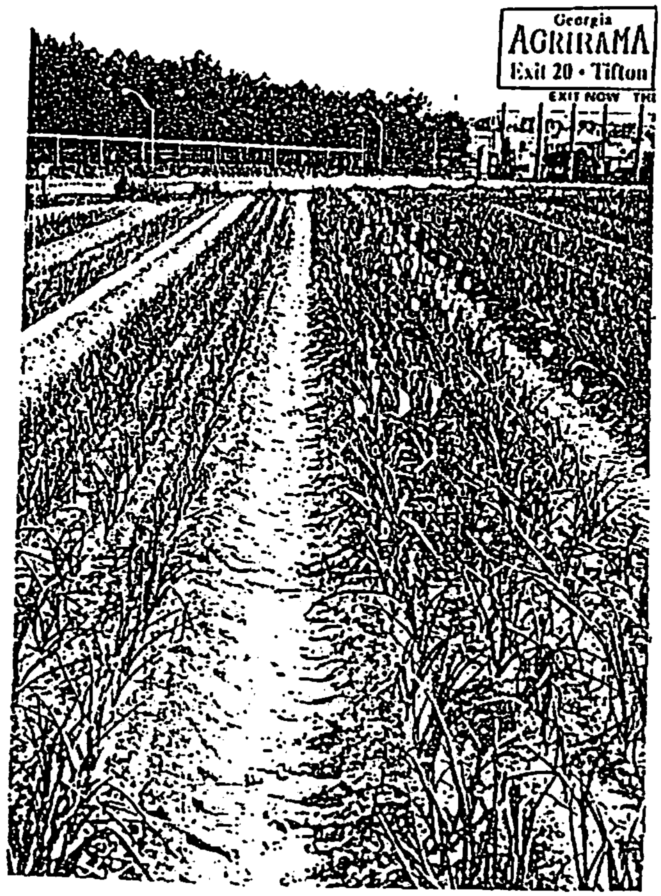

Figure 5. Comparison of onions grown with standard (left) and excessive (right) amounts of fertilizer in Tifton, GA. Plants displaying symptoms of bacterial streak and bulb rot, caused by Pseudomonas viridiflava, in early February were marked with blue flags and were more frequent in plot receiving the high fertility treatment.

COMPUTERIZED ONION DISEASE MODEL

Rick Hartley, Toombs County Extension Service

Onion blight caused by the plant pathological fungus Botrytis is the number one leaf disease organism found in the Vidalia Onion producing counties.

The disease increases most rapidly during extended periods of wet, humid weather accompanied by moderate temperatures of 47-75 degrees Fahrenheit. Once infection occurs, elongated, white lesions, which eventually become straw-colored in their center, die back and blighting can occur. Under these circumstances, both bulb growth and yield can be significantly reduced.

Using and Envirocaster during the 1991-92 onion year showed evidence of a model such as this as to its effectiveness in predicting when the environment is conducive for leaf blight or Botrytis on Vidalia Onions.

The Envirocaster Leaf Blight Model can be programmed on any spray interval as desired.

Onions were planted in the field to be monitored on November 18, 1991 and the initial protective fungicide spray applied was programmed for a 14-day program on small onions. If conditions exist that favor disease development within that 14-day interval the assumption is made that protective fungicides are adequate for control, therefore no fungicide control is recommended.

The computer model uses the humidity, air temperatures, a pre-programmed disease index, historical data, and rain or irrigation in order to provide a spray advisory. The grower must enter when he sprays into the computer.

As the onions became larger, the spray interval was shortened to 10 days. The amount of foliage on the onions and warmer temperatures required shorter spray intervals. The Envirocaster was programmed for 10 days on March 4, 1992.

The Mitt & Jerry Rollins farm was used to monitor the Envirocaster. In addition to the onions that were being sprayed using the computer advisory an adjacent field was being sprayed based on grower knowledge and visual disease pressure.

In early March, Purple Blotch became a problem in both fields. Since the same chemicals are used for Purple Blotch as for Botrytis and additional fungicide spray was applied to the Envirocaster onions on March 21st. (See Charts).

<u>Conclusions</u>

Until peak disease pressure occurred, from all leaf diseases, no visible difference could be seen from the Envirocaster onions and the regular onions. At this time the Envirocaster onions had been sprayed 8 times as compared with the regular onions being sprayed 11 times. The sprays on the 21st of March and April 1st were applied to both fields of onions as onions neared harvest.

While this preliminary work was done with a computer model, programmed for only one leaf disease, an entire leaf disease complex could be programmed. If this was done, a greater evaluation of this instrument as a spray forecaster and monitoring system could be evaluated.

The future use of a model such as the Envirocaster could prove beneficial to growers for several reasons:

1. Help them keep up with a spray program.
2. Assist with monitoring of irrigation or rain.
3. Provide needed information and documentation on environmental factors and their influences.
4. Provide a base for using pesticides (fungicides) more soundly and beneficially.
5 Save fungicides - sprays could off-set cost of the machine . . .

MONITORING FIELD			GROWER FIELD	
SPRAY #	SPRAY DATE	DAYS PROTECTION	SPRAY #	SPRAY DATE
1	Nov. 19, 1991	14	1	Nov. 19, 1991
2	Dec. 12, 1991	14	2	Dec. 12, 1991
3	Jan. 4, 1992	14	3	Dec. 30, 1991
4	Feb. 1, 1992	14	4	Jan. 4, 1992
5	Feb. 15, 1992	14	5	Jan. 17, 1992
6	Feb. 29, 1992	14	6	Feb. 3, 1992
7	Mar. 4, 1992	10	7	Feb. 10, 1992
8	Mar. 16, 1992	10	8	Feb. 20, 1992
9	Mar. 21, 1992	10	9	Feb. 25, 1992
10	Apr. 1, 1992	10	10	Mar. 4, 1992
			11	Mar. 9, 1992
			12	Mar. 21, 1992
			13	Apr. 1, 1992

EVALUATION OF IMPACT DAMAGE ON VIDALIA ONIONS

Y.-C. Hung, Research Food Scientist
E. W. Tollner, Research Agricultural Engineer
B. W. Maw, Research Agricultural Engineer
D. A. Smittle, Research Horticulturist

Introduction

The production of sweet onion has gradually increased in recent years. A potential drawback in the adoption of sweet onions by food chains and restaurants is the short shelf life and ease of physical damage. Physical damage may then give the entry of naturally occurring pathogens. Pathogens such as *Aspergillus niger* may enter wounds and infect the onion. Sometimes the first ring within an onion will rot.

The purpose of this study was to evaluate the effect of fertility, maturity and impact energy on the stability of Vidalia onions.

Materials and Methods

Coated Granex onion seeds were planted at a population of about 150,000 seeds per acre on October 14, 1991 in double line rows, 4 rows per 6 foot wide bed. Standard and excessive fertilizer programs were based on a plant population of 150,000. The standard program was the UGA recommended rate consisting of 1,000 lbs/A 5-10-15 preplant plus 200 lbs/A 10-34-0 at planting with 200 lbs/A 15-0-14 at 8, 12, and 16 weeks and 200 lbs/A calcium nitrate at 20 weeks. The excessive rate received the same fertilization at 0 and 20 weeks, but received 1,000 lbs/A 5-10-15 at 8, 12, and 16 weeks after seeding.

Onions were harvested at 4 different maturity levels.
1) Very immature, necks hard (tops break over 3" above bulb).
2) Immature, necks softer (tops break over 1" above bulb).
3) Mature, 7% of the tops broken over.
4) Overmature, all tops down and beginning to dry.

At harvest, onions were undercut, clipped and the bulbs were weighed and cured in peanut wagons until the necks were dry. Drying time varied from 3 days for very immature onions to one half day for overmature onions.

About 100 medium size bulbs from each plot were used for the evaluation of the feasibility of the onions to withstand physical impact damage. Cured bulbs were impacted by a pendulum impactor at four different energy levels and then stored in a cold room for 4 months. Impact energy levels of 0, 1, 2, 3 were equivalent to free dropping of onions from heights of 0, 4, 15, 61 cm, respectively. Impacted bulbs were visually evaluated monthly. Five bulbs from each treatment combination were destructively evaluated for damage.

At each time period, four types of damage were evaluated.
1) Visual bruise damage was assigned as 1 for no sign of impact damage, 2 for sign of flat deformed surface but no decay, 3 for sign of flat deformed surface with decay.
2) Number of other surface damage spots (like blemish) for the whole onion was also recorded. If the entire surface of the onion was rotten then a score of 99 was assigned.
3) Depth of bruise (number of rings damaged) was evaluated by cutting onion open at the point of impact.
4) Number of internally rotten cutting spots was also evaluated.

Data presented in this report represents means of values obtained from the combination of 4 replicated plots and 5 replicated samples. Statistical analysis of data was performed using ANOVA and Duncan's Multiple Range Test procedures of Statistical Analysis System.

Results

Damage recorded is presented in Table 1. Generally, fertility had no effect on any of the properties evaluated.

Degree of bruise damage was not affected by storage time and maturity. However, the higher the impact energy the higher the degree of bruise damage. Degree of bruises were 1.0, 1.59, 1.92, 2.07 for impact levels of 0, 1, 2, 3; respectively.

Maturity and impact energy both had significant effect on the depth of impact damage (# of damaged rings). Overmature onions (maturity 4) had a higher number of ring damage (1.08) than onions from other maturity groups (average of 1.00 ring damage). The higher the impact energy the deeper the bruise damage. Depths of bruises were 0.00, 0.78, 1.20, 2.10 rings for impact levels of 0, 1, 2, 3; respectively. Onions stored for four months also had the lowest number of ring damage (0.79 vs. 1.10).

The number of other surface-damaged spots (like blemish) is also presented in Table 1. Very immature onions (maturity 1) had the lowest number of other surface damage (8.3 vs. 15.9). for the first three months of storage, onions only had an average of 0.4 surface damage spots. After an additional month of storage, the first layer rotted over half of the onions. Impact energy levels had no significant effect on the number of other surface damage spots.

The number of internal rotted spots has also been evaluated. The number of rotted spots after the first month of storage (0.075) was lower than any other storage periods (0.83, 1.30, 0.92 for the month of 2, 3, 4; respectively). Overmature onions (maturity 4) had the least number of internal rotted spots (0.34 vs. 0.92). Impact energy had no effect on the number of internal rotted spots.

Table 1. Effect of maturity and impact energy on the stability of Vidalia Onions.

Storage Time (Month)	Maturity	Impact level	Degree of Bruise (1 to 3)	Depth of Bruise (3 ring)	# of other surface damage	# of rotted spots
		0	1.0	0.0	0.08	0.15
	1	1	1.5	0.8	0.05	0.05
		2	2.0	1.3	0.12	0.15
		3	2.0	2.5	0.02	0.05
		0	1.0	0.0	0.20	0.00
	2	1	1.6	0.7	0.12	0.18
		2	2.0	1.2	0.05	0.05
1		3	2.0	2.4	0.05	0.08
		0	1.0	0.0	0.25	0.02
	3	1	1.8	0.8	0.20	0.00
		2	2.0	1.2	0.25	0.00
		3	2.0	2.4	0.22	0.10
		0	1.0	0.0	0.78	0.05
	4	1	1.6	0.8	0.98	0.00
		2	2.0	1.4	0.75	0.12
		3	2.0	2.4	0.72	0.00
		0	1.0	0.0	0.30	1.05
	1	1	1.6	0.5	0.15	1.30
		2	2.0	1.0	0.18	0.82
		3	2.1	2.1	0.25	0.95
		0	1.0	0.0	0.32	0.65
	2	1	1.6	0.6	0.42	1.12
		2	2.1	1.2	0.45	1.88
2		3	2.2	2.0	0.35	1.92
		0	1.0	0.0	0.52	0.52
	3	1	1.5	0.6	0.22	0.62
		2	2.0	1.0	0.35	0.55
		3	2.0	2.1	0.40	0.35
		0	1.0	0.0	0.43	0.43
	4	1	1.4	0.7	0.46	0.23
		2	2.0	1.5	0.54	0.37
		3	2.1	2.4	0.38	0.18
		0	1.0	0.1	0.20	0.28
	1	1	1.6	1.4	0.32	1.15
		2	1.8	1.5	0.20	1.18
		3	2.0	2.0	0.22	1.45
		0	1.0	0.0	1.08	2.02
	2	1	1.4	1.2	0.80	1.90
		2	1.7	1.4	0.50	1.98
3		3	2.0	2.0	0.68	1.38
		0	1.0	0.0	0.32	1.58
	3	1	1.6	1.3	0.55	1.48
		2	1.6	1.4	0.85	2.30
		3	2.0	2.0	0.58	1.48
		0	1.0	0.0	0.82	1.02
	4	1	1.4	1.1	0.58	0.70
		2	1.8	1.4	0.28	0.25
		3	2.0	2.4	0.48	0.62
		0	1.0	0.0	24.75	0.90
	1	1	1.8	0.4	39.60	0.88
		2	1.8	0.9	34.65	1.08
		3	2.0	1.8	32.20	1.08
		0	1.0	0.0	54.45	1.34
	2	1	1.8	0.5	61.88	1.05
		2	2.0	0.9	58.38	1.13
4		3	2.4	1.8	59.40	1.20
		0	1.0	0.0	71.78	1.03
	3	1	1.7	0.7	64.35	0.95
		2	2.1	0.8	76.72	0.76
		3	2.1	1.6	52.02	1.10
		0	1.0	0.0	59.48	0.22
	4	1	1.5	0.5	72.18	0.38
		2	1.8	1.0	61.88	0.38
		3	2.0	1.7	45.69	0.48

THE SHELF LIFE OF VIDALIA ONIONS FOLLOWING HARVEST

Bryan W. Maw, Research Engineer

Abstract

The window for onion storage under the prescribed conditions, as may be found in a supermarket, or in a dwelling house, is fairly short, only three months. This limits the time over which fresh quality onions may be available to the consumer. Some onions will last longer, but so far we cannot predict which ones. In order to extend the shelf life of onions, environmental conditions must be improved, beyond these prescribed conditions, to the extent of providing more extensive controlled atmosphere storage.

Introduction

How easily Vidalia onions may be stored determines the way in which they must be cared for on their way from the field to the consumer and even while in the hands of the consumer before they are finally consumed. The experiment described here makes a contribution to the knowledge of onion storage, specifically in the realm of storing onions in an air conditioned environment, as found in many supermarkets around the country. The experiment helps to determine just how long onions may be held under those conditions before they need to be used, so as to ensure that the consumer is having available an acceptable quality onion. The experiment takes into account certain variables of harvest, as for example the state of maturity of the onions at harvest, for how long they may be cured or how deep they may be in the curing wagon.

Methods

As an assessment of survivability in storage, samples of Granex onions, from each of five harvests, have been examined at intervals of two weeks and the rotten onions removed at the time of examination.

The harvests were referred to in terms of the maturity or condition of the onions at the time of harvest as follows :

Harvest	Date	Condition
1	4/27/92	0% tops down, hard necks
2	5/1/92	0% tops down, soft necks
3	5/7/92	7% tops down
4	5/13/92	40% tops down
5	5/25/92	100% tops down

Once harvested, the onions were placed in curing wagons and cured for lengths of time 12, 24 or 48 h at different depths in the wagons, classified as bottom, middle or top. Following curing, the onions were placed in traditional onion open net sacks and placed on shelves in a storage room (12 ft x 8 ft x 6.5 ft). The environment of the storage room was maintained within a temperature range of 70-80 degrees fahrenheit and a relative humidity of 30-50%, using a window air conditioner (8,000 Btu/h) readily available as a household unit. The temperature range was chosen because of the recommendation that 72 degrees fahrenheit is considered a comfortable temperature for most people and the hum\d\t\ because not only was it in an acceptable range, but the air conditioner reduced the humidity to that level when being regulated by the temperature in the room. Air circulation in the room was generated by the air conditioner fan when it was running and a small domestic fan. It was decided to have the onions in sacks on shelves in order to keep samples separate from each other. Onions do have the tendency to affect one another, once one of them begins to deteriorate.

At biweekly intervals, the onions in a particular bag were visually examined, those going rotten, removed, the rotten ones weighed and the remaining onions weighed. Those going rotten were also identified as being small, medium, large or jumbo by grade standards passing through a mesh 1 in. square, 2.25 in. square, 3.25 in. square and larger. The remaining good onions were, after each examination, returned to the shelf for continued storage. As of the time of writing, the onions have been on the shelf for 14 weeks.

Results and Discussion of Results

An analysis of variance reveals important factors in the results of the study. The results are presented here in the form of a table (Table 1) and figures (Figure 1 and Figure 2).

Perhaps the most revealing result of the study seems to be that, under the conditions described, onions can be expected to begin to decay after 10 -12 weeks in shelf life storage. This is referenced in Table 1 where the shelf life component of the analysis shows significance at the 1% level and more explicitly in Figure 1 where the percentage of total onions still available after this time begins to fall away rather rapidly with time. Break down could even occur earlier should the onions be stored under less favorable conditions than those prescribed in the experiment. For example, keeping onions in a higher humidity or having onions in close proximity to each other in large quantities creates around each onion a micro climate that may be more conducive for microorganisms to flourish in the onions.

Maturity at harvest does have some effect upon longevity of shelf life. This is shown as significant in the harvest factor in Table 1 and more explicitly as separating lines in Figure 1. It appears from the graph that onions harvested at maturities 1, 2 and 3 tend to hold their initial condition longer than those of the later maturities. Yet once decay sets in it does so more dramatically.

Based upon analysis of the results the difference in shelf life as a result of cure time was significant at the 1% level. This is better described in Figure 2. Examining the means, there is a trend towards less decay among those onions cured for a longer time, especially for those onions harvested early. During our study all onions received at least 12 hours of cure time, which is obviously better than non at all.

The difference in shelf life as a result of a difference in depth was not significant at the 1% level. A drying front moves up through onions from the air vent floor to the top of the stack. It is necessary for that front to move the entire journey from bottom to top in order for the top onions to be cured. On the other hand it is important not to have a stack so deep that it takes a long time for the drying front to reach the top causing lower onions to become partially desiccated, with a consequential loss in weight. However the means show that not only did the bottom onions have a poorer shelf life but so did the top onions. Apparently, the middle position was more appropriate for the combination of conditions during our study.

Based upon the study we can not say that any particular size of onion keeps significantly better than another. However examining the means, there was a tendency for larger onions to decay sooner than other sizes.

We can not determine from this study, just how much weight loss takes place among onions being stored under the conditions described. We did not weigh each and every onion. When onions were discarded because of decay we did not have a way of determining the weight of the remaining onions.

In our study, when onions became rotten they did so at a rate of no more than 7% of the remaining onions during any two week period, up to week 10. Then the rates increased dramatically for certain combinations of factors.

Acknowledgements

The author wishes to recognize the help of Mr. Don. Hickey in conducting much of the details of this study, as well as Mr. Ben Mullinix for assistance with the statistical analysis.

Table 1. Analysis of variance

Source of Variation	Degrees of Freedom	Mean Square	F.Test		Degrees of Freedom	Error Mean Square
Harvest	3	2463.6	4.27	+	5	576.3
Cure Time	2	28.3	0.08		18	379.4
Depth	2	13.1	0.04		58	316.2
Shelf Life	7	12,639.8	453.00	**	315	27.9
Harvest x Shelf Life	28	421.0	15.10	**	315	27.9
Shelf Life x Cure Time	14	165.4	5.90	**	315	27.9
Shelf Life x Depth	14	27.7	1.00		315	27.9
Other Interactions	252	38.6	1.40	+	315	27.9

+,*,**, denote significant at levels 10%, 5% and 1%. respectively.

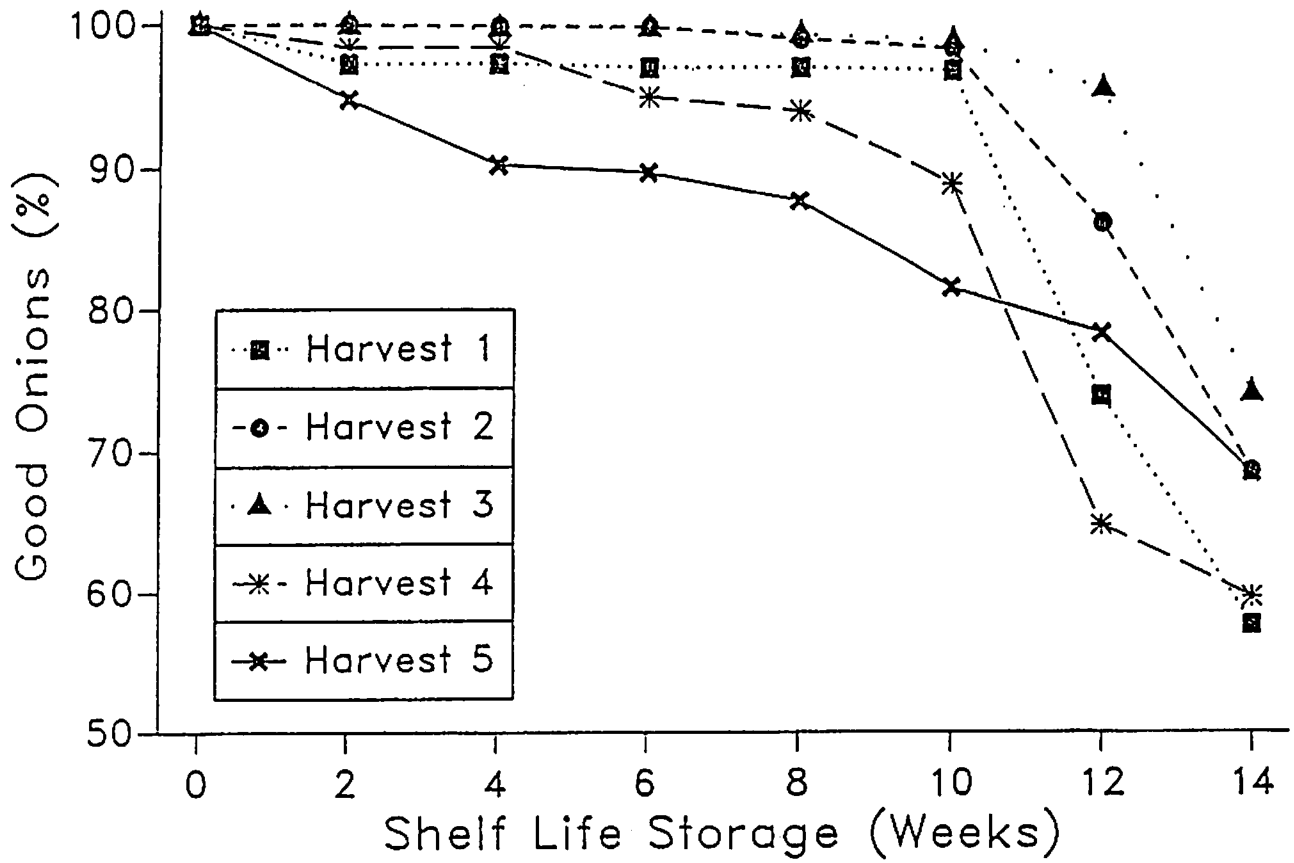

Figure 1. Available good onions as a percentage of the original number in the sample, as provided by different harvests.

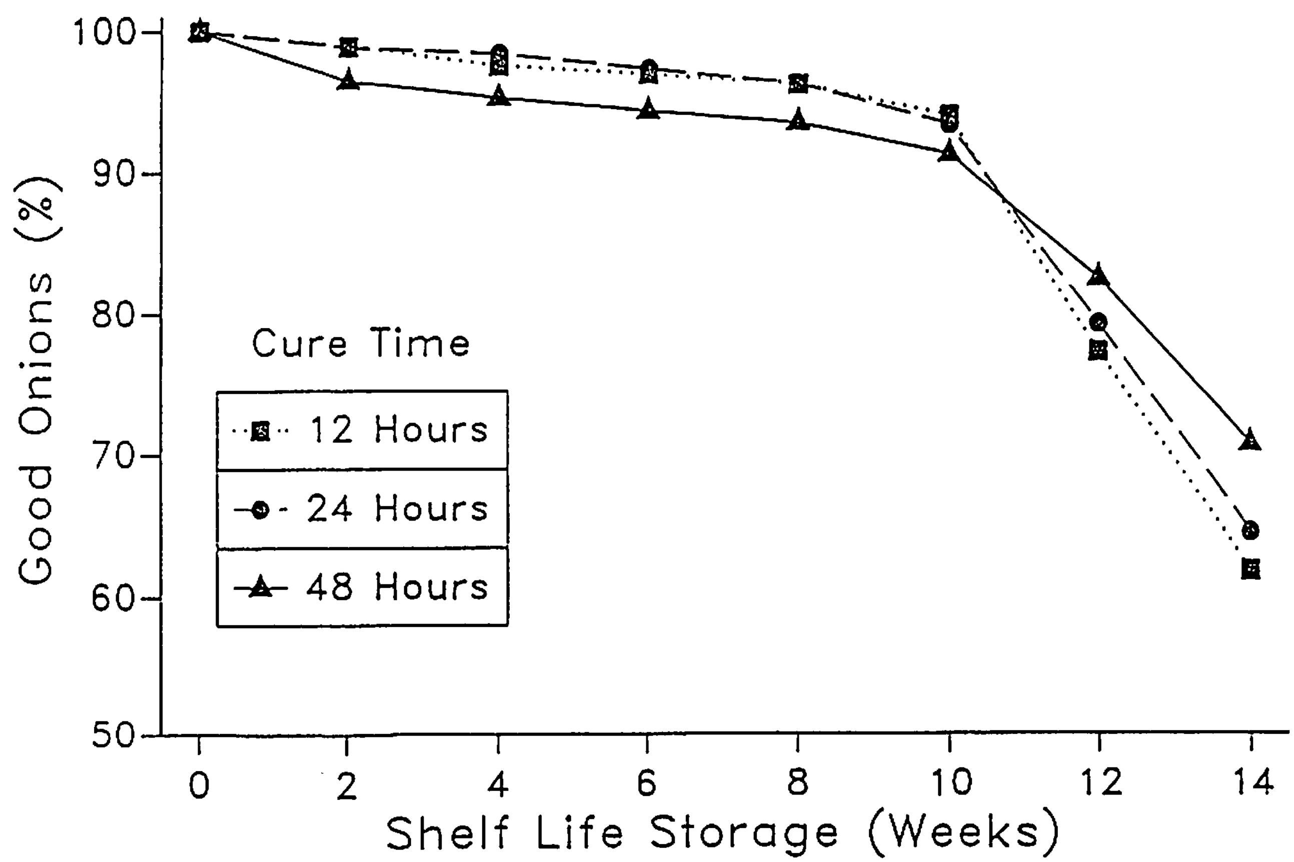

Figure 2. Available good onions as a percentage of the original number in the sample, as provided by different cure times.

INFLUENCE OF ONION MATURITY AND FERTILIZATION ON YIELD, QUALITY, STORAGE AND SHELF LIFE OF GRANEX 33 ONIONS 1992

Doyle A. Smittle, Research Horticulturist

Coated Granex onion seeds were planted at a population of about 150,000 seeds per acre on October 14, 1991 in double line rows, 4 rows per 6 foot wide bed. Standard and excessive fertilizer programs were based on a plant population of 150,000. The standard program was the UGA recommended rate consisting of 1,000 lbs/A 5-10-15 preplant plus 200 lbs/A 10-34-0 at planting with 200 lbs/A 15-0-14 at 8, 12, and 16 weeks and 200 lbs/A calcium nitrate at 20 weeks. The excessive rate fertilization at 0 and 20 weeks, but received 1,000 lbs/A 5-10-15 at 8, 12, and 16 weeks after seeding. Onions of these fertilization treatments were harvested at maturities of:

1) very immature, necks hard (tops break over 3" above bulb)
2) immature, necks softer (tops break over 1" above bulb)
3) mature, 7% of the tops broken over
4) slightly over-mature, 40% of the tops broken over
5) over-mature, all tops down and beginning to dry.

At harvest, onions were undercut and clipped, then the bulbs were weighed and cured in peanut wagons until the necks were dry. Drying time varied from 3 days for harvest maturities 1 and 2 to one half days for harvest 5. Storage and shelf-life decay would have been much more severe had drying time been inadequate. Harvest dates for the 5 bulb maturities were:

Maturity	Harvest date
1	April 27
2	April 30
3	May 7
4	May 13
5	May 25

The bulbs were sized and the weights of small, medium, large, and jumbo onions were recorded. Decayed bulbs were removed for disease assay and samples were removed for quality, shelf-life, damage susceptibility, and cold storage analyses.

Quality analyses were sugar and pungency. Sugars are expressed as per cent total sugar. Pungency was measured as pyruvic acid development and is expresses as PAD (micromoles of pyruvic acid developed per gram of fresh onion tissue).

Shelf-life evaluations were conducted by placing 25 lb onion samples from each plot in a room having a small air conditioner that ran almost constantly and produced temperatures of 55-75° F and RH levels of 30-60%. Samples were graded every 2 weeks. Shelf-life data are expressed as percentage marketable bulbs.

Cold storage was evaluated by placing 25 lb onion samples from each plot in a room at 34° F, 70-80% RH. Samples were graded every month for 4 months. Data are expressed as per cent marketable bulbs.

Results and Discussion

Marketable bulb yields increased as the maturity of the onions bulbs increased from very immature to over-mature (Table 1). The high population and artificial disease inoculation of these research plots reduced the average bulb size at each of the harvest, but many onions in the Vidalia area were harvested at bulb maturities represented by the very immature and immature stages. Marketable yields doubled during the period from April 27 to May 25.

Yields of jumbo bulbs, the size of most demand, and of the highest price, increased more than 600 bags/A when harvest was delayed from April 30 to May 5 (Table 1). With the high population and artificial disease inoculation of this test, jumbo yields may have increased more with later harvests than would occur in commercial fields; however, at least a 100% jumbo yield increase could have been realized across the Vidalia onion production area in 1992 if harvest had been delayed until the onions were mature. Yields of large onions generally increased as harvest was delayed while yields of medium and small bulbs remained constant or decreased with delayed harvest.

It was anticipated that the number of decayed bulbs would increase as harvest was delayed; however, the yield of decayed bulbs was highest at the first harvest and the last harvest (Table 2). The yield of decayed jumbo bulbs tended to increase as harvest was delayed, but decayed bulbs represented 4.4% of the jumbo yield for very immature bulbs and about 2.0% of the jumbo yield of mature to over-mature bulbs. No rainfall occurred from April 22 until May 25, but the onions received several irrigations during the period from April 27 to May 25. It is likely that diseases would have been more severe if the more mature onions had been exposed to several periods of heavy rainfall.

Onion quality generally increased as harvest was delayed (Table 3). The sugar concentration in the bulbs increased slightly as the bulbs matured with the greatest increase occurring after the tops had begun to fall over. Pungency, the primary quality parameter of sweet onions, was highest in immature onions and decreased as the onion bulbs became more mature.

Shelf-life, expressed as the percentage of marketable bulbs, of all maturities was very good after 4 weeks in the air conditioned room (Table 2). About 95% of the onions (by weight) were marketable after 4 weeks even when the plants had been artificially infected with disease organisms in the field. All onions of this test were properly cured (1 to 3 days in a drying wagon). The low level of post-harvest decay, even with disease inoculation, emphasize the importance of curing and postharvest environment on the shelf-life of sweet onions. After 8 weeks in the air conditioned room, 80-95% of the bulbs were marketable, but weight loss by the bulbs resulted in only 75-90% of the bulb weight being marketable. These data suggest that several farmers in the Vidalia area lost money by harvesting and selling immature onions in 1992 if onion price changes in 1992 (onions sold for about $15/bag on April 30 and $20-25/bag on June 30) are typical, if properly cured were stored for 4-8 weeks in an air conditioned room, and if the cost of the air conditioned structure ($7-10/bag) were amortized over 7 years.

None of the onions were decayed or sprouted after 1 month of cold storage (Table 4), but about 2% weight loss occurred under the dry cold storage conditions. About 1-2% of the bulbs from all maturities showed some decay after 2 months of cold storage, but additional weight loss of 1-2% during the second month resulted in 95-97% of the initial weight being marketable. After 3 months of cold storage, about 25% of the very immature and 20% of the immature bulbs were decayed, whereas only 3-4% of the mature and slightly over-mature bulbs were decayed. About 9% of the over-mature bulbs were decayed or sprouted after 3 months of cold storage. The lower percentage of marketable weights of very immature and immature onions after 3 months were primarily due to decay and weight loss, although some of the more immature bulbs had sprouted. Generally, the immature bulbs were soft and rings appear to be separated after 3 months of cold storage. Data for the 4 months storage period are not complete at this time.

Total yields tended to be larger and jumbo yields tended to be smaller with the excessive fertilization rate (Table 5), but the differences were not significant, statistically. Sugars were not affected by fertilization rate, but the onions receiving additional sulfur in the 5-10-15 applications on December 9, 1991, January 7, 1992, and on February 4, 1992 were more pungent. Data collected in earlier tests indicate that the differences in quality of onions from these fertilizer programs would become even greater during storage under room temperature, cold storage, or CA storage conditions. The change in pungency of the two fertilization rates with maturity were similar, but onions from the recommended rate would be classified as very mild at the last two harvests while onions from the excessive rate were classified as mild at all harvests. Onions classified as mild are routinely grown in Texas and New Mexico. Shelf-life and cold storage losses were relatively small and were not affected by fertilization rates.

Summary

In summary, excessive rates of fertilizer had little effect on onions other than to reduce quality by increasing the pungency level. The excessive fertilization rate changed the pungency of the onions from a very mild to a mild classification, according to recently published pungency assay (ONION WORLD 8 (5):19-20).

Marketable yields, especially jumbo yield, increased when harvest was delayed. The total production of decayed onions was greatest for very immature and for over-mature onions, but the percentage of the total jumbo yield as decayed bulbs was less for mature bulbs than for immature bulbs. Pungency of the onions from both fertilization rates decreased with maturity, but pungency of the excessive rate remained in the mild classification while onions from the recommended rate were classified as very mild at the last two harvests. Shelf-life and cold storage losses were less when 10-40 % of the tops were down at harvest.

Table 1. Effect of onion maturity on marketable bulb yields of Granex onions.

Maturity[z]	Marketable yields (50 lb bags/acre)				
	Total	Jumbo	Large	Medium	Small
1	634	159	175	183	117
2	639	126	173	178	161
3	913	352	261	171	129
4	1141	558	317	173	91
5	1272	787	247	156	80

[z] Maturities:
1 = Very immature (necks hard)
2 = Immature (necks break over about 1 inch above bulb)
3 = Mature (7% of tops down)
4 = Slightly over-mature (40% of tops down)
5 = Over-mature (100% of tops down and some dry)

Table 2. Effect of onion maturity on decayed bulb yields of Granex onions.

	Decayed bulb yields (50 lb bags/acre)				
Maturity[z]	Total	Jumbo	Large	Medium	Small
1	25	7	8	7	3
2	9	2	4	2	1
3	13	7	3	2	1
4	13	10	2	1	1
5	22	15	3	4	1

[z] Maturities:
1 = Very immature (necks hard)
2 = Immature (necks break over about 1 inch above bulb)
3 = Mature (7% of tops down)
4 = Slightly over-mature (40% of tops down)
5 = Over-mature (100% of tops down and some dry)

Table 3. Effect of onion maturity on sugar, pungency, and shelf-life of Granex onions.

Maturity[z]	Sugar (%)	Pungency (PAD)	Marketable bulbs (%) 4 weeks	Marketable bulbs (%) 8 weeks
1	6.1	3.3	96	88
2	6.7	3.8	95	75
3	6.4	3.6	96	85
4	7.2	3.0	96	90
5	7.0	2.8	93	85

[z] Maturities: 1 = Very immature (necks hard)
2 = Immature (necks break over about 1 inch above bulb)
3 = Mature (7% of tops down)
4 = Slightly over-mature (40% of tops down)
5 = Over-mature (100% of tops down and some dry)

Table 4. Effect of onion maturity on per cent marketable bulbs during storage at 34° F storage.

	Months of cold storage			
Maturity[z]	1	2	3	4
	Marketable bulb weight (%)			
1	98	95	75	--
2	98	96	78	--
3	98	95	92	--
4	98	97	93	--
5	98	95	87	--

[z] Maturities:
1 = Very immature (necks hard)
2 = Immature (necks break over about 1 inch above bulb)
3 = Mature (7% of tops down)
4 = Slightly over-mature (40% of tops down)
5 = Over-mature (100% of tops down and some dry)

Table 5. Effect of fertilizer treatment on Granex onion yield, quality, shelf-life and cold storage life.

	Fertilizer treatment[z]	
Parameter measured	Recommended	Excessive
Marketable yield	926	913
Jumbo yield	380	413
Large yield	244	225
Medium yield	182	163
Decayed bulbs at harvest (bags/A)	13	20
Sugar (%)	6.6	6.7
PAD	2.8	3.8
Shelf-life (% marketable by weight)		
4 weeks	96	94
8 weeks	84	86
Cold storage (% marketable by weight)		
1 months	98	98
2 months	96	95
3 months	84	86

[z] Fertilizer treatments: All received 1,000 lb/A 5-10-15 plus 200 lb/A 10-34-0 at seeding and 200 lb/A calcium nitrate at 20 weeks. The recommended rate received 200 lb/A 15-0-14 at 8, 12, and 16 weeks for a total(lb/A) of 150 N, 134 P, 234 K, and 70 S. The excessive rate received 1,000 lb/A 5-10-15 at 8, 12, and 16 weeks for a total (lb/A) 210 N, 434 P, 500 K, and 280 S.

ROOT DISEASES AND BULB ROTS IN ONION

D. R. Sumner, Research Plant Pathologist

Field plots at Site A, Toombs County and Site B, Montgomery County were fumigated October 22, 1991, with MBC-33 (67% methyl bromide, 33% chloropicrin) at 78 or 113 lb/A (5.5 and 8.0 gal.), HD-PIC (96.5% chloropicrin) at 75.4 or 110 lb/A (8.0 and 10.8 gal.), MBC concentrate (98% methyl bromide, 2% chloropicrin) at 144 or 230 lb/A (10 and 16 gal.), or Telone C17 (80% dichloropropene, 17% chloropicrin) at 12 gallons/A by Hendrix and Dail, Inc. Chemicals were injected 8 inches deep into raised beds 5 ft wide with chisels 12 inches apart using a tractor-mounted applicator. Plots were not covered with plastic, and the nonfumigated control plots were not covered or chiseled. Immediately after application, plots were irrigated with approximately 0.5 inch of water with overhead sprinklers to help seal the soil surface and prevent volatilization of the chemicals. There were three replications of each treatment in each location, and each treatment was three beds wide and 75 feet long. Site A had been in an onion-soybean rotation each year for the previous 5 years, and had a cropping history of onion for at least 20 years. Site B had been in onion-summer fallow for the previous 5 years. Onions were transplanted November 19 and 25 at Site A and Site B, respectively.

Soil samples were collected in each plot (10 cores, 4 inches deep) October 20 and 21 (before fumigation) and November 16, 1991; and January 16 and March 16, 1992. Soil cores from each plot were mixed thoroughly, and assayed for the pathogenic fungi Rhizoctonia solani, Pythium spp., Phoma terristris (the pink root pathogen), and bacteria. Onions were transplanted November 19 and 25, respectively at Site A and Site B. March 31 and at harvest 10 plants per plot were removed from each field and rated for external and internal discoloration and decay. Internal tissues from each bulb were removed aseptically and incubated on selective media in the laboratory. Fungi and bacteria growing from the tissues were identified.

Fumigation with MBC 67-33 and HD-PIC reduced populations of the pink root-rot pathogen (Phoma terristris), Pythium spp., and Rhizoctonia solani in soil November 15 at both the Site A and Site B. MBC (98-2) concentrate was effective in reducing populations of Pythium spp. at Site A, and Telone C17 was effective against Pythium spp. at both sites, but neither chemical was effective in controlling P. terristris and R. solani (Tables 1 and 2). The beneficial effects of fumigation with MBC 67-33 and HD-PIC could be measured in lowered populations of R. solani through the last sampling March 16.

Bulbs were harvested April 13 and April 22, respectively Site A and Site B. The middle 10 or 15 ft of the middle two rows in the center bed of each plot were dug, weighed, and graded. Yields of marketable onions were greater in plots fumigated with the highest rate of HD-PIC and MBC-33 (Tables 3 and 4) compared with control plots at Site A, but differences may have been related to fewer bolted plants in the plots fumigated with high rates of HD-PIC and MBC-33. There were no differences in yields among treatments at Site B. Only 1.4 and 1.0% of the bulbs had internal discoloration and decay March 31 or at harvest, respectively.

Fungi were isolated from 6% of the bulbs March 31 and 26% of the bulbs at harvest in April. The fungi isolated most frequently were Fusarium oxysporum (7.3%), F. moniliforme (5.1%), Phoma terristris (0.6%), and Pythium spp. (0.6%).

In research in Tifton, bulbs with symptoms of pink root increased with maturity, and disease severity was greatest in overmature bulbs. Excessive fertilization increased pink rot significantly (Table 5). The fungi isolated most frequently from marketable bulbs at harvest (before curing) were Fusarium oxysporum (14%), F. solani (1.0%), F. moniliforme (1.0%), F. moniliforme f. sp. subglutinans (1.0%), Aspergillus niger (0.5%), and Penicillium spp. (0.2%). After storage at 6 and 8 weeks at 55 to 75°F, 30-60% relative humidity, fungi were isolated from an average of 31 and 22% of the decayed bulbs, respectively. Fungi were isolated from more overmature decayed bulbs than from other harvests both 6 and 8 weeks after storage, and Aspergillus niger was the primary pathogen isolated from overmature bulbs (Table 6). The optimum temperatures for infection by A. niger are 82 to 92°F. Fertility levels in the field did not influence the number of fungi isolated from decayed bulbs from storage.

Table 1. Populations of fungi in soil that may cause root diseases in onion at Site A, Toombs County, 1991-1992[w]

Treatment	Rate (gallons)	*Phoma terristris*[x] (CFU/g)[y]			*Pythium* spp. (CFU/g)[y]			*Rhizoctonia solani* (CFU/100g)[z]		
		Nov. 15	Jan. 16	March 16	Nov. 15	Jan. 16	March 16	Nov. 15	Jan. 16	March 16
Methyl bromide-chloropicrin 67-33	5.5	0	4	0	6	33	14	2	0	0
Methyl bromide-chloropicrin 67-33	8.0	0	6	6	3	13	35	0	0	0
HD-Pic (96.5% chloropicrin)	8.0	0	0	3	0	26	104	0	0	0
HD-Pic (96.5% chloropicrin)	10.8	0	0	3	4	1	53	0	0	2
Methyl bromide-chloropicrin (98-2)	10.0	8	1	14	3	78	118	0	2	0
Methyl bromide-chloropicrin (98-2)	16.0	11	9	15	2	4	91	12	0	0
Telone C17	12.0	11	13	3	7	35	53	10	4	0
Control	-	6	4	6	32	51	107	16	6	0

[w] Soil was fumigated Oct. 22, 1991.

[x] Causes the pink root disease in onion.

[y] CFU = colonies forming on selective media per gram of soil.

[z] CFU = colonies forming on a selective media per 100 g of soil.

Table 2. Populations of fungi in soil that may cause root diseases in onion at Site B, Montgomery Countyt, 1991-1992[w]

Treatment	Rate (gallons)	*Phoma terristris*[x] (CFU/g)[y]			*Pythium* spp. (CFU/g)[y]			*Rhizoctonia solani* (CFU/100g)[z]		
		Nov. 15	Jan. 16	March 16	Nov. 15	Jan. 16	March 16	Nov. 15	Jan. 16	March 16
Methyl bromide-chloropicrin 67-33	5.5	1	4	6	14	23	113	0	0	2
Methyl bromide-chloropicrin 67-33	8.0	0	2	2	0	56	84	2	0	0
HD-Pic (96.5% chloropicrin)	8.0	0	2	3	1	15	94	0	0	0
HD-Pic (96.5% chloropicrin)	10.8	0	0	0	0	53	85	0	0	0
Methyl bromide-chloropicrin (98-2)	10.0	4	3	8	23	76	102	0	0	4
Methyl bromide-chloropicrin (98-2)	16.0	4	4	10	16	72	218	6	0	9
Telone C17	12.0	1.4	0	3	6	32	48	2	0	2
Control	-	7	0	8	20	103	151	4	4	7

[w] Soil was fumigated Oct. 22, 1991.

[x] Causes the pink root disease in onion.

[y] CFU = colonies forming on selective media per gram of soil.

[z] CFU = colonies forming on a selective media per 100 g of soil.

Table 3. Yield of onions in experiment one at Site A, Toombs County, harvested April 13, 1992

Treatment	Rate/A (gallons)	Marketable Bulbs: 50 lb bags per acre	Marketable Bulbs: Number (%)	Plants bolted (%)	Rotten bulbs (%)	Jumbo bulbs (%)
Methyl bromide-chloropicrin 67-33	5.5	480	74	21.3	0.7	23
Methyl bromide-chloropicrin 67-33	8.0	640	93	2.7	0	8
HD-PIC (96.5% chloropicrin)	8.0	496	84	11.7	0.7	17
HD-PIC (96.5% chloropicrin)	10.8	642	87	9.3	0	15
Methyl bromide-chloropicrin (98-2)	10.0	549	84	10.7	0	13
Methyl bromide-chloropicrin (98-2)	16.0	526	84	18.0	0	8
Telone C17	12.0	569	85	10.3	0	18
Control	-	488	77	16.3	0	8

Table 4. Yield of onions in experiment two at Site B, Montgomery County, harvested April 22, 1992

Treatment	Rate/A (gallons)	Marketable bulbs 50 lb bags per acre Total	Jumbos	Jumbos, by weight (%)	Rotten bulbs (%)
Methyl bromide-chloropicrin 67-33	5.5	697	640	92	0.6
Methyl bromide-chloropicrin 67-33	8.0	679	611	90	0.6
HD-Pic (96.5% chloropicrin)	8.0	680	602	89	1.2
HD-Pic (96.5% chloropicrin)	10.8	662	599	90	0.0
Methyl bromide-chloropicrin (98-2)	10.0	634	547	86	0.0
Methyl bromide-chloropicrin (98-2)	16.0	632	573	91	0.0
Telone C17	12.0	613	525	85	1.3
Control	-	660	573	87	1.3

Table 5. Root disease severity and fungi isolated from onion bulbs grown at the Horticulture farm, Coastal Plain Experiment Station, Tifton in 1992

	Bulbs with pink root		Fungi isolated from marketable bulbs at harvest				
Maturity level[u] and harvest date	Total (%)	Moderate[v] (%)	*Fusarium*[w] *oxysporum* (%)	Total *Fusarium*[w] spp. (%)	*Penicillium*[x] spp. (%)	*Aspergillus*[y] *niger* (%)	*Phoma*[z] *terristris* (%)
1 April 27	57	0	15	15	0	0	1
2 April 30	70	0	16	20	0	0	0
3 May 7	--	-	10	12	0	0	0
4 May 13	75	4	14	19	0	0	0
5 May 25	64	19	14	20	1	2	0
Fertilization levels							
A. Standard	54	4	16	18	1	1	0
B. Excessive	79	7	12	16	0	1	1

[u] 1. Very immature, necks hard; 2. Immature, necks softer; 3. mature, 7% of the tops broken over; 4. slightly overmature 40% of the tops broken over; 5. overmature, all tops down.

[v] Bulbs with more than 10% of the roots pink and decayed.

[w] May cause *Fusarium* basal rot or soft rots.

[x] Causes blue mold rot.

[y] Causes black mold.

[z] Causes pink root.

Table 6. Fungi isolated from bulbs with external decay or soft rot after storage at 55 to 75°F, 30-60% relative humidity, for 6 and 8 weeks after harvest at the Coastal Plain Station, Tifton, 1992

Maturity levels[w] and harvest date	*Fusarium oxysporum*[x] wks 6 (%)	*Fusarium oxysporum*[x] wks 8 (%)	Total *Fusarium* spp. wks 6 (%)	Total *Fusarium* spp. wks 8 (%)	*Penicillium*[y] spp. wks 6 (%)	*Penicillium*[y] spp. wks 8 (%)	*Aspergillus*[z] *niger* wks 6 (%)	*Aspergillus*[z] *niger* wks 8 (%)
1 April 27	11	4	11	4	22	19	14	5
2 April 30	5	0	5	0	5	15	0	0
3 May 7	0	0	4	2	0	7	4	0
4 May 13	0	0	0	0	0	0	0	0
5 May 25	4	3	4	2	0	0	57	100
Fertilization levels								
A. Standard	6	2	7	4	8	4	12	9
B. Excessive	2	0	2	1	2	19	21	0

[w] 1. Very immature, necks hard; 2. Immature, necks softer; 3. mature, 7% of the tops broken over; 4. slightly overmature 40% of the tops broken over; 5. overmature, all tops down.

[x] May cause *Fusarium* basal rot or soft rots.

[y] Causes blue mold rot.

[z] Causes black mold.

ONION WEED CONTROL WITH GOAL

Reid Torrance, Tattnal County Extension Director

Goal herbicide has been found to perform better in onions in Georgia than any other material (Buctril, Dacthal, Enquik) providing the broadest spectrum and greatest consistency of control.

Only recently has it been used widely by growers. It has been most often used at rates of 1 1/2 - 2 pints per acre. It has been applied to the soil surface prior to transplanting and also as an early post transplant treatment.

However, one of the primary concerns regarding the use of Goal is the injury that may occur in the form of white bleached bands or irregular spots on leaves, or death of plants.

Even when application is made prior to transplanting, damage can occur due to vaporization of the material when wetted. This can reoccur throughout the season as environmental conditions allow, but usually is of no consequence. However, small transplants with stem diameters of less then 1/16 of an inch will often die. Damage is most severe on transplants that are sapped up less hardy.

Post transplant applications usually guarantee some injury to plants, but is rarely fatal to a transplant of appropriate size and hardiness. The cooler or wetter the environment at the time of application, the more severe the injury. Higher rates under the right conditions have resulted in <u>no</u> injury whatsoever in many cases too.

Post transplant treatments fit into grower practices better in many cases and that is why I initiated the procedure. My observations have been that treatment should be made as soon after transplanting as possible when P-T applications are to be used. Treatments made beyond two weeks or so unusually result in more severe injury due to the reestablishment of the onion root system.

Damage may be extremely severe even to good transplants when environmental conditions are adverse. However, tests have shown there to be no visible difference two weeks after P-T applications between treated and untreated plots even when injury is severe. Neither have there been any indications that disease infection is worse in Goal damaged onions. So, although damage often occurs and can even be expected, (the material is quite erratic in that regard) it is widely used due to its exceptional weed control capabilities and lack of long-term injury to onion plants.

Goal is also being used to clean up weed problems behind other herbicides. Treatments have been made to onions at rates of 4 - 8 oz. per acre 8 - 12 weeks after transplanting after weeds emerge. Lower rates on small weeds is preferred. Higher rates naturally cause greater crop damage, and larger winter weeds such as wild mustard, wild radish, swinecress, shepardspurse, and others are difficult to eliminate. The bud continues to develop and grow on well established weeds even where burn down appears to be initially adequate. It has also been observed that higher sprayer pressure results in more severe onion damage. Pressures of 35 psi for example are more desirable with regard to crop safety than are pressures of 100 psi. The use of Goal in this way requires considerable additional evaluation to determine the best methodology for application and its capabilities on various species.

ONION PLANT BED WEED CONTROL

Reid Torrance, Tattnal County Extension Director

Dacthal is the only real option for weed control in plant beds. With the trend of losing materials on minor crops escalating, I felt it necessary to continue to prepare plots for the evaluation of other herbicides. Also, Dacthal would not control a number of real problem weeds in the area.

In addition, I have observed considerable stunting of onion plants where 8-10 oz. per acre of Dacthal were used. This rate is required for control levels necessary to justify the use of Dacthal.

Preliminary results with the use of Gramoxone showed much promise. These plots were not treated with Dacthal and therefore grew off quicker than Dacthal treated beds. When the test plot plants reached six inches in height, 3 and 6 oz. per acre rates of Gramoxone were used. Weeds species included swinecress, cutleaf, evening primrose, Shepardspurse, watersedge, and wild mustard.

At both rates excellent weed control was attacked and crop injury was limited to tip burn that extended down the leaf no more than 1-2 inches.