Bermuda Agriculture - Spring 2024 Newsletter

Agronomic Consultant

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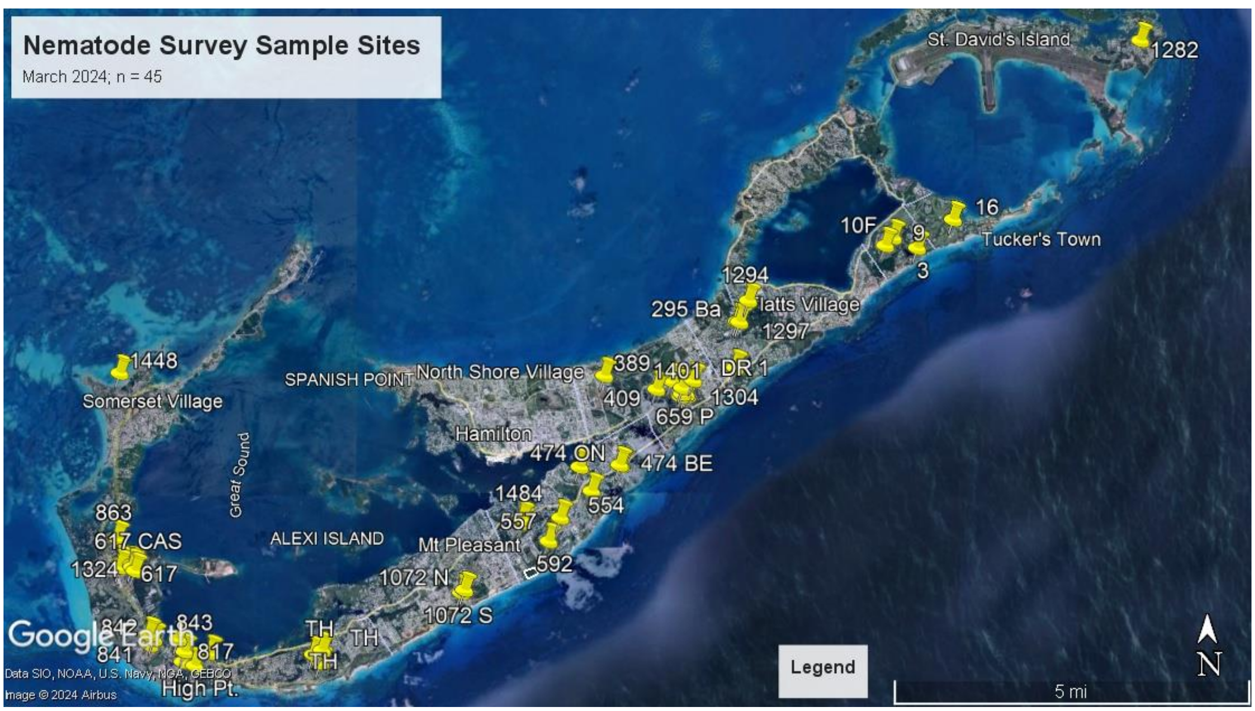
Table Contents

The following is the report by Dr. Crow on the nematode survey that was undertaken in March 2024.

2024 Survey of Plant-Parasitic Nematodes in Bermuda Agriculture

William T, Crow, Ph.D.

In March 2024 a survey of plant-parasitic nematodes in Bermuda agriculture was conducted. A similar survey was conducted by Perry et al. (1962). The earlier survey took fewer crop samples, and included samples from various ornamentals, citrus, and cedar that were not sampled in the current survey. Samples were collected from 42 agriculture fields, 6 golf course sites, and 1 lawn. Multiple soil cores were taken from the plant rhizosphere with either a cone samples or hand trowel. The cores from each field were mixed, and then 100 cm^3 of soil was placed into bottles of 5% formalin solution. The samples were then shipped to the University of Florida Nematode Assay Lab for extraction (Jenkins, 1964) and identification to genus.



Genera identified in the current survey that were not found in the 1962 survey include: *Mescriconema, Hemicriconemoides, Paratylenchus,* and possibly *Heterodera*. The *Heterodera* identification is tentative, being based on the presence of juveniles and males, while no cysts were observed. The juveniles and males are being held for molecular identification.

Molecular identification of plant parasitic nematodes to species from formalin-preserved samples is not generally recommended. However, it has been done successfully in some instances (Thomas et al., 1997). Individuals of *Rotylenchulus* (several populations), *Meloidogyne* (several populations), *Heterodera* (several populations), *Tylenchoryhnchus, Helicotylenchus* (several populations), *Belonolaimus, Paratylenchus, Pratylenchus*, and *Xiphinema* were hand picked for attempted molecular identification at a later date. If successful, species identifications will be sent in a later report.

[Reniform Nematode](#) Rotylenchulus spp.

As with the 1962 survey, the predominant plant-parasitic nematode in Bermuda agricultural fields is reniform nematode, most likely *Rotylenchulus reniformis*. Reniform nematodes were found in every sample except for one weed fallow field, one parsley field, and the turfgrass samples. Some crops grown in Bermuda that are known to be damaged by reniform nematode are: sweet potato, potato, tomato, various beans, papaya, cucurbits, cassava, and onion. Some crops that are grown in Bermuda are hosts to reniform nematode but are not considered to be damaged by them include banana, crucifers, and lettuce. Non-hosts include corn and oats. The host status of other Bermuda crops and weeds to reniform nematode is not known. Because crops in Bermuda are regularly rotated, and often fields have weed infestations, presence of low numbers does not necessarily mean the sampled crop is a host.

Reniform nematodes curl into tight rings as a survival behavior under dry conditions. Many nematodes like this were observed in samples with high numbers of reniform nematode, but were not counted since their identification could not be verified. **Therefore, the true reniform nematode numbers were likely several times higher than are reported herein.**

Tightly curled nematode suspected
as reniform nematode.

High numbers of reniform nematode were recovered from the root zone of sweet potato and symptoms consistent with reniform nematode on sweet potato were observed in multiple fields. This nematode is likely damaging sweet potato and other crops in Bermuda and the most important plant-parasitic nematode in the country.

Root-knot nematodes **Meloidogyne spp.**

Root-knot nematodes are the most important group of plant-parasitic nematodes worldwide. There are many species of root-knot nematodes with differing virulence and host range. Different species of rot-knot nematode are known to damage all the host crops on which they were found. The 1962 survey reported *M. incognita*, a nematode common in tropical and subtropical agriculture. However, the species on the turfgrasses in probably *M. graminis* or *M. marylandi*. Populations from green bean, cassava, banana, broccoli, and bermudagrass were selected for attempted molecular species identification.

Despite their wide distribution in Bermuda, root-knot nematode juveniles were only found in soil at excessive numbers on cassava, turfgrasses, beans growing in above-ground containers, and banana. This may be due to the soil type in much of Bermuda. Root-knot nematodes tend to prefer sandy soil while reniform nematode prefers silty soil. The soil in much of Bermuda seems to favor reniform over root-knot nematodes. However, several of the fields we sampled were sandy enough for root-not nematode to thrive. It was observed that many of the root-knot nematode juveniles observed were being infected by *Pasteuria penetrans*, a bacterial parasite of root-knot nematodes. It is possible that the soil in many of the agriculture fields of Bermuda have become suppressive to root-knot nematode from *Pasteuria* and other nematode antagonists. The number of grass root-knot nematode juveniles in turfgrass soil was very high in some of the samples, and in Florida I would recommend treatment on the golf courses based on those numbers.

Sting nematode ***Belonolaimus* spp.**

The sting nematode *Belonolaimus longicaudatus* is native to sandy soil in Florida and the coastal sands of the southeastern USA. This is one of the most damaging plant-parasitic nematodes to a wide range of plants where it occurs. Sting nematode was likely imported to Bermuda on infested turfgrass sod or sprigs originating from sod fields in the USA. On golf course visits, damage consistent with that caused by sting nematode to bermudagrass was observed at the locations where this nematode was recovered. On golf courses in Florida, I would recommend treatment where this nematode is found. It should be noted that this nematode is extremely damaging to many other crops grown in Bermuda, so care should be taken to restrict movement of soil and plant material from the golf courses where it occurs.

Cyst nematodes ***Heterodera* spp.**

As mentioned previously, the identification of these nematodes is tentative. Based on the hosts on which it was detected (broccoli and celery) I suspect it is *Heterodera schachtii*, but further confirmation is required. Hopefully we can get good molecular identification from the formalin-preserved specimens. To better detect this nematode, plant roots should be inspected instead of soil samples. I recommend that after harvest plants be dug up and roots inspected for the presence of cysts.

Spiral nematodes *Helicotylenchus* spp.

The only species of spiral nematode that is a major problem is the banana spiral nematode *Helicotylenchus multicinctus* which is the major nematode problem on bananas and plantains in tropical regions of the Americas and Caribbean Islands. Other spiral nematodes are of minor importance. Interestingly, while *H. multicinctus* was found on banana in Bermuda in 1962, none were found in the current survey. I consider these nematodes to be low risk to crops in Bermuda.

Stunt nematodes Tylenchorynchus spp.

These nematodes are rarely damaging, although extremely high numbers are known to cause yield loss in potato, tobacco, and corn. I consider these nematodes to be low risk to crops in Bermuda.

Lesion nematodes *Pratylenchus* spp.

Some species of lesion nematode are very damaging to different crops. For example, coffee lesion nematode *Pratylenchus coffeae* is very damaging to banana, citrus, and ornamentals. This species was reported in the 1962 survey, but only in leaves of chrysanthemum. However, we only found lesion nematode in the zoysia lawn sample, indicating it is likely a grass-infecting species. I consider these nematodes to be low risk to crops in Bermuda.

Dagger nematodes Xiphinema spp.

Some species of dagger nematode can cause yield losses to some crops, such as corn. However, they generally occur in low numbers and seldom are a major problem. They also can vector certain plant viruses on perennial crops like grape and stone fruit. *Xiphinema americanum* was reported in the 1962 survey from the rhizosphere of the Bermuda cedar. In the current survey dagger nematode was only found from banana and bermudagrass. The species from the bermudagrass were extremely long and were not X. *americanum*. Hopefully we can get a species identification. I consider these nematodes to be low risk to crops in Bermuda.

Criconematides Mesocriconema, Hemicriconemoides, Paratylenchus spp.

Three genera of criconematid nematodes were found, ring (*Mesocriconema*), sheathoid (*Hemicriconemoides*), and Pin (*Paratylenchus*) nematodes. These nematodes are minor "nibblers" and are not likely to cause damage to any crops grown in Bermuda. I consider these nematodes to be low risk to crops in Bermuda.

Recommendations for future nematode studies

If I was to do something similar again, there are some things I would do differently.

1) Different sampling tools. In many spots the soil was too hard and compact for the cone sampler we were using. Often, we were not able to penetrate but a couple of inches, and in some cases not at all. Knowing what I know now, I would have used an auger to get better, deeper samples.
2) Dig up whole plants at harvest and inspect the roots with a dissecting microscope for infection by reniform nematode and cyst nematode.

Table 1. List of plant-parasitic nematode genera found in the 2024 survey of Bermuda agriculture and associated crops.

Genus	Crop	# Samples	# Infested	Highest count
Rotylenchulus	Banana	4	4	434
	Beets	2	2	496
	Bok Choy	1	1	6
	Broccoli	4	4	177
	Cabbage	1	1	3
	Carrot	4	4	93
	Cassava	1	1	29
	Celery	1	1	4
	Cucurbits	2	2	119
	Lettuce	1	1	18
	Oat	1	1	102
	Onion	2	2	123
	Papaya	1	1	317
	Parsley	2	1	70
	Potato	6	6	123
	Strawberry	1	1	5
	Sweet Corn	2	2	158
	Sweet potato	1	1	587
	Tomato	2	2	14
	Weed fallow	2	1	3
Meloidogyne	Banana	4	4	67
	Beets	2	2	11
	Bermudagrass	6	6	358
	Broccoli	4	2	24
	Carrot	4	3	9
	Cassava	1	1	175
	Cucurbits	2	2	6
	Onion	2	2	7
	Parsley	2	1	5
	Potato	6	2	5
	Sweet Corn	2	1	15
	Tomato	2	1	2
	Zoysia	1	1	42
Tylenchorynchus	Broccoli	4	2	25
	Carrot	4	2	30
	Cassava	1	1	2
	Cucurbits	2	2	636
	Lettuce	1	1	27
	Oat	1	1	7
	Onion	2	2	57
	Potato	6	5	33
	Sweet corn	2	2	1

Genus	Crop	# Samples	# Infested	Highest count
Tylenchorynchus	Tomato	2	2	4
	Weed fallow	2	2	4
	Zoysia	1	1	14
Helicotylenchus	Bermudagrass	6	5	237
	Carrot	4	2	1
	Lettuce	1	1	2
	Papaya	1	1	96
	Parsley	1	1	2
	Potato	6	1	4
	Tomato	2	1	44
	Zoysia	1	1	146
Mesocriconema	Bermudagrass	6	6	212
	Carrot	4	2	5
	Zoyzia	1	1	24
Belonolaimus	Bermudagrass	6	3	46
Heterodera	Broccoli	4	1	14
	Celery	1	1	23
	Sweet corn	2	1	1
Paratylenchus	Parsley	2	2	725
Pratylenchus	Zoysia	1	1	19
Hemicriconemoides	Bermudagrass	6	1	4
	Cucurbits	2	1	1
Xiphinema	Banana	4	1	1
	Bermudagrass	6	1	14

Table 2. Full list of sample locations, crops, nematode genera and abundance.

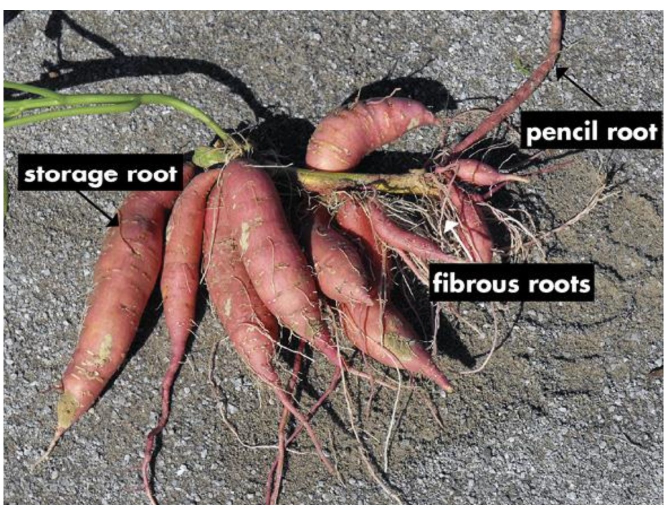
Sample	Crop	Reniform	Root-knot	Stunt	Spiral	Ring	Sting	Cyst	Pin	Lesion	Sheathoid	Dagger
295 BA	Banana	403	20			1						
409	Banana	434	16									
557	Banana	387	44									
817	Banana	342	67									1
474BE	Beets	496	5									
1072No	Beets	2	11									
Bel	Bermudagrass		4		237	212					4	
MO3	Bermudagrass		13		29	60	18					
MO9	Bermudagrass		13		32	28	46					
MO16	Bermudagrass		18		52	64	15					
MO10	Bermudagrass		358		3	72						
TH	Bermudagrass		22			29						14
1401	Bok Choy	6										
295	Broccoli	8	24									
618	Broccoli	25		10								
863	Broccoli	1										
1324	Broccoli	177	1	25				14				
High Point	Cabbage	3										
592	Carrot	31	9			1						
815	Carrot	93	9		1							
DR1	Carrot	83		30								
CF Car	Carrot	70	6		1	5						
617CAS	Cassava	29	175	2								
841	Celery	4						23				
476	Cucurbits	119	6	636								
554	Cucurbits	23	1	13							1	
362	Lettuce	18		27	2							
842	Oats	102		7								
474ON	Onion	123	2	57								
1301	Onion	71	7	2								
659P	Papaya	317			96							
435	Parsley	70	1		2				24			
1072So	Parsley		5						725			

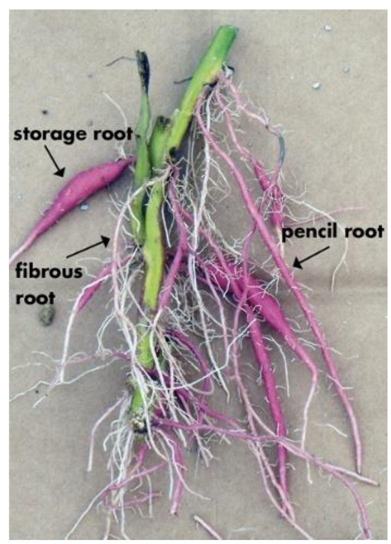
Sample	Crop	Reniform	Root-knot	Stunt	Spiral	Ring	Sting	Cyst	Pin	Lesion	Sheathoid	Dagger
389	Potato	45		17								
499	Potato	38	5	10								
617	Potato	19		33	4							
1297	Potato	20		2								
1448	Potato	68										
1484	Potato	123	1	7								
659SB	Strawberry	5										
816	Sweet Corn	60	15	1								
1282	Sweet Corn	158		1				1				
1432	Sweetpotato	587										
1294	Tomato	6		1	44							
1304	Tomato	14	2	4								
843	Weeds	3		4								
975	Weeds			4								
Zoy	Zoysia		42	14	146	24				19		

Sweet Potato Storage Root Initiation

Sweet potato yields are ultimately determined by the **number of sweet potato plants** per acre, the **number of storage roots** per plant, and the **size of each storage root** at harvest. Under commercial production conditions, fields with identical plant densities that remain in the field for the same time may have drastically different yields. This is likely due to factors that affect storage root initiation and development. Unlike the bulking of sweet potato storage roots in the last third of the growing season, sweet potato **root number is determined early** in the production cycle. Current research has found that environmental and cultural conditions during the first 2 weeks to 30 days after transplanting are critical in deciding the number of storage roots initiated per plant. In the production environment, every season is different and unique.

Adventitious roots begin to grow in as little as 24 hours after transplanting if soil moisture and temperature conditions are adequate. An adventitious root can become one of three different types of roots.





Under ideal growing conditions, adventitious roots become storage roots. However, if adventitious roots are damaged at or before planting, fibrous roots are generated, and these will not become storage roots. In addition, adverse or unfavorable environmental conditions shortly after transplanting may result in pencil root production (thin, elongated roots measuring less than four-fifths of an inch wide at maturity). To maximize marketable yields, it is important to achieve the greatest possible number of storage roots.

Soil Moisture

Evenly moist soil provides the best environment for storage root initiation and development. Wet soils are detrimental to both root development and growth. Low soil moisture levels (those approaching the wilting point) within the first 2 weeks after transplanting contribute to increased pencil root development and misshapen storage roots.

Soil and Air Temperatures

Soil and air temperatures play an important role in storage root initiation and crop development. Research conducted at Mississippi State University indicates that sweet potato slips transplanted when daytime high air temperatures are 85 to 89 degrees and nighttime low temperatures are in the lower 70s will have quicker root initiation, a profuse root system, and rapid growth. Daytime/nighttime temperatures greater than 104/90 degrees or less than 77/63 degrees can be detrimental to storage root initiation.

Nitrogen

A moderate amount of nitrogen is required for adventitious roots to develop properly into sweet potato storage roots. However, developing adventitious roots will not "seek out" nitrogen, so placement of nitrogen is important. Excessive soil nitrogen concentration has been associated with increased pencil root production and contributes to increased foliar growth and reduced root yields.

Planting Depth

Research shows that increasing slip planting depth directly increases yields. Maximum yields are observed at a planting depth of at least 5 inches. There are several reasons increased planting depth increases yield. Deeper slip planting allows more nodes to be underground. This increases the potential number of storage roots that can be produced from each plant. Deeper planting generally provides developing roots with a more stable environment. Soil temperature and moisture nearer to the soil surface can be highly variable, while those at greater depths are more constant.

Storage Root Initiation and Days until Harvest

Increasing the number of sweet potato storage roots per plant will often increase the days until harvest. Because the developing plant must spread its resources among more storage roots, each individual storage root requires more time to reach USDA No. 1 size. In the "bulking" stage of sweet potato development, carbohydrates from the foliage are moved into the roots. At the same time, storage roots take up water from the soil. Under dry conditions, this bulking process is slowed.

Sweet potato Storage Root Initiation extension.msstate.edu/publications/sweetpotato-storage-root-initiation Filed Under: Sweet Potatoes Publications Publication Number: P2809 View as PDF: P2809.pdf

Reniform Nematode Impact on Sweet Potatoes

As Dr. Crow mentioned, high levels of reniform nematodes were found in at least one sweet potato field in Bermuda. Reniform nematode is one of the most damaging plant-parasitic nematodes of sweet potato in the southern U.S. Upon infection, they feed on roots and greatly reduces the quantity, size, and quality of storage roots. In many cases, misdiagnosis occurs mainly because the foliage symptoms resemble nutrient deficiency or water stress, and reniform nematode infected roots do not produce visible symptoms. Crop rotation is not an effective management strategy for this nematode because of its ability to persist in soil up to 20 years in the absence of suitable hosts, and its ability to quickly rebound to damaging levels when a susceptible host becomes available.

The above photos show the high number of pencil roots and few marketable sized sweet potatoes in a field in Bermuda with high reniform nematode levels. The yield per acre in this field was a mere 12.5% of the yield from the original field from which the cuttings were taken. Of course, when comparing the yields from the two fields one must consider that the plants were grown under different field and environmental conditions, but it is much more likely that the presence of the high nematode population accounted for the eight-fold decrease in yield.

In a 2020 trial in Hawaii a trial comparing nematicides with and without cover crops was undertaken. Effective control of root-knot nematodes by a synthetic nematicide, fluopyram, increased the marketable yield of sweet potato by 6.3-fold compared to the untreated control. Effective management of reniform nematode populations by pre-planting of a sunn hemp cover crop followed by monthly application of Molt-X (a.i. azadirachtin), a neem product, did not significantly improve sweet potato yield (Waisen et al., 2021)

Waisen P., Wang K., Uyeda J., Myers Y.. Effects of fluopyram and azadirachtin integration with sunn hemp on nematode communities in zucchini, tomato and sweet potato in Hawaii. *Journal of Nematology.* 2021;53:e2021–30.

U.S. Clean Plant Network - Sweetpotato

Virus diseases are one of the most important production constraints facing sweet potato producers. In the US four viruses are common; each is very similar to the most common, sweet potato feathery mottle virus (SPFMV). Yield, skin color, shape and quality of storage roots can be greatly reduced when sweet potatoes become infected with these viruses. Yield reductions can exceed 40%, and cracks may develop in the roots making them unmarketable. Often 100% of plants in a field are infected by the end of one growing season. Many sweet potato viruses are vectored by aphids and whiteflies. These insects can be carried on machinery and the wind, and are responsible for spreading viruses both short and long distances.

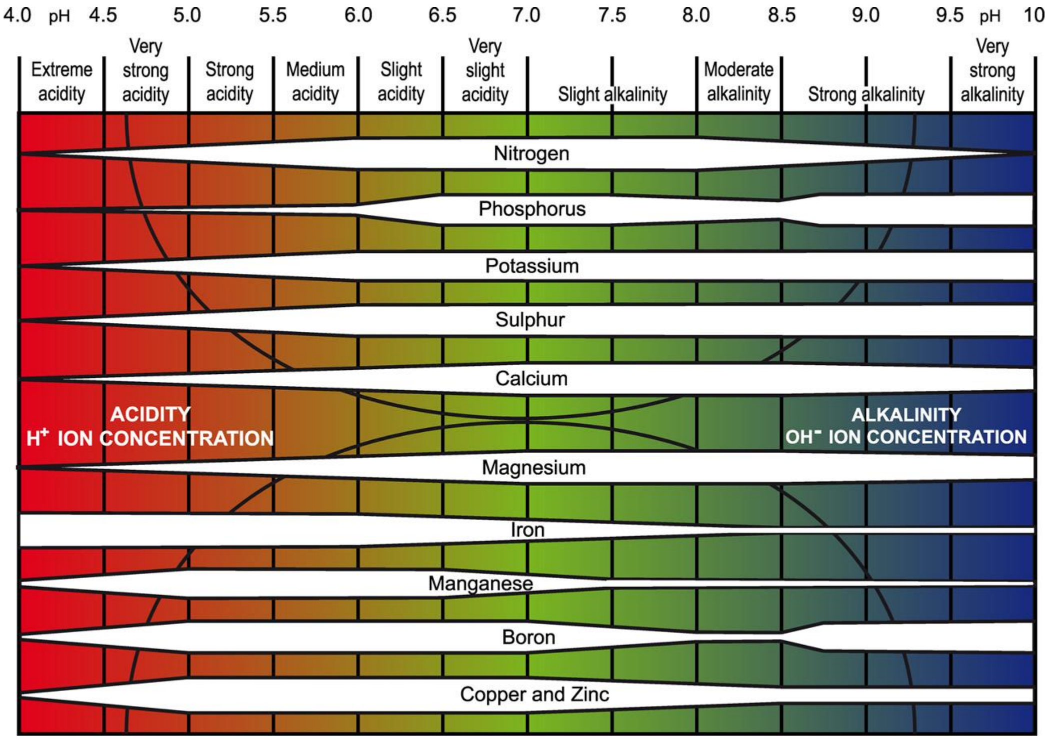
Planting clean, virus-tested plants can help mitigate the issues caused by sweet potato viruses.

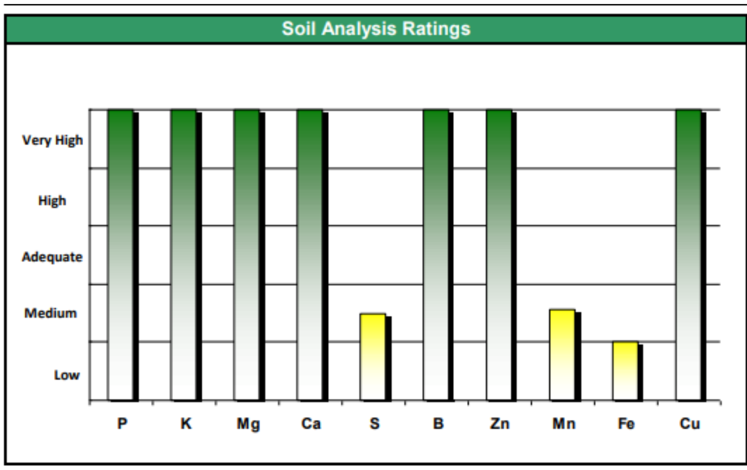
Clean Plant Process | NCPN (nationalcleanplantnetwork.org)

(Ctrl+Click to follow link)

Micronutrient Issues

As was discussed in a previous newsletter, the high pH's of the Bermuda soils (8.0 to 8.2 in the November soil survey) can lead to micronutrient deficiencies. Especially: iron, manganese and boron. And we also learned from the survey that all the soils in Bermuda have low sulfur levels.





Cation Exchange Capacity: 74.8 meq/100g

Base Saturation

K:	0.8 %	K/Mg:	0.24
Ca:	93.0 %	Ca/K:	116.3
Mg:	3.3 %	Ca/Mg:	28.2
H:	2.7 %		
Na:	0.2 %		

Crop: CARROTS — Fertility Recommendations (lbs/1000SqFt) — Yield: MAX

Lime	Gypsum	N Nitrogen	P205 Phosphate	K20 Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
		3.7				0.1					

* = Maintenance Recommendation

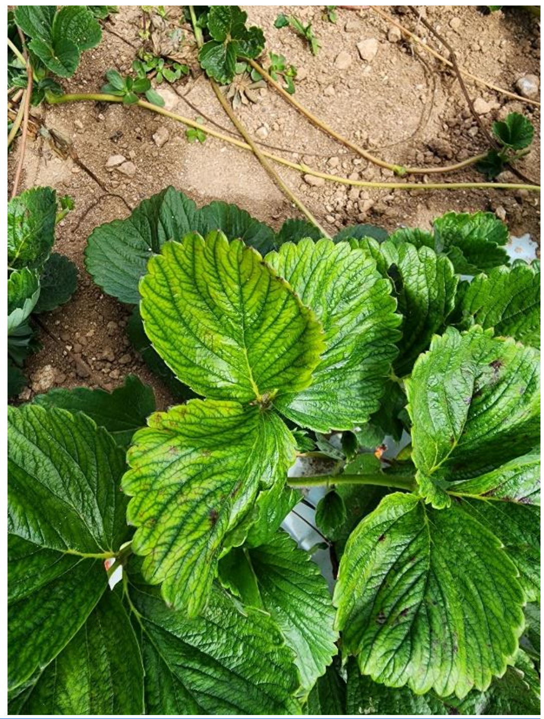
Comments

SPLIT APPLICATIONS OF NITROGEN AND POTASSIUM RECOMMENDED. PLANT SAMPLES SHOULD BE TAKEN DURING THE GROWING SEASON. ADDITIONAL OR SUPPLEMENTAL NUTRIENTS MAY BE NEEDED.

Irish potato fields sampled amounted to 7 fields and onions 1 field. The sulfur recommendation for all 8 of these fields was 39 lbs/acre. All of the other crop recommendations called for additional sulfur. One acre of harvested potatoes will contain 18 lbs. of sulfur.

Ammonium sulfate is an excellent way to side dress with nitrogen and add sulfur to the soil at the same time. On this last trip I noted that Aberfeldy nursery has potassium sulfate (18% S) and magnesium sulfate (Epsom salt = 12.5% S). Either of these would potentially help any sulfur deficiency. Sulfur deficiency symptoms are similar to nitrogen deficiency: overall yellowing of leaves. You can distinguish between the two because sulfur is not mobile in the plant, and hence the yellowing will occur in the newer leaves while older leaves remain green. The opposite is true for nitrogen which is mobile in the plant.

Also, on this last trip I noticed a nutrient deficiency in several different crops which I have diagnosed as an iron deficiency, although it could also be a manganese deficiency. Iron and magnesium, like sulfur, is immobile in the plant, so while the older leaves remain green the newer leaves will show interveinal chlorosis.



This can be treated with foliar micronutrient sprays. I found a chelated iron with Mn foliar spray available at Aberfeldy's. For those growing on drip with fertigation, Peter's 20-20-20 has a formulation that includes micronutrients including both iron and manganese.

Common Name: Garden Fleahopper
Scientific Name: ***Microtechnites bractatus***

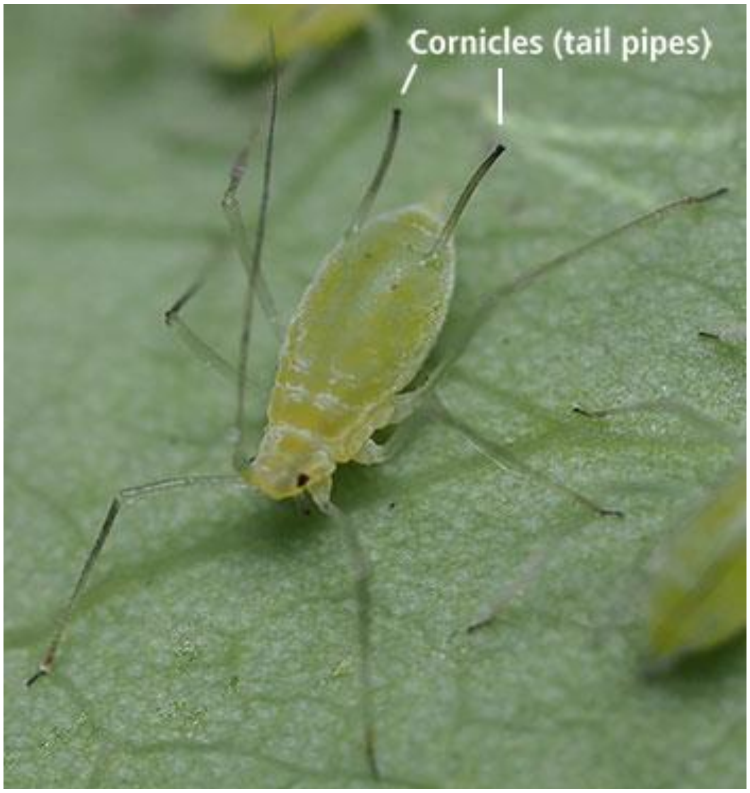
At first it was thought that the watermelon plant above might be suffering from a micronutrient deficiency, but on closer examination the damage was due to the presence of a large population of garden fleahoppers.

Nymphs and adults frequent the stems and surfaces of plant leaves, sucking the sap from individual cells and causing their death. The result is a whitish or yellowish speckling on the foliage. Extensive feeding may cause stunting of plant growth and death of seedlings. Adults were noticed on the top of leaves and the underside of the leaves were crowded with immature garden fleahoppers.

The adults have greatly expanded hind legs and hop when disturbed. Thus, in both behavior and form, the fleahoppers resemble flea beetles.

The nymphs are light green and can be confused with other insects like the green peach aphid.

The aphids have cornicles on the rear of their abdomens while these “tail pipes” are missing on the garden fleahopper nymphs (photo above).



Green Peach Aphid

Vegetable crops that host garden fleahopper include bean, beet, cabbage, celery, cowpea, cucumber, eggplant, lettuce, pea, pepper, potato, pumpkin, squash, sweet potato, and tomato. They are easily controlled with a contact insecticide.

Black Rot of Crucifers

Black rot is a plant disease caused by the bacterium, *Xanthomonas campestris* pv. *campestris*.

Cabbage, broccoli, cauliflower, kale, kohlrabi, Brussels sprouts, rutabaga, turnip, collards, radish, mustard, water cress, and other plants in the cabbage family are susceptible. Vegetables other than crucifers (cabbage family) are not susceptible. Cruciferous weeds such as wild radish (Indian mustard), pepper grass (Virginia pepperweed), and shepherds purse are susceptible.

The disease can be devastating and can lead to total crop failures. Since the causal agent is a bacterium it is easily spread in rainy windy weather. It can also be spread by people and equipment moving through the field. Prevent introduction of the disease by using certified disease-free seeds and transplants.

If certified disease-free seed is not available, use hot water seed treatments to eliminate the pathogen. Treat seeds of Brussels sprouts, collards, and cabbage for 35 minutes in water that is 122ºF. Treat seeds of broccoli, cauliflower, kale, kohlrabi, rutabaga, and turnips for 20 minutes in water that is 122°F. DO NOT plant cruciferous vegetables in the same area of your fields every year and rotate transplant beds and fields.

Unless thorough decomposition of cruciferous debris occurs, black rot bacteria will survive from one year to the next. Where rotation can be used, it is good insurance against black rot. Do not locate field beds or greenhouse transplant sites within 1/4 mile of production fields with cruciferous crops. Raise transplant beds above the surrounding area or trench the periphery to provide for drainage of excess rainfall. Flooding of the seed bed area can result in widespread infection. Eliminate wild cruciferous weeds near the transplant production areas and production fields.

Field Sanitation

An important aspect of reducing the potential outbreak of both insects and disease problems is to practice good field sanitation! Once harvesting of a field has been completed, it is important to disk or plow down the crops as soon as possible. Older fields can become excellent nurseries for the build up of insect populations and disease pathogens.

The photo above is an example of how a tomato field in Florida is being sanitized after the harvest. The fire kills any insects and disease pathogens that may be present (of course it also gets rid of the string used in tying up the crop during the season). This may appear to be very expensive, but when compared to the devasting results of insects and disease run rampant in your crop, it is economically practical.

An example of the need for good sanitation practices happened in the mid 1990's in the South Florida tomato crop. The following information comes from a paper I published after an economic, entomological and pathological analysis of what transpired that season.

> **Swanson, G.S.** and P.A. Stansly, 1994. *Market and Management Influences on the Incidence of Whitefly and Tomato Mottle Virus.* 105 Proceedings of the Florida Tomato Institute.

Generally, in South Florida there are two distinct tomato growing seasons, fall and spring. Most of the fall crop will be over after the usual 3 harvests, and the Spring crop will be transplanted in January. In the 1993-94 season however, a very good tomato market (see chart below) led to the growers continuing to harvest older fields, sometimes as many as 5 or 6 times. The acreage being harvested in mid-January 1993-94 was more than double the acreage being harvested in the previous season.

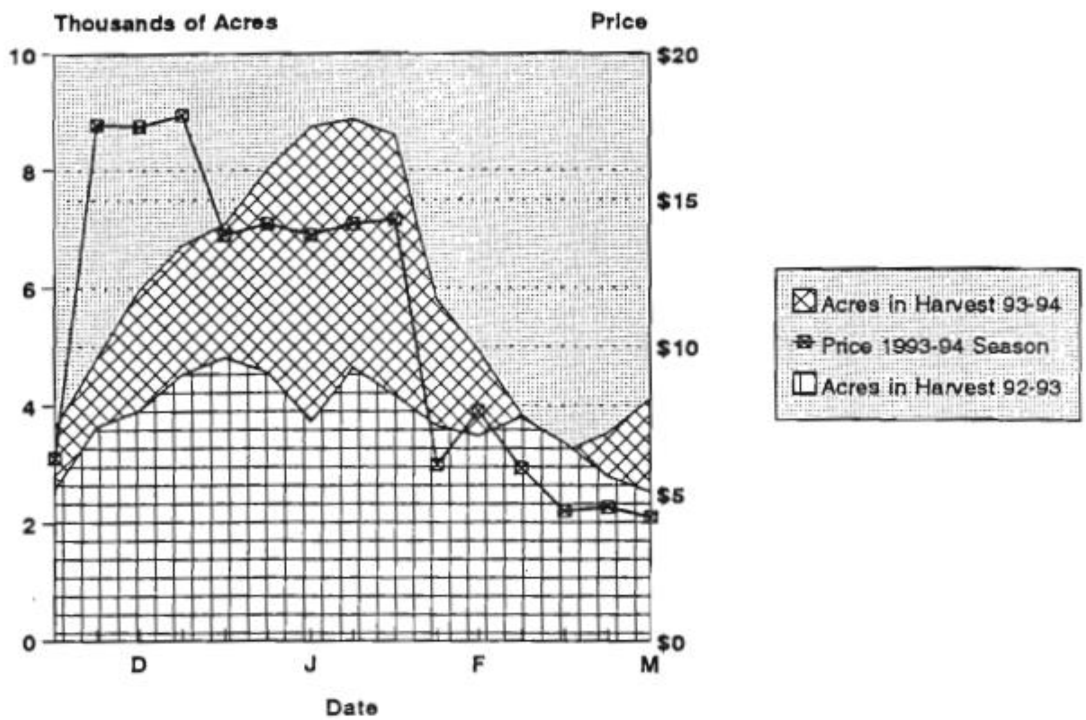


Figure 2: Average Tomato Price vs Total Acres Being Harvested
(Florida Tomato Committee & Florida Agricultural Statistics Service)

This extended harvest window, where older fields were not being sprayed because of the pesticide pre-harvest intervals, led to a huge sweetpotato whitefly (*Bemisia tabaci*) population in these fields. These fields were acting as a nursery and incubator for insect and disease pathogens. In mid-January when the prices for tomatoes fell, 5,000 acres of tomatoes were taken out of production in less than three weeks. The abandonment of this acreage coincided with the peak spring planting season where over 4,000 acres of young tomatoes had just been planted.

Of course, the sweetpotato whitefly moved from the old fields over into this young crop, we had sticky trap data showing that the whitefly captures were over 4 times as high as they were in the previous season. And the insect also was transmitting the Tomato Mottle Virus to this young spring crop, which resulted in an almost total crop failure that spring.