Field Notes

by

Dr. Ernie Flint

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Dr. Ernie Flint

Born to a World War II veteran and a farm girl from Ethel, MS, Ernest Hilmon Flint Jr. came into the world in 1947. He grew up in a very rural part of Attala County, MS, with agrarian values all around him. As a young man he was a part of the local 4-H and the FFA and competed in judging contests from his dairy cattle to his award-winning corn crops. At the age of 18 he enlisted in the Army National Guard and bounced around to different units in the state from Kosciusko to Durant and others, but would finally find his home at Camp McCain in Elliot, MS. Camp McCain was a small base when he was transferred as an officer in those years, but he is credited with helping obtain surrounding property and building this base into a very large and destination training place for artillery and troop maneuver training nationwide. While excelling in the National Guard, Ernie had also acquired B.S. and M.S. degrees from Mississippi State University in agronomy and seed technology. He went on to work for a number of seed companies and helped develop new seed cleaning and handling techniques. He eventually started his own businesses in crop consulting, custom seed cleaning, custom crop spraying, and many other smaller ventures through the 1980's. In 1991 he accepted the position as county extension agent in his home county of Attala and moved his wife, Doris, and five children to central Mississippi from their home in the Mississippi Delta. With this new venture he went back to college and received a Ph.D. in agronomy from Mississippi State University in 1998. Through the years, Ernie was instrumental in the implementation of new ideas in agronomic practices from no-till farming and soil health to plant physiology and how plants react to certain environmental conditions. Ernie leaves behind a legacy of giving to his country by working to become a full Colonel in the Army National Guard to the positive effects on the agricultural world through his weekly field notes which have been seen by farmers in much of the United States and Canada. Ernie was always generous of his time with the younger generation in agriculture. Ernie served the farmers of his area until his death on January 20, 2018. He was dedicated to agriculture to the end, and I hope, as his son, his legacy will live on in the work he so passionately loved.

Bio provided by: Greg Flint, Field Agronomist and Executive Secretary, Mississippi Crop Improvement Association

We are honored to continue the work Dr. Flint began many years ago. His "Field Notes" are still used in a variety of reference books. His family shared those "notes" with us and you can find them on our resources page of our website at www.OrganisanCorp.com.

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The use of O2YS For Yield Enhancement In Cotton And Soybeans

By: Ernest H. Flint, Ph.D

January 2014

Abstract

Applications of O2YS have been shown to be beneficial to crops in several ways, including increases in the concentration of chlorophyll in leaves, the reduction of transpiration water loss during drought conditions, and the reduction of damage caused by several kinds of insects and nematodes, especially the reneform and root knot nematodes that are known to reduce yields of cotton, soybeans, and many other crops. O2YS is a formulation of chitosan and the sap of the yucca plant. Chitosan has for many years been recognized for its effect on the formation of chitin, thereby reducing the activity of organisms dependent upon this material for reproduction and dissemination. This report is a brief summary of several studies, both formal and informal, which show the effect of O2YS on nematodes, stomatal conductivity, chlorophyll index and yield of cotton and soybean plants growing in soil that has been treated with the material, or that have received foliar applications. This report also attempts to utilize these several studies and their individual methods and timing of application to suggest which methods of use may be expected to be most effective. The application of one pint of product to the soil surface at or prior to planting was shown to be an effective method of use that can be expected to produce good results.

Background and Review of Literature

Chitosan is the processed, water-soluble form of a common organic and natural substance that has come to be referred to as chitin. The exoskeletons of arthropods (ants, shellfish, etc.) and the cell walls of many molds, yeasts and fungi are composed of chitin. Chitosan was first discovered in 1811 by Henri Braconnot, director of the botanical garden in Nancy, France. Bracannot found chitin in fungi that did not dissolve in acid. Over the last 2 centuries, research into the characteristics of chitosan has revealed that it has many forms and capabilities. Today researchers continue to add to the body of knowledge about this material.

Chitosan and chitin have many proven and potential uses, however this brief review will focus on its potential for use in agriculture, and more specifically in field crops. Both chitin and chitosan have shown antiviral, antibacterial, and antifungal capabilities, and have been

widely evaluated for many agricultural uses. They have been utilized to aid in the management diseases and to enhance the natural defense processes of plants.

When used to support plant health, chitosan has been shown to work in both monocots and dicots to suppress the development of viral, bacterial, and fungal infections, as well as the activities of insects and nematodes. Responses include several complex defense mechanisms, both biochemical and physical. The response to chitin, chitosan, and derived oligosaccharides varies with their degree of acetylation. Chitosan has been shown to increase the level of chlorophyll in the tissue of soybeans and corn. (Hadrami, et. al., Chitosan In Plant Protection, Marine Drugs, 8(4):968-987, 2010)

Bittelli et al. (Reduction of transpiration through foliar application of chitosan. Agric Forest Meteorol. 2001;107:167–175) suggested that chitosan may be effective in the reduction of transpiration to preserve water resources for use in agriculture. In their investigation, they examined the potential of foliar applications of chitosan on the transpiration of pepper plants in a growth chamber and in the field. Reduced water use by pepper plants following treatment with chitosan was 26–43%, while there was no change in biomass production.

Chitosan has been shown to reduce the incidence of several common plant diseases, including Fusarium wilt, Botrytis, and the incidence of infection by *Aspergillis flavus* in corn and peanut. Several researchers have suggested that chitosan provides improved tolerance to these and other infections through improvement of natural defense mechanisms of the plant. (Hadrami, et. al., Chitosan In Plant Protection, Marine Drugs, 8(4):968-987, 2010)

Chitosan has been shown to influence an extremely wide range of organisms and processes in nature. Among these are insects and nematodes due to the importance of chitin in their reproduction and growth processes. Nematode proliferation can be modified by the application of chitosan to the soil since chitinolytic microorganisms destroy nematode eggs and degrade the cuticle of young nematodes. (Gohel, et. al., Bioprospecting and antifungal potential of chitinolytic microorganisms. African J. Biotechnol. 5: 54-72, and Rodriguez-Kabana, et.al, Effects of chitin amendments to soil on the soybean cyst nematode , *Hetedodera glycines*, microbial population, and colonization of cysts by fungi. Nematropica 14:9-25.)

There are many articles about chitin, chitosan, and related compounds suggesting an extensive number of potential uses and applications. One may get the idea that chitosan is capable of doing almost anything from medical, to food, to pest management. However the reaction of chitin and chitosan is closely tied to the precise chemical structure and molecular weight of the specific form being used for each purpose. It is in effect a biopolymer with an extremely wide range of forms and combinations. Two approaches may be considered in its use, one being that of using a mix of many different forms with a wide range of molecular weights, and the other is that of refining it to a narrow range for a specific purpose. As I see it today, the best approach will be to retain a fairly wide range of molecular weights in order to meet nature on its own terms and deal with its diversity with diversity.

Materials and Methods

Since this is not a "formal" report, I will only give some background and a general description of some the work that has been done in evaluation of this material. I started working with O2YS in 2010 as an entry in a trial of products applied to the foliage of soybeans in the first trifoliate stage. I included it mainly as a way of filling out the area that I had chosen for the test. There were about a dozen individual products, combinations, and rates of products in the test. They were applied with a backpack sprayer as a 12 inch band in row beans.

That test was repeated at three locations, and included lime at an equivalent rate of one ton per acre, two tons of poultry litter, and gypsum at one half ton per acre. Two of the locations had soil pH levels that would have indicated the need for lime application. On both of these locations the yield from the plots treated with the O2YS was at or above that for the lime, and above both the poultry litter and gypsum. This is not meant to suggest this product is capable of replacing these fundamental products, but that its effects are beneficial in other ways that are also capable of improving plant growth and yields.

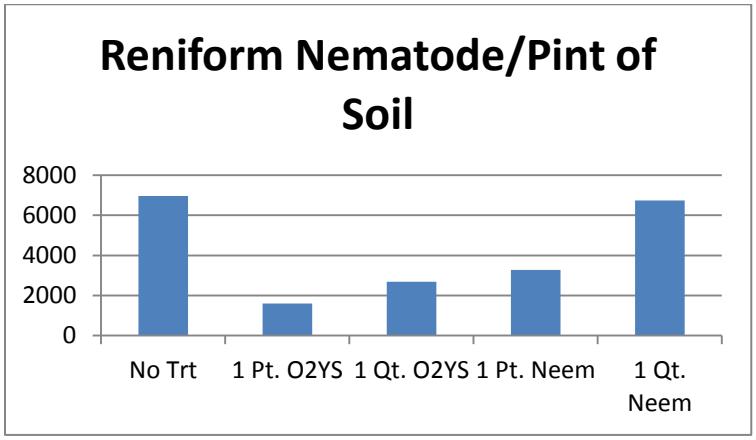
At first I did not have confidence that the results were valid since the simple spraying of this material I had never heard of at a pint per acre rate had performed better than materials proven through many years. In my mind this should not be happening. The next year in 2011 I did similar trials, and since a farmer had asked me about the need for boron on soybeans I included that element with some of the products in the test, including the O2YS. And again, the O2YS performed well, and even a little better with the boron.

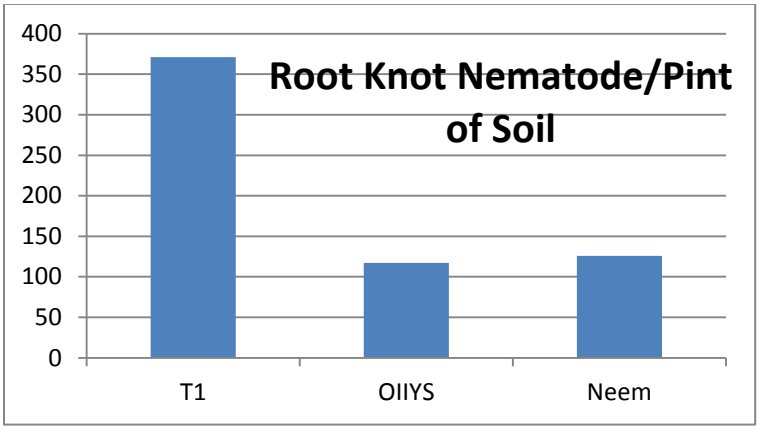
Since that time I have been continuing some of this kind of work, but I have moved toward the management of nematodes with the O2YS as a possible underlying cause of the yield boosting effect of the product. Two replicated trials were done in the late fall of 2012 in which I injected the equivalent of a 1 pint per acre rate of O2YS at rates of one pint and one quart per acre. As a comparison, another material, neem oil, was included at the one pint and one quart rates. Each treatment, including an untreated check were replicated four times.

Results

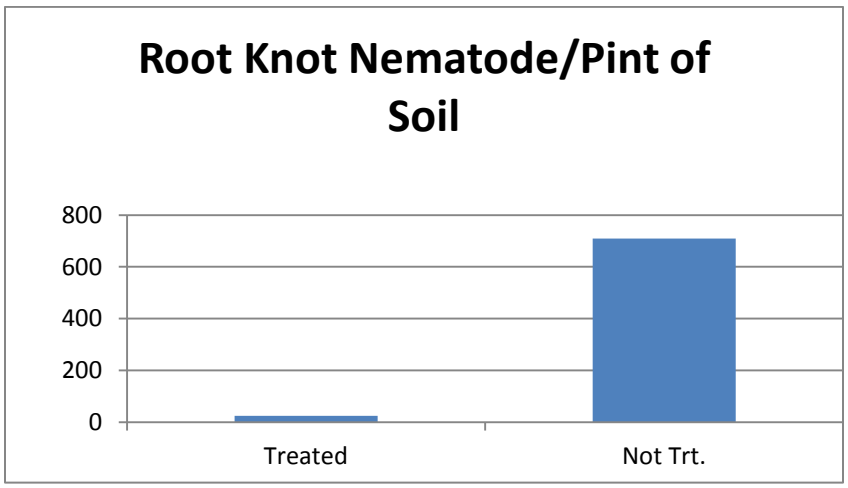
Nematodes and their effects:

In one location, the predominant nematode species was reniform (Seneasha Farm near Goodman, MS), and in the other it was root knot (Carter Farm near Walnut Grove, MS). This replicated trial was done in similar fashion at both locations, and in both locations there were large reductions in nematode numbers in samples taken one month after establishment of the tests. In both locations, the reduction in nematode numbers was around seventy percent compared to the untreated check.

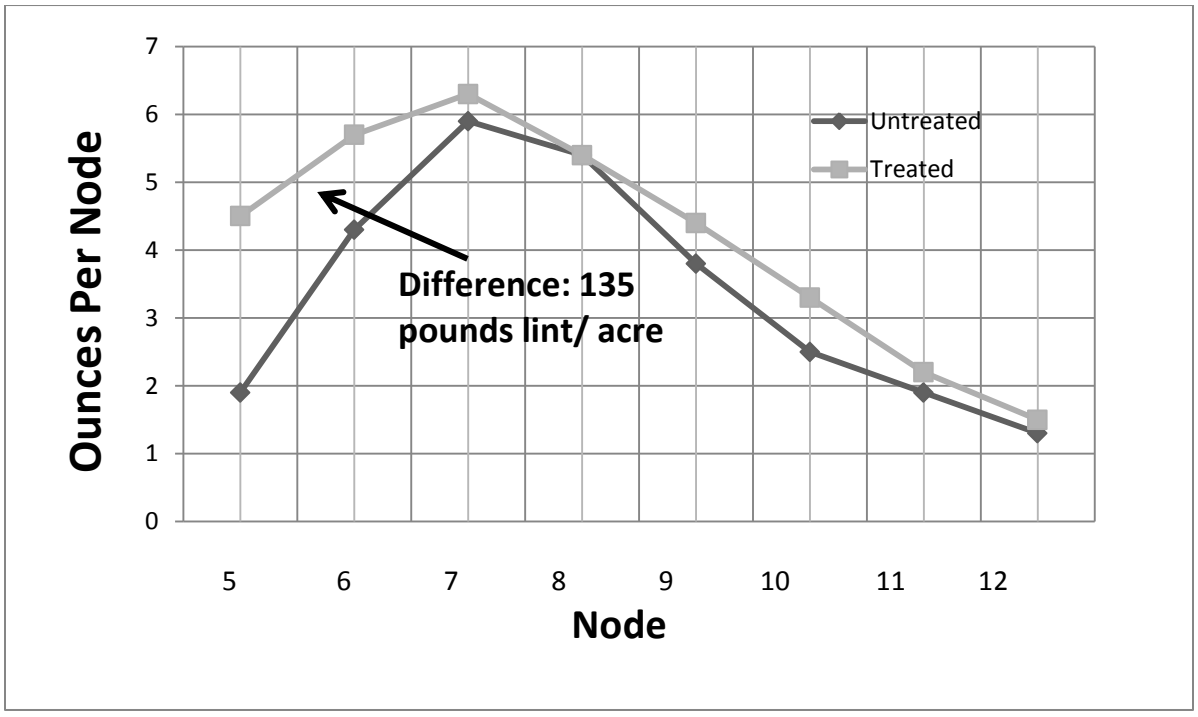




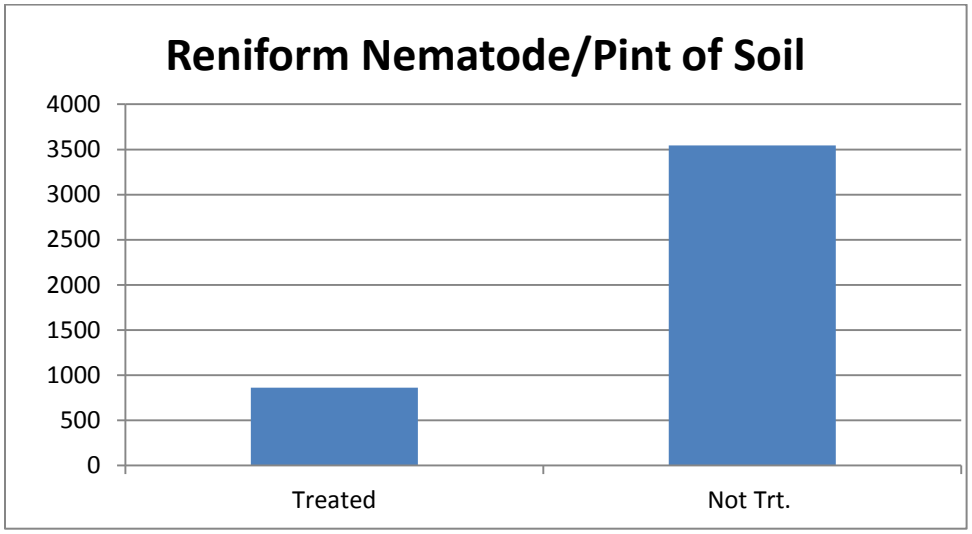
In 2013 I expanded to full size field plots that were treated by growers with their own equipment. One of these (Carter Farm) was sprayed preplant with O2YS alone at 1 pint per acre, applied to bare tilled soil which was then harrowed prior to planting. On this farm, where the predominant nematode species was root knot a large part of their acreage was treated with the material, but an untreated strip was kept as a check. This area produced 135 pounds more cotton in the treated portion than in the untreated, and numbers of nematodes found in soil was reduced by an almost unbelievable 96.8 percent.



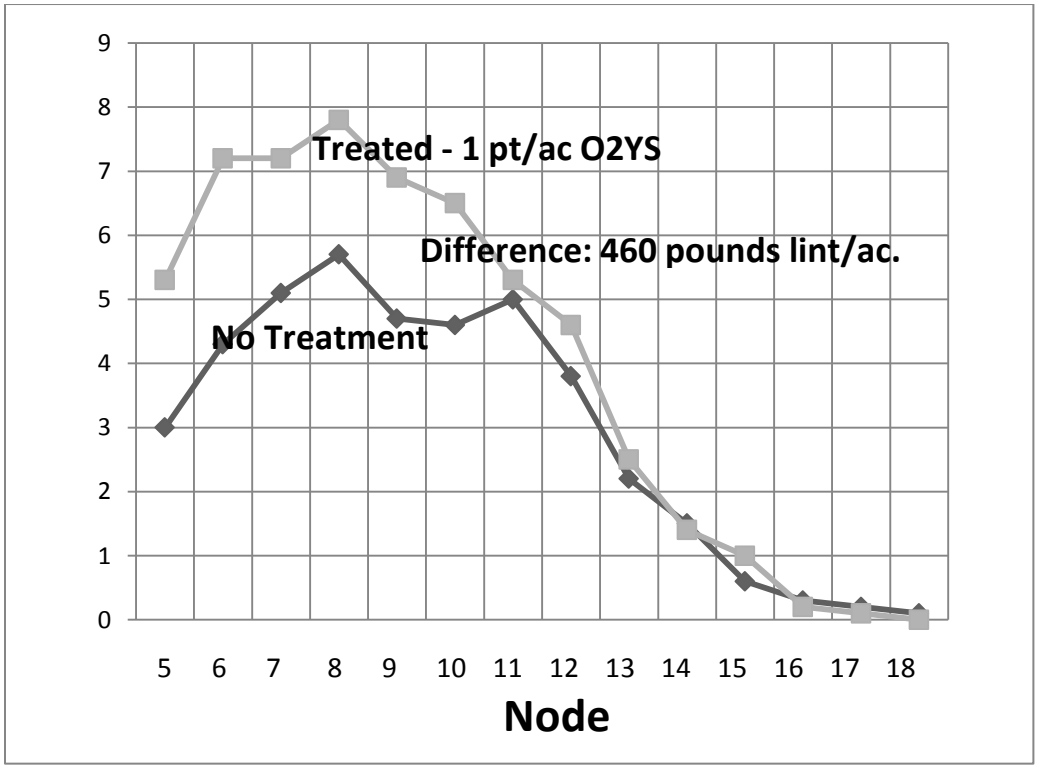
Plants from the comparison area were mapped at harvested with the following result.



At a second location (Jones Farm) the field was treated with O2YS in combination with Cotoran herbicide to stale soil. This field was known to have reniform nematode at high levels for many years. The field was planted without tillage except for the minimal disturbance caused by the planter. At this farm the difference in reniform nematode numbers in the treated and untreated samples showed a reduction of over seventy percent from the application of the one pint rate of O2YS at planting.

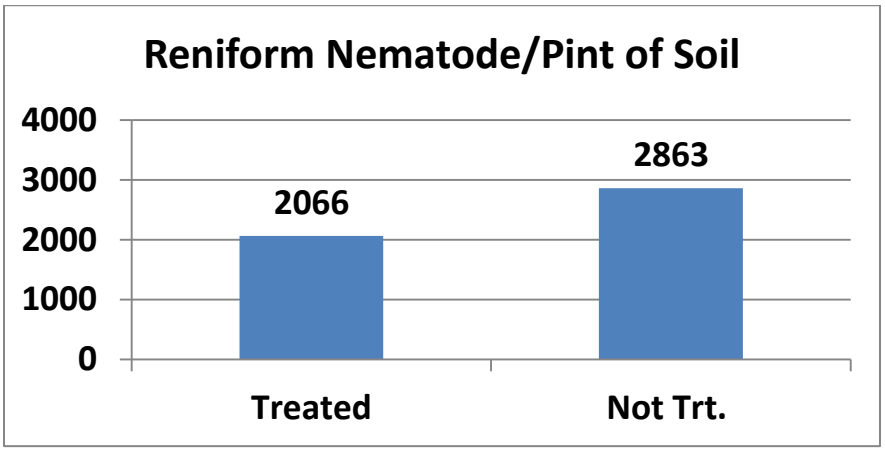


Mapping plants from treated and untreated areas showed the following result, with an estimated 460 pound difference in favor of the treated area. Mapping data produced the following result.



Shirley Farm location near Vaiden:

This location was utilized primarily as a site for a midseason foliar application of O2YS. That work is shown separately in the section on stomatal conductance. The soil was also sampled to determine the effect on nematode numbers for a midseason foliar application at 1 pint per acre. The result showed a reduction in nematode numbers, but not as dramatic as for applications done at or prior to planting. The results are shown here:

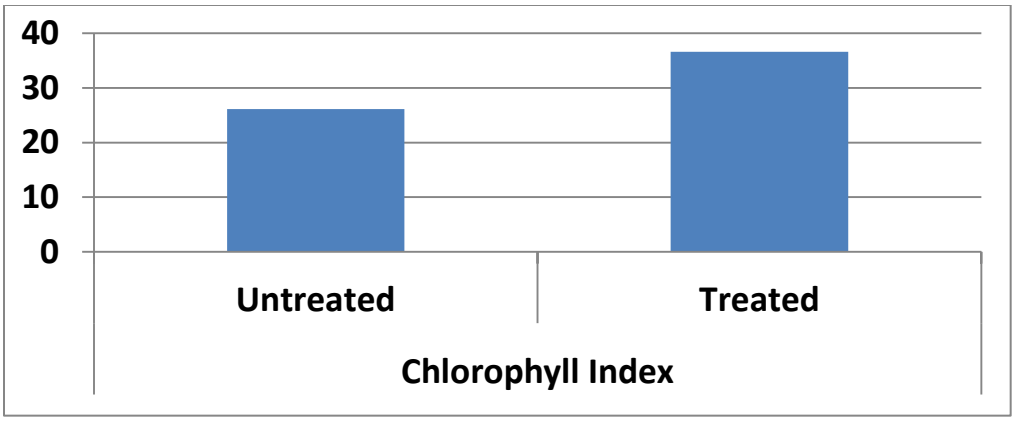


Stomatal Conductance and Chlorophyll Index:

As part of this work readings were taken to evaluate the influence of O2YS on two physiological indicators. Chlorophyll Index (CI) readings were done with an Apogee CCM-200 meter and are expressed as "Chlorophyll Index" units. Stomatal Conductance was measured with a Decagon SC-1Leaf Porometer and are expressed as (mmol/m^2s).

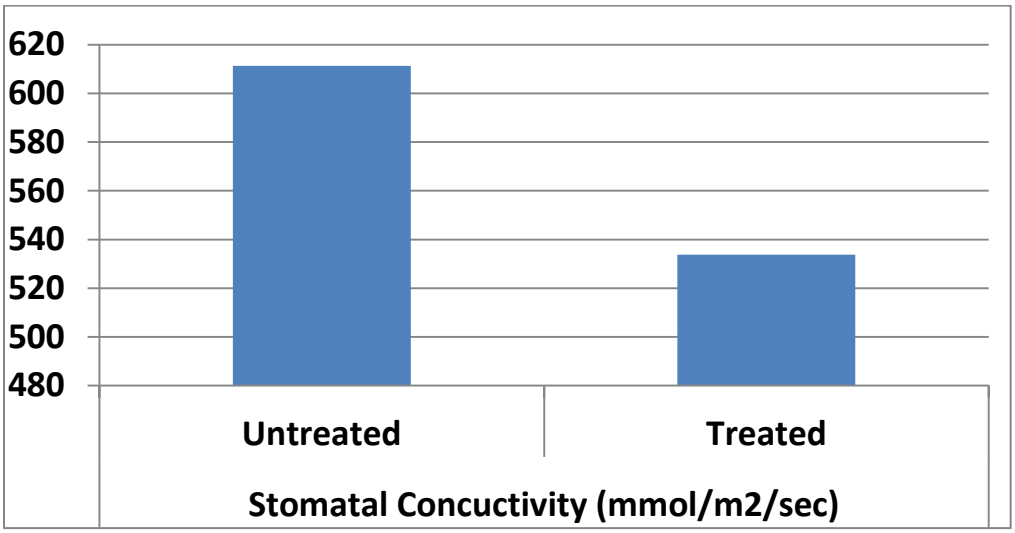
Cotton at Walnut Grove location:

Chlorophyll Index readings were taken at the Walnut Grove location in cotton that was treated at planting. The CI readings were taken at the mid to late bloom stage. The mean CI was higher for plants in the portion of the field that had been treated with O2YS at 1 pint per acre.



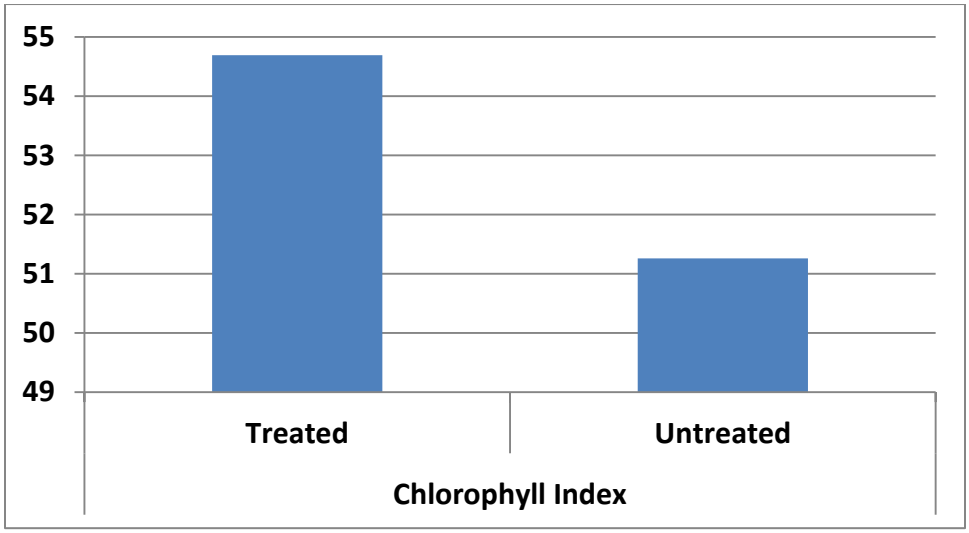
Stomatal Conductance at Walnut Grove location:

Determinations for stomatal conductance at the Walnut Grove location showed that more water was being transpired from the leaves of the untreated plants. The reduction shows a 12 percent reduction in water use at the time the readings were made.



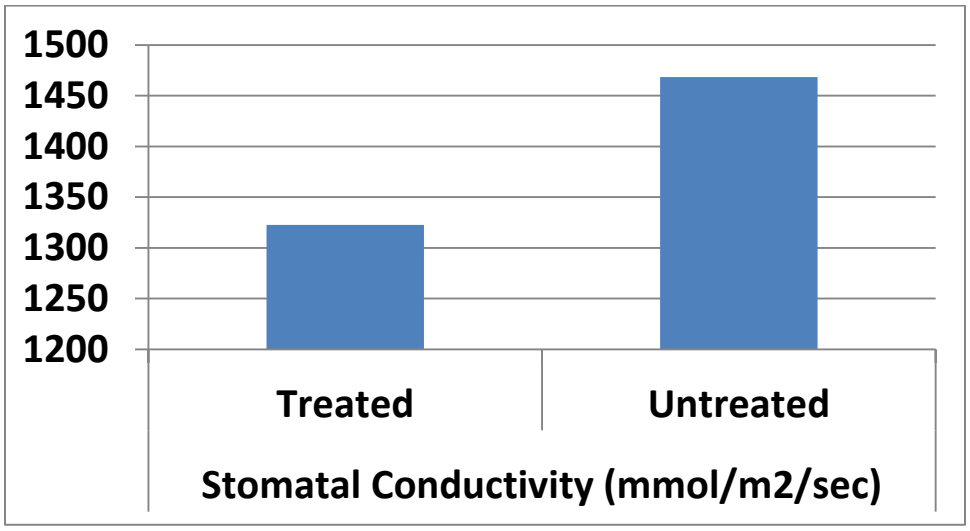
Cotton at Vaiden, MS:

Chlorophyll Index readings were higher for plants in the treated portion of the field on the Jones farm near Vaiden, MS.



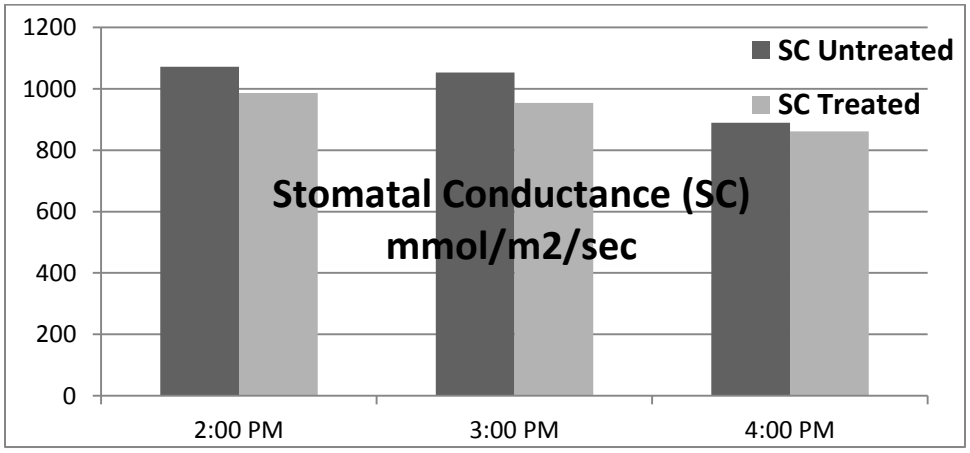
Stomatal Conductance at the Jones Farm Location:

Stomatal Conductance readings were higher for plants in the untreated portion of this field. The difference represents a 10 percent reduction in transpiration for the treated plants at the time the measurements were taken.



Stomatal Conductance in cotton at the Shirley location:

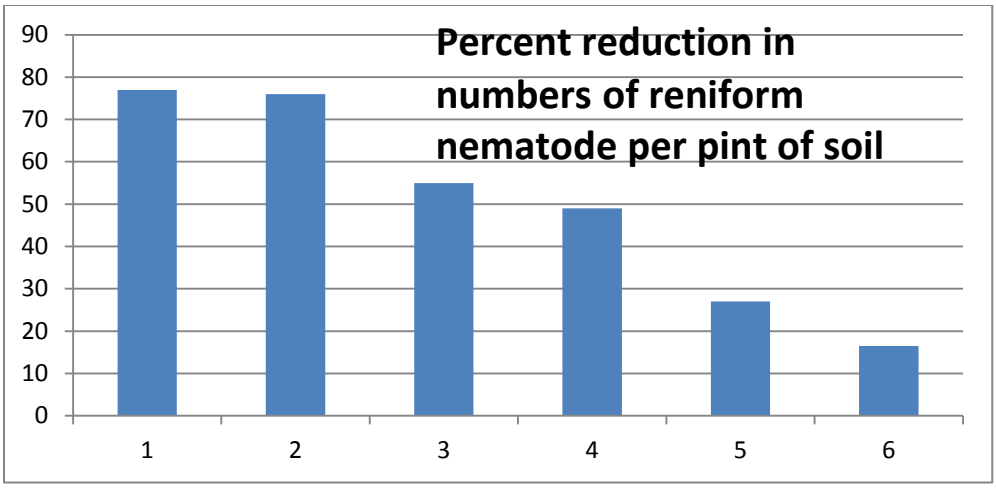
Another location near Vaiden, MS on the Shirley farm was chosen for a midseason foliar application, mainly for the purpose of measuring immediate effects on Stomatal Conductance (mmol/m^2/sec)). An application of 1 pint of O2YS was made at 1:00PM under good sunlight with a relative humidity of around 70%, temperature of 92 degrees F, and light wind of less than 5 MPH. Readings of SC were made at one hour intervals for three hours at 2:00PM, 3:00PM, and 4:00PM to produce readings 1, 2, and 3 hours after the application. The mean readings produced a consistent reduction in SC with an overall reduction for the period of 7 percent.



Method and timing of application of O2YS:

The applications used in this comparison were all made at the 1 pint per acre rate. There were variations in soil, water quality, combination with other products, spray volume, solution pH, and other factors, rendering this comparison questionable. However it reveals a pattern of effectiveness in the results of these applications that is difficult to ignore, and it offers some insight into the most appropriate means and timing for applications of this product to crops. The following is offered as material for discussion only, and as a tool for use in future work with this material.

Comparison of times and methods of application of O2YS for management of reniform nematode:	Reniform Nem./pt of soil Reduction %
T1: Winter application injection study at Goodman -	77
T2: At Planting broadcast to stale beds at Vaiden	76
T3: To Peanuts at pegging stage - broadcast	55
T4: At planting application at Goodman - Injected 2X2	49
T5: Midseason foliar spray to early bloom cotton at Vaiden	27
T6: R1 (Early bloom) foliar soybeans at Newport	16.5



This comparison suggests that O2YS is very effective in controlling reniform nematode in soil when applied broadcast at or before planting, and that incorporation of the material does not appear to be needed. It also suggests that applications done later in the season for other purposes such as disease or insect suppression can also reduce reniform numbers but should not be expected to produce major reductions in their numbers. Ideally, a combination of an application of 1 pint at or prior to planting, followed by a midseason application should offer advantages for management of nematodes as well as providing some of the beneficial effects on diseases, insects, and water use efficiency.

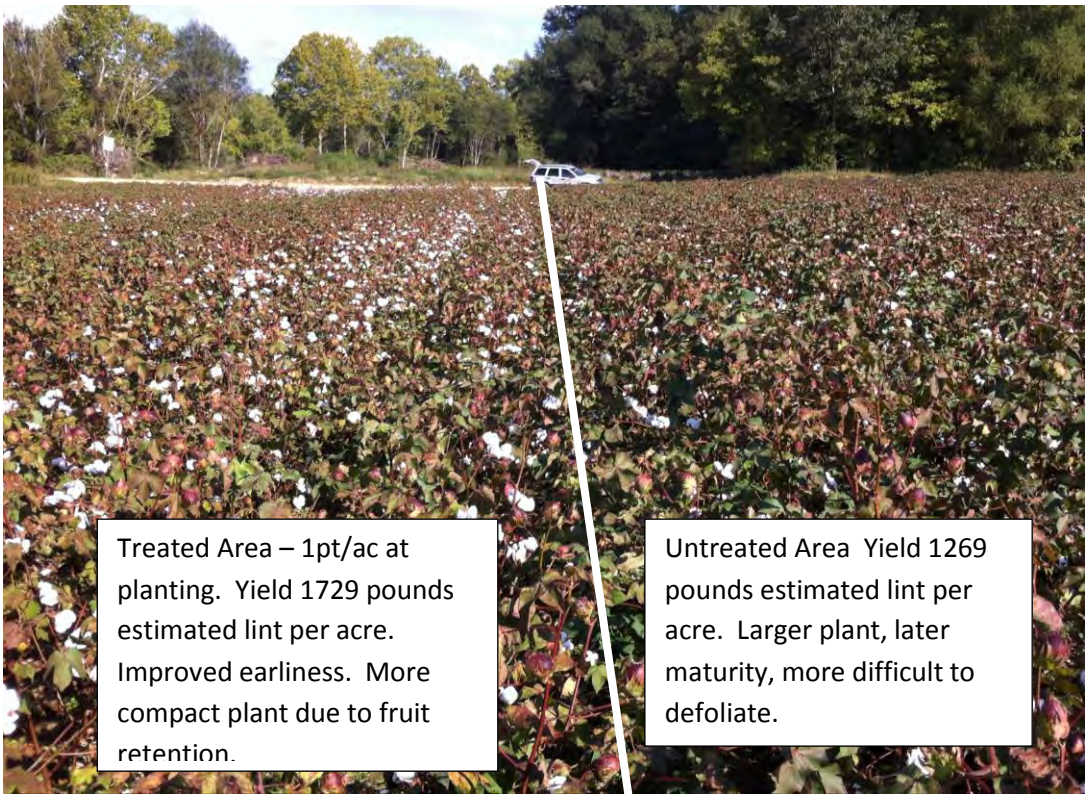
Conclusions:

The results of this study suggest the following points be considered as further evaluations of the chitosan product O2YS.

1. The product has potential for use in the management of both reniform and root knot nematodes.
2. In situations where rotation to a nonhost crop is not practical or profitable, this material may be considered as a means to suppress nematodes and the development of diseases associated with monoculture.
3. When an objective is the management of nematodes in soil the product should be applied broadcast at or prior to planting.
4. The product can be expected to perform well if applied in fall or winter prior to establishment of the summer crop.
5. Incorporation of the product into the soil was not an apparent advantage toward the functioning of the product in the suppression of nematodes, allowing it to be effective in no-till and reduced tillage systems. However, tillage did not appear detrimental to effectivensss.
6. Foliar applications done later in midseason offer some suppression of nematodes, but should not be expected to reduce numbers as well as preplant or at planting applications.
7. Consistent increases in leaf chlorophyll were seen following application of the product.
8. Consistent decreases in stomatal conductance were seen following the application of the product. This finding suggests that the product may offer an opportunity to decrease water use and increase water use efficiency in crops.
9. Yield increases were seen in cotton as determined by mapping plants in treated and untreated areas of the test fields. Other tests suggest this may also be true for soybeans.
10. Some degree of improved cotton earliness was seen as indicated by more productive boll being set on nodes 5 through 10 of plants from the treated portions of trial fields. The photo presented below is offered to support this statement.

Photo of Jones field near Vaiden, MS just prior to defoliation:

The white line shows location of the approximate boundary between treated and untreated portions of the field. This field produced exceptional yield for this area, with the treated portion at 1729 pounds of lint compared with 1269 pounds for the untreated portion. This yield will likely be somewhat higher than a machine harvested yield since it was determined by adding together the hand-picked bolls during the mapping process. The estimated yield from the untreated area was similar to other actual yields on similar soils in the area during the 2013 harvest.



Ernie Flint Report Notes

I stand by the results that are described in my report in that OII-YS showed surprisingly good results in reducing the numbers of both reniform and root knot nematodes in replicated trials I did on farms here in Mississippi. Yields of cotton also responded well to treatment of the soil at or just prior to planting, with the least response at approximately 150 pounds of lint cotton per acre and the greatest response at 460 pounds of lint per acre under conditions of very high nematode numbers.

As you can see in the report, I also documented situations in which the chlorophyll index was increased in both cotton and soybeans, and transpiration rate was decreased in both crops in replicated trials. This could have implications for the current debate over water use for irrigation.

The O2YS material continues to surprise me with its ability to positively influence a wide range of issues from nematodes to diseases to insects. I do not have documentation for its impact on fungal diseases or insects so far, but I have seen in-field indications that suggest the need for further investigations into these issues. I have seen very interesting reductions in insect pests in soybeans and cotton that suggest that the product may have the capability to reduce the impact of these and other pests on yields of these crops. However, I only have my own observations to back up this statement so far – even though the works of others have agreed with what I have seen.

In my opinion, the effect of chitosan as formulated in O2YS has the capability to make significant impact on several aspects of crop production and I hope to do more work with it in order to document these effects. I am currently in the process of assembling a review of research that has been done globally with this and other similar materials. I hope this will offer more evidence to others that this material is worthy of further evaluation.

Flint on Crops: We Often Ignore Important Things - Commentary

By Ernie Flint, Mississippi State University Agronomist

December 11, 2017

Through the years since I started working with farmers in the mid 1970's there has been a growing awareness of how many producers choose to bypass or intentionally ignore some of the most basic things that could increase their yields and profitability.

Later when I joined the Extension Service and it became my job to bring these principles to their attention I was even more surprised at how some people will actually get pretty good at doing these things that in many cases are fairly simple or even passive and some don't cost anything because most of the time they produce more value than the cost.

I want to mention just a few of these things just for the record so at least some of them will be talked about together.

The first of these, as you might expect, is soil quality, including soil pH, a good soil testing program, and the additional principles that have become more apparent in recent years including crop rotation, cover crops, reduced and fall tillage, and as always that important thing called drainage. All of these when addressed well come together to make some of the most successful farmers I have known, and all they have to do is take care of the land first and then it takes care of them.

Next is something that a lot of people would rather not even hear me talk about, especially the seed salesmen. Most farmers plant way too many seed. This is especially true for soybeans and cotton. We do a pretty good job with corn because of the excellent work that has been done with populations in that crop. However with soybeans most people plant around 130,000 or more seed per acre, and in some cases a lot more than that.

Most of the "real world" trials that have been done show that seeding rates in the 100,000 range are sufficient even when emergence is not ideal and the final populations drop as low as around 70,000. In fields with lower populations there are normally fewer issues with insects and diseases since sunlight is able to enter the canopy more readily, and these populations can endure drought stress better than the higher densities.

Another one is that so many people treat sub-economic numbers of pests, often destroying most of the native predators that can help suppress the problem pests and save a lot of investment in money and time. This is especially true for cotton, but soybeans as well. In recent years I have seen some of the more conservative cotton producers achieve some of the highest yields without treating for insects very much at all except for thrips at emergence.

As for soybeans, the entry of the RBSB has changed the scenario dramatically and growers have been forced to spray more, but any and all applications should be based on sound scouting data.

Finally, one of the most overlooked things of all is the importance of managing nematodes. Both cotton and soybeans are extremely vulnerable to these invisible pests that can make a field of cotton or soybeans produce half or less of its potential. Reniform, root knot, and for soybeans the old enemy cyst is slowly returning to our fields after being wiped out by a disease around 20 years ago.

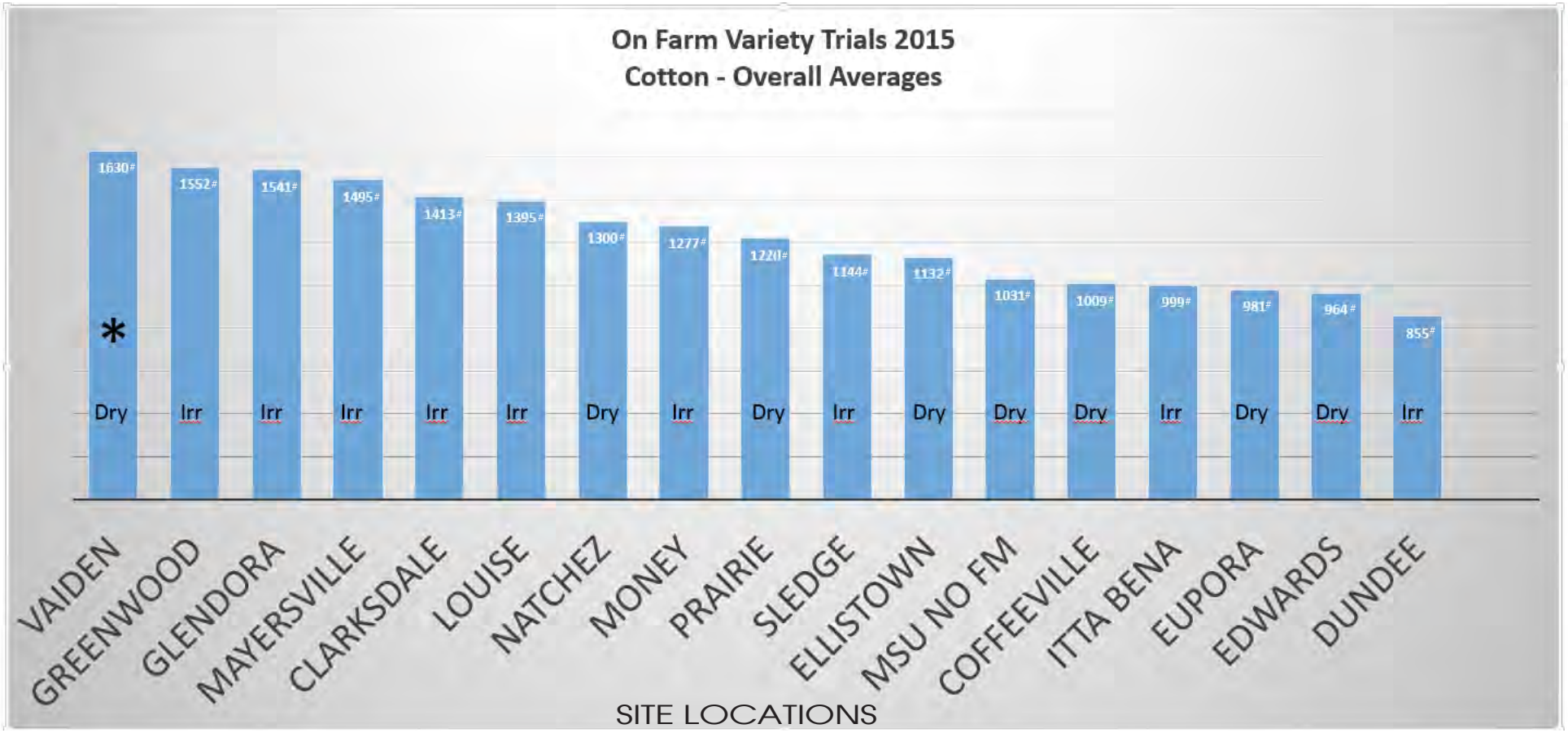
Many North Mississippi fields already experience yield losses in the 30 to 50 percent range from cyst and sometimes there are multiple species present. Crop rotation can help as well as the planting of non-host cover crops like wheat.

A fairly new development in this subject is the introduction of a chitosan based material called Nemasan which when applied correctly can decimate nematodes within a few days of application, allowing crops to then form better roots, use nutrients and water more efficiently, and yield as they should.

This material has not been highly publicized by the media and it has been slowly accepted. It is more commonly used in other parts of the South and in both agronomic and horticultural crops. And I almost forgot to say it is safe for those working with it and for the environment unlike some of the older product that are so dangerous.

Just a few basic changes can bring a farm from red ink into the black, but these things are all too often passed over in favor of work with other things that seem more demanding on the immediate situation. Maybe it's time to go back and make sure these basics are being managed properly.

Thanks for your time.



*The only thing different about the Vaiden trial is that it was treated at planting with a biological product containing chitosan.

Each year the MS Extension Service has each of the Regional Agronomist conduct a cotton variety trial in their area. It can be on irrigated or non-irrigated fields which are the name tags at the bottom of the chart above. Dr. Ernie Flint conducted his trial at Vaiden, MS on a non-irrigated field but he broadcast applied OII-YS™ at 1 pt/acre after planting. While it doesn't have a check plot, we feel that the results were pretty outstanding considering his trial out performed all the other trials both irrigated or non-irrigated.

It should be noted that OII-YS™ did not financially support this trail since Dr. Flint personally sought only to see how the OII-YS™ would perform on irrigated/non-irrigated cotton.