

## **MANAGEMENT ZONES FOR COTTON NEMATODES**

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### **Abstract**

The site-specific application of a nematicide requires some method of delineating the different treatment areas within a field. Research conducted in Louisiana during the past several years has concentrated on the use of apparent electrical conductivity ( $EC_a$ ) to measure soil texture within a field. The greatest nematode losses and most favorable response to nematicide application have been associated with the areas within a field that have the lowest  $EC_a$  readings. Three trials were conducted in Louisiana during 2008 to evaluate different methods of developing nematode management zones. The first method involved the use of  $EC_a$  combined with incidence and population densities of plant nematodes to develop treatment zones. The second method utilized the producer's historical knowledge of the field to divide it into treated and untreated areas. The third method incorporates the use of  $EC_a$  and previous cotton yield to develop risk zones. Although yields were severely impacted by weather events during 2008, this study shows that multiple methods may be utilized by producers in the development of management zones.

### **Introduction**

Nematicides were generally applied in the past based on "whole field concepts" and based on a standard nematode threshold that was derived from a limited number of soil samples collected from the field. The development of several new technologies over the past decade have now made it possible to apply nematicides in a more site-specific manner (Overstreet, 2004). These technologies include the use of mapping soil texture within fields (Veris 3100 Soil EC Mapping System), cotton yield monitors, imagery obtained during the growing season, and software and hardware for developing treatment zones and variable rates for nematicides. Several researchers have begun investigating the use of site-specific application of nematicides in cotton (Monfort et al., 2007; Khalilian et al., 2001; Wolcott et al., 2005). The development of management zones has been reported by Overstreet et al., 2007 and Ortiz et al., 2008. The objective of this work is to evaluate several different ways that management zones can be created and applied to producer's fields.

### **Materials and Methods**

All three of these trials were conducted in Tensas Parish, Louisiana. The first method that was evaluated was conducted on Tru Goldman's farm in several consecutive fields totaling 278 acres. The method used for defining management zones was the use of soil  $EC_a$  combined with nematode incidence and population levels. These fields have had a history of reniform nematode. The fields had previously been evaluated for  $EC_a$  using a Veris 3100 Soil EC Mapping System and were divided into five different zones based on natural breaks for  $EC_{a-dp}$ . The fields had been zone sampled for nematodes in the fall of 2007 and five different population categories were assigned by natural breaks to each of the zones. The zones that were found to have nematode populations above the threshold population (1500 per 500cm<sup>3</sup>) were then designated as zones to receive a Telone treatment. Telone was applied pre-plant in April using a six-row applicator and applied in a site-specific manner using a FarmWorks Titan computer with FarmWorks SiteMate. Five verification strips that included 24 rows of untreated and 24 rows of treated through the entire length of the field were assigned to measure the effectiveness across soil zones. At harvest, the field was harvested with a 6-row John Deere picker with a yield monitor. The raw yield was processed first through Yield Editor and then brought into ArcGIS 9.2 for further analysis of the two treatments within various zones.

The second location was conducted in an 84 acre field in Tensas Parish on Allen Crigler's farm that has had a history of nematode problems. The entire field is listed as being a Bruin-Commerce silt loam. The producer divided the field into treatment zones based on his previous experiences with this field. Telone was applied with the same applicator as previously described in April. Two verification strips that included 24 rows of untreated and 24 rows of treated through the entire length of the field were assigned to measure the response of the fumigant. The field had been measured with the Veris 3100 Soil EC Mapping System previously and was used to get a more accurate assessment of  $EC_a$  within the field. Cotton was harvested using a 6-row picker with a yield monitor. The yield data was processed similar to the first location. Nematode samples were collected by soil zones after harvest to give a better idea of their distribution.

The third location was a 212 acre field in Tensas Parish with Panola Plantation that was infested with root-knot nematode. The field was divided into five natural breaks for  $EC_{a-dp}$  and each zone assigned a number from 1-5 with one having the lowest  $EC_{a-dp}$  readings and five being the highest. Cotton yield from this field (from two years prior) was processed through Yield Editor and divided in ArcGIS 9.2 into five natural break classes based on percentage of the average yield across the field. Each of these classes was then assigned a 1-5 number with one being the lowest level of yield (34-72% of normal) and five being the highest class (145-216% of normal). A risk map was then developed by combining the rankings of both  $EC_{a-dp}$  and percentage of normalized yield. The risk map was divided into five natural break categories with a risk of 2-3 being considered the greatest risk for damage and most likely to respond to a nematicide to the risk category of 8-10 which would not likely respond to a nematicide. The field was divided into the two treatment zones based on the risk map. Four verification strips (12 rows untreated and 12 treated each) were included in the field to measure the response in the various risk map areas. Yield was collected using a 6-row John Deere picker with a yield monitor and processed similar to the first and second location.

### **Results and Discussion**

The growing season during 2008 turned out to one with both extreme drought for most of the growing season (May until early August) followed by severe flooding and prolonged cloudy weather during August and September. Rainfall totals averaged 26 inches for August and September resulting from Hurricane Gustav and Ike. Yields were drastically reduced throughout this region and likely seriously impacted these trials.

Figure 1 shows the  $EC_{a-dp}$  reading and breakdown into five natural break zones within the first location at Goldman Farms. The range of  $EC_{a-dp}$  readings was from 30 – 184 mS/m. Figure 2 shows the distribution of reniform nematode within the fields based on zone sampling. The ranges were from 0 (none detected) to a high of 18,880 per 500 cm<sup>3</sup> of soil. Corn had been the previous crop in these fields and may have accounted for the slightly lower populations detected in the samples. When both  $EC_{a-dp}$  zones and nematode distribution were compiled, a treatment plan could be developed for the application of Telone (Figure 3). Unfortunately, when cotton lint was evaluated at the end of the season in the treatment areas, no differences could be observed in any of the soil zones and especially in Zone 1 which had the lightest soil (Table 1). Yields are down considerable in these fields and any differences could easily have been masked by the terrible weather conditions that prevailed during the growing season. Although the results from this study showed little impact from the application of Telone, the concept of matching soil texture as determined from  $EC_{a-dp}$  and matching them with nematode populations that are present based on zone sampling should provide an excellent method for developing site-specific management of nematodes such as reniform.

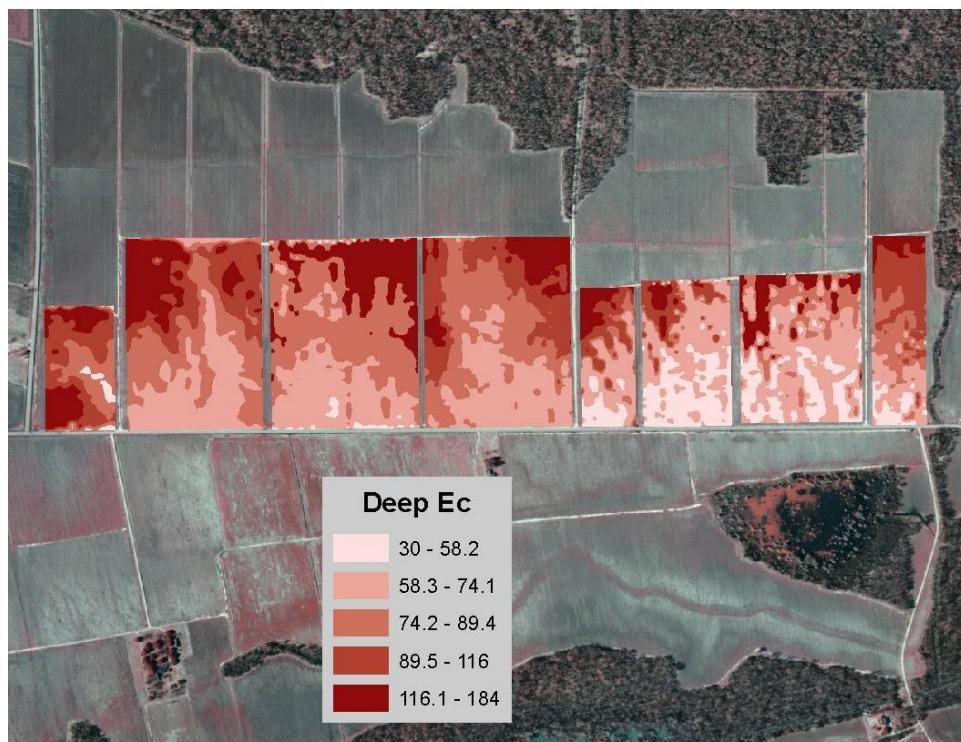


Figure 1. The ECa-dp reading and breakdown into five natural break zones for the Goldman fields.

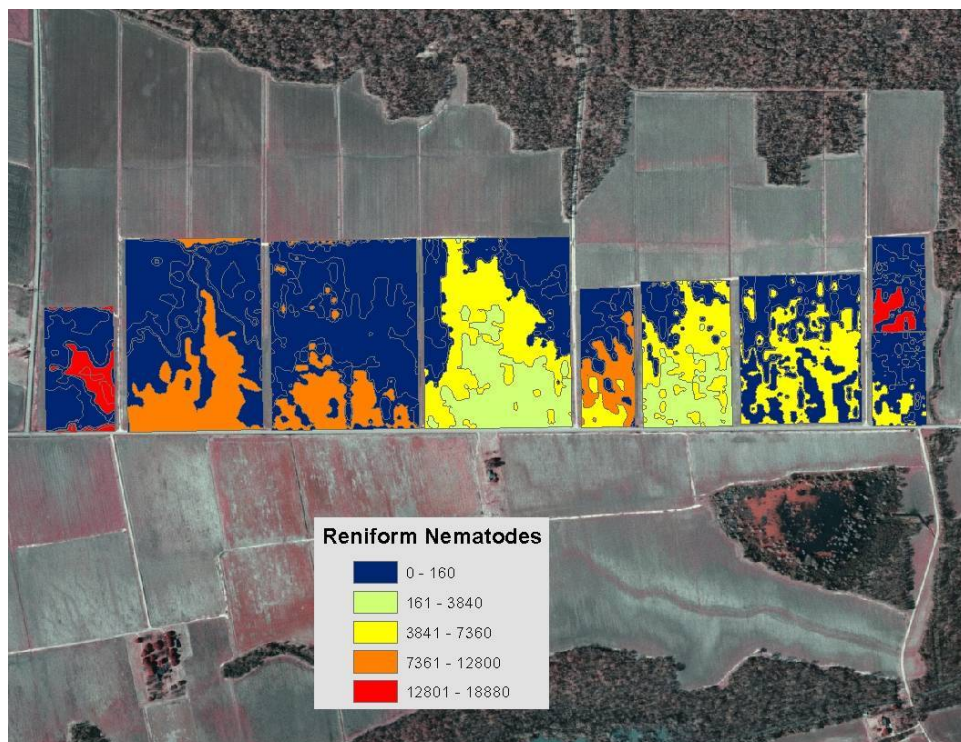


Figure 2. The incidence of reniform nematode within the various zones (delineated by  $EC_{a-dp}$ ) in the Goldman fields.



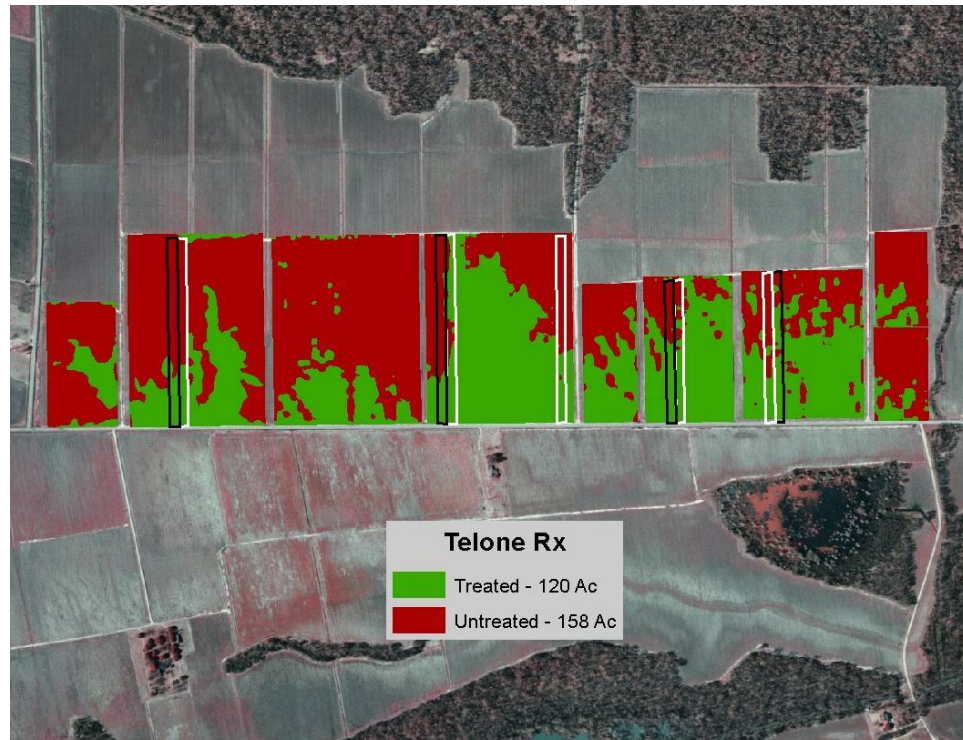


Figure 3. The fields divided into treatment zones based on incidence of reniform nematode and soil  $EC_a$  zones. The verification strips in the field outlined in black are Telone treated throughout the length of the field and the strips in white were not treated.

Table 1. Cotton lint response to Telone across the five soil zones delineated by  $ECa-dp$  in the Goldman fields.

Nematicide	Soil zones				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Telone	650	679	629	693	777
Untreated	644	669	719	762	790
Difference	6	10	-90	-69	-13

The second location with Allen Crigler did provide slightly more favorable results. The producer divided up part of the field into management areas based on his historical experience with the field. These were the areas of the field where he had observed problems in the past as well as areas that have consistently performed well. Figure 4 shows how the producer decided to break the field into treatment areas. Most of the field was included in the area that would require treatment but about a fourth had never exhibited symptoms that suggested nematode injury. The verification strips are evident in Figure 4 with the Telone treated strips outlined in black and the untreated strips outline in white. Figure 5 shows the  $EC_{a-dp}$  reading of the field and the breakdown into four classes. These reading begin much lower than in the previous fields and indicate deep sands in the lightest zones. Table 2 shows the response of Telone in the four zones within this field. There was an economic response in three of the four zones with the least response occurring in the zone with the highest  $EC_{a-dp}$  readings. Nematode samples were collected from the field after harvest to better determine the nematode incidence in the field. Both root-knot and reniform nematode were present and might explain why there was such a favorable response to Telone application in the higher  $EC_a$  zones. The producers knowledge of the field enabled him to fairly accurately predict where to treat and not to treat. The application of the  $EC_{a-dp}$  information and knowledge of where the nematodes occurred in the field may have helped him slightly refine the management zones in this field.

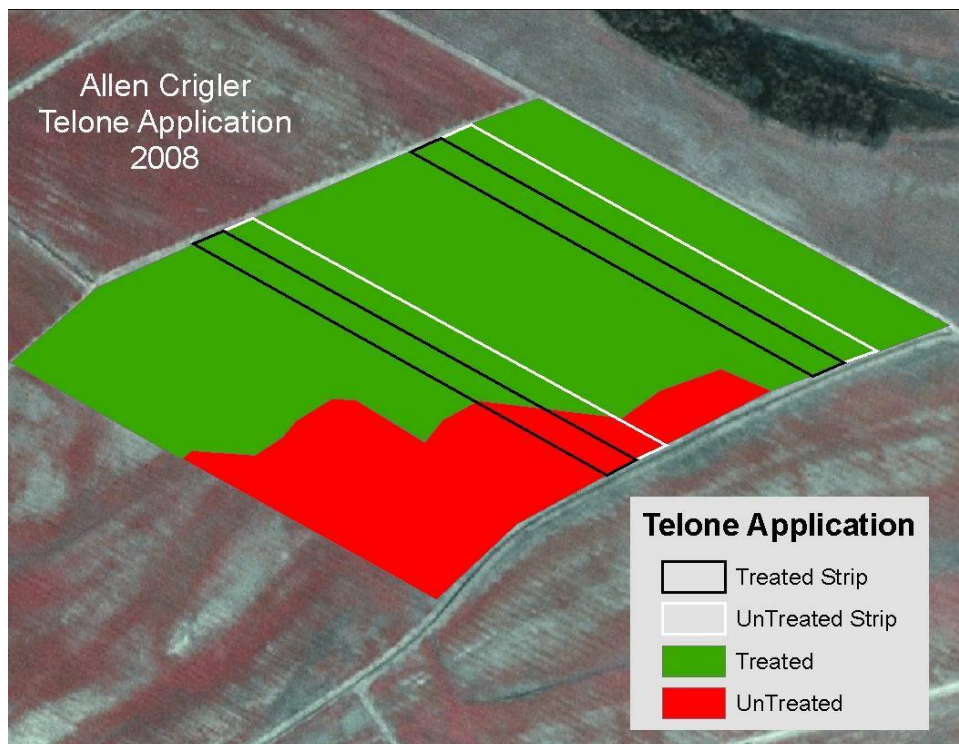


Figure 4. The breakdown of the Allen Crigler field into management zones based on the producer's personal experience in this field. Notice the two verification strips of treated and untreated rows throughout the length of the field.

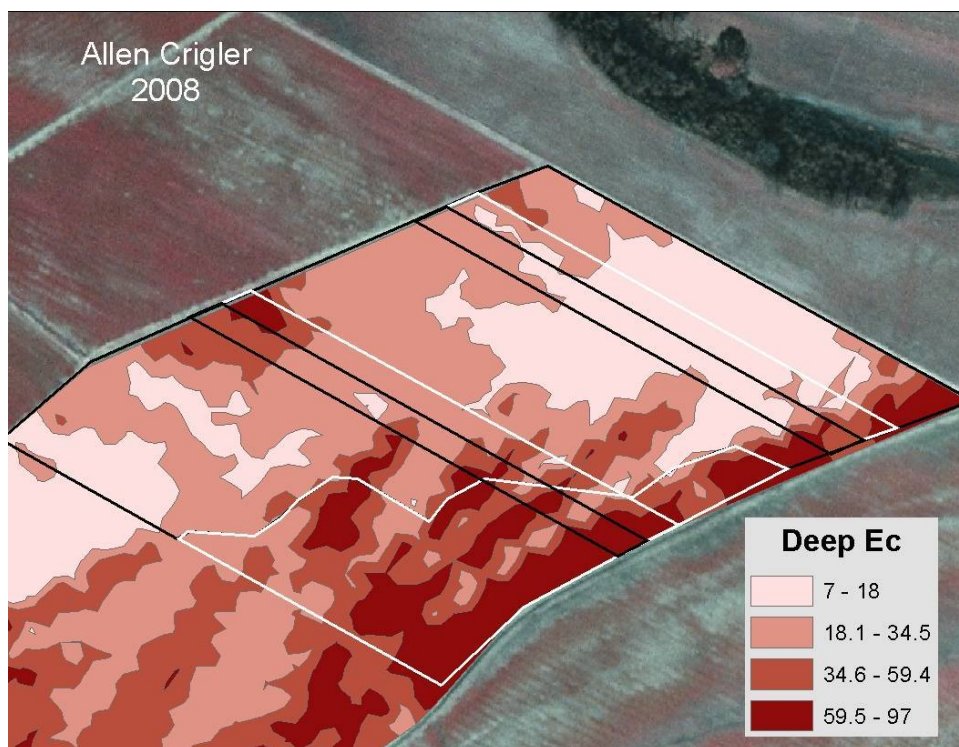


Figure 5. The delineation of the Allen Crigler field into four zones based on  $EC_{a-dp}$ . The  $EC_{a-dp}$  reading are in mS/m.



Table 2. Cotton lint response to Telone across the four soil zones delineated by  $EC_{a-dp}$  in the Crigler field.

Nematicide	Soil zones			
	Zone 1	Zone 2	Zone 3	Zone 4
Telone	684	746	1008	795
Untreated	407	615	907	797
Difference	277	131	101	-2

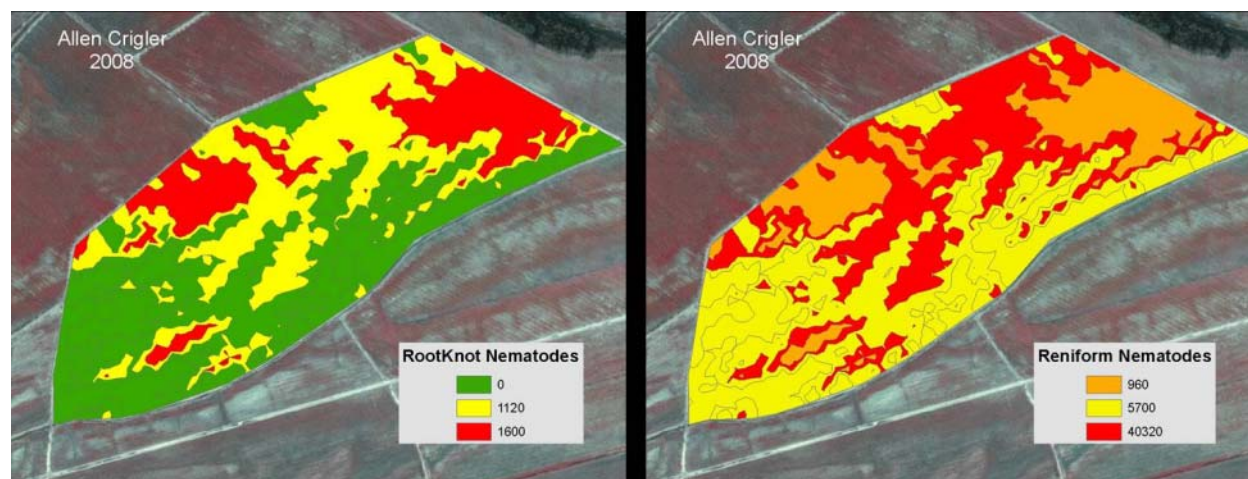


Figure 6. The distribution of either root-knot and reniform nematode in the Crigler field based on zone sampling after harvest in 2008.

The third location was with Panola Plantation and the development of risk maps. Figure 7 shows the breakdown of the field into five soil zones based on  $EC_{a-dp}$ . A value of 1 was assigned to the zone with  $EC_{a-dp}$  reading of 1.9-9.6 mS/m, 2 to the zone with 9.7-15.2 mS/m, 3 to the zone with 15.3-22.4 mS/m, 4 to the zone with 22.5-32.6 mS/m, and 5 to the zone with 32.7-53.5 mS/m. Figure 8 shows the field that has been divided into five zones based on normalized yield from the previous cotton crop in 2006. Each of the zones was then assigned a value of 1-5. The value 1 was assigned to zone with the poorest yield (34-72% of the field average), zone 2 from 72-95%, zone 3 from 95-117%, zone 4 from 117-145%, and zone 5 from 145-216%. A risk map could then be compiled from looking at the combination of the  $EC_{a-dp}$  and normalized yield. Figure 9 shows the risk map divided into five natural break categories based on the sum of the values assigned to  $EC_a$  and normalized yield. The field could then be divided into management zones based on the risk map. Since the areas with the lowest sums for yield and  $EC_{a-dp}$  (colored in red or orange) have the lightest soil texture and have a history of being below the average for yield in the field, then these areas would be at the greatest risk from nematode injury. Figure 10 shows the treatment zones that would be developed utilizing those factors for risk in the field and the verification strips that were used to measure the effectiveness of the fumigant Telone. Yield was very poor in the field this year due to weather and approached 50% or less of what would have been a normal yield. The response of Telone is shown in Figure 11 for the high risk zones and low risk zones. There were no differences observed with the application of Telone with either the high or low risk zones. However, the low risk zone was significantly higher ( $P=0.004$ ) in yield than the high risk zone. Although weather most likely seriously impacted yield and response to nematicides in this field, the use of risk maps that incorporate multiple components such as soil texture and previous yield could be a useful tool in further development of management zones.

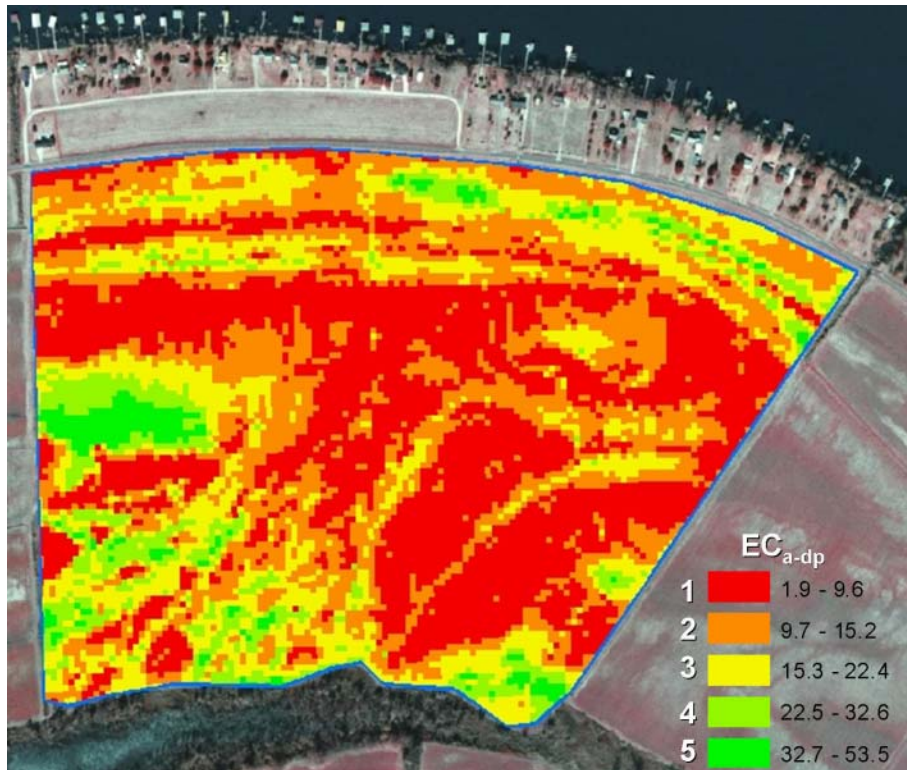


Figure 7. The Island field with Panola Plantation that has been divided into five zones based on ECa-dp. The readings are in mS/m. A number value from 1-5 was assigned to each of the zones.

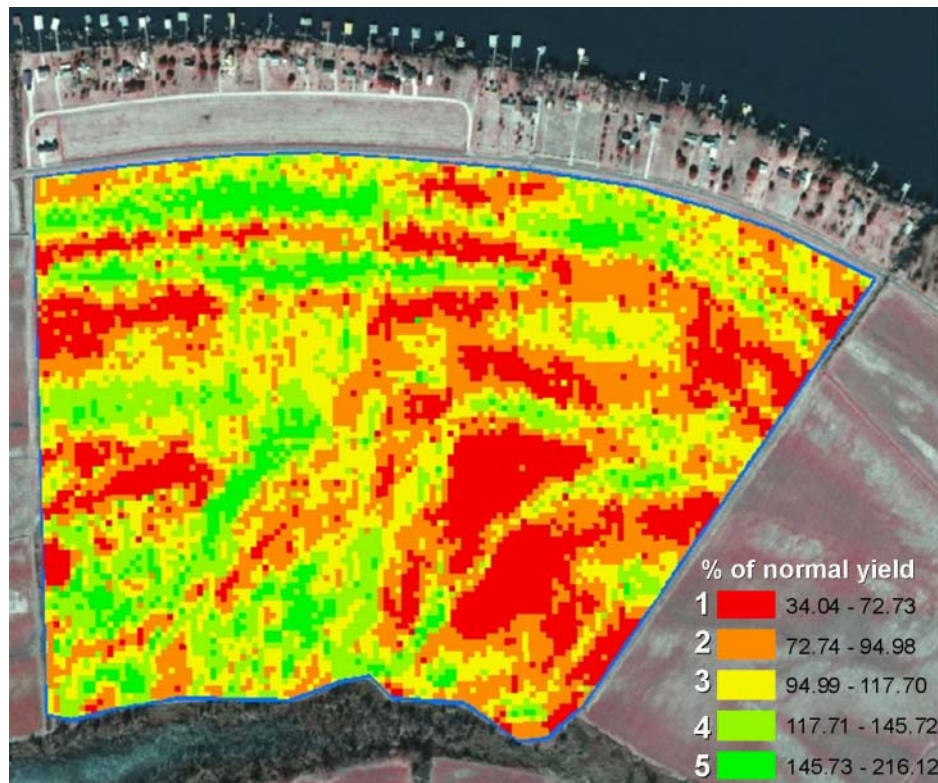


Figure 8. Normalized yield for the Island field based on cotton grown in 2006. Each of the percentage ranges is assigned a value of 1-5.



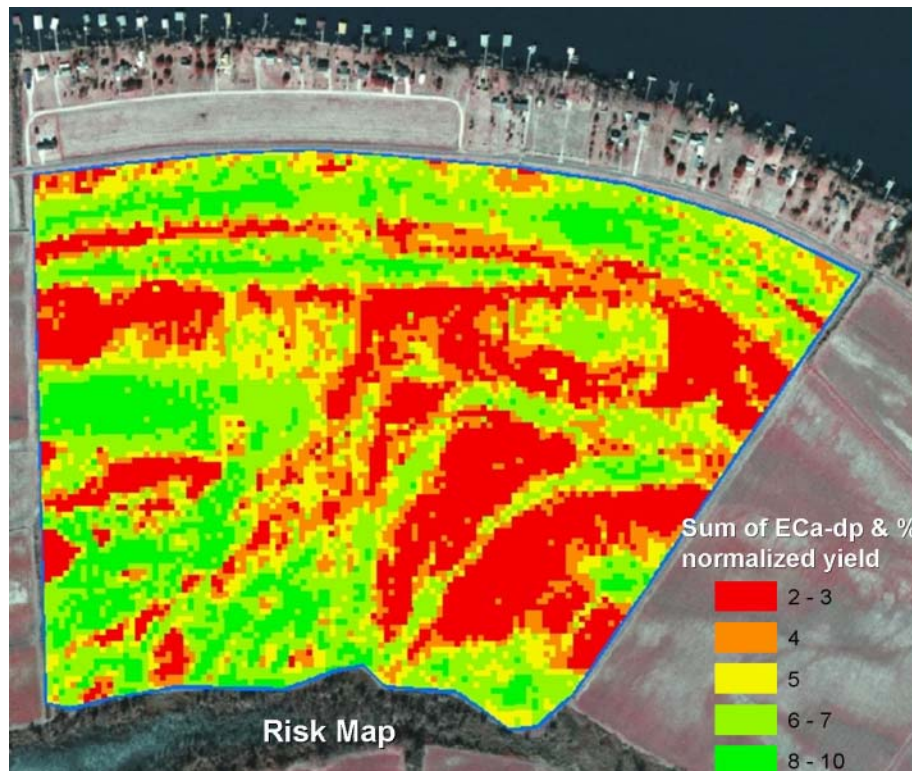


Figure 9. A risk map of the field based on the sum of the ECa-dp values and normalized yield values. Zones in red or orange are the greatest risk from nematode injury and light green and green would be at the least risk.

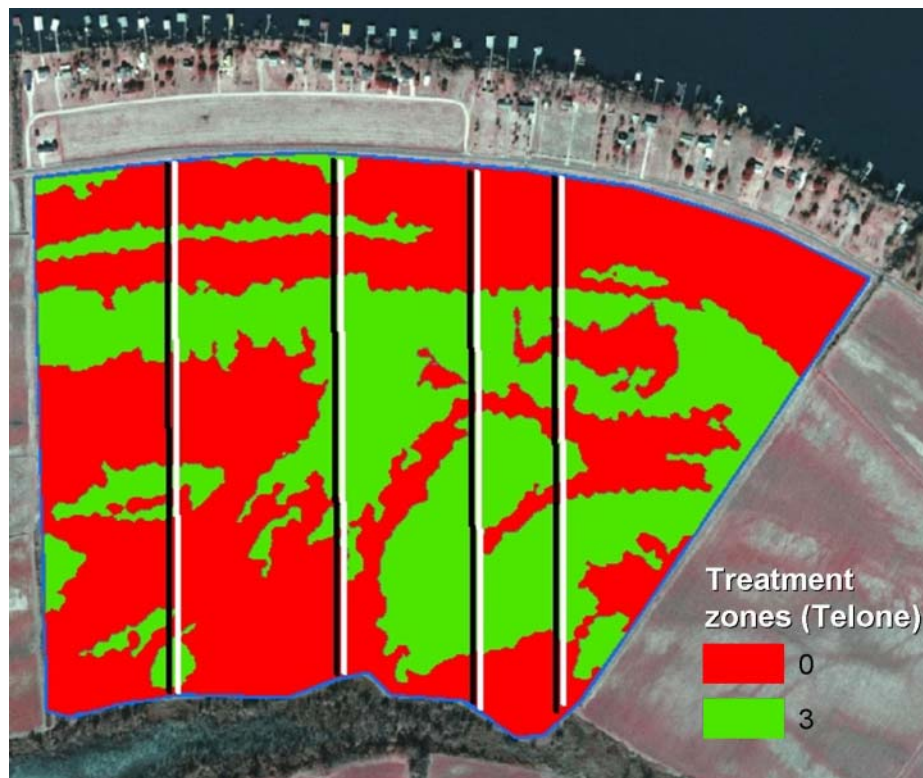


Figure 10. Management zones based on risk. The green areas require a fumigant and the red areas would not need to be treated. The verification strips included : black as continuous Telone and white which did not receive any Telone.



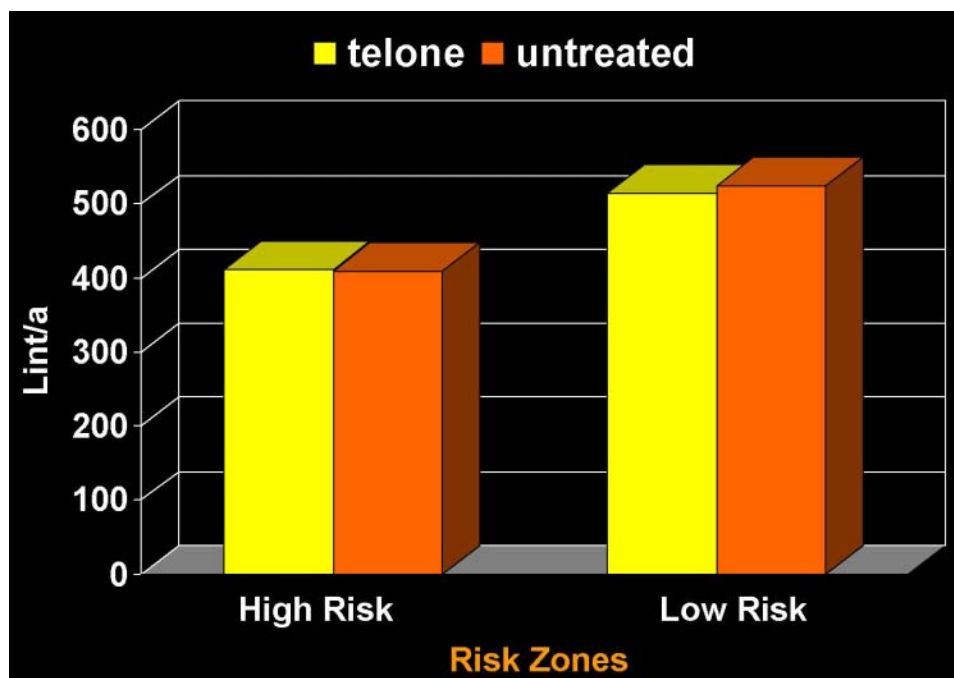


Figure 11. The response of Telone in the two risk zones at the Island field with Panola Plantation.

### Summary

Although the growing season in 2008 may not have been the best for evaluation of different management zone strategies because of weather conditions, the different approaches that were utilized in this study would likely have valuable in a normal year. There currently is not any standard method used to create management zones for nematodes. The best strategy would be to use all the available data that is known about the field in trying to develop treatment zones within a field. Verification strips would certainly be important in evaluation of zones that are created. Producers should be able to adjust the zones based on response or be able to make adjustments in the future depending on commodity and input prices, impacts of crop rotation, or changes with nematode types or populations.

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