RENIFORM NEMATODE SURVEYS IN CENTRAL QUEENSLAND COTTON

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Summary

The reniform nematode is a major constraint to cotton production in the USA. Recent detections in Central Queensland have led to an extensive soil survey of the Theodore district. Reniform nematodes were found to be widespread, inhabiting 72-75% of fields in the northern districts, 49% of sampled fields to the south of Theodore as well as a limited area in Emerald. Although summer/winter fluctuations have been observed, there is some early indication of net population increases between cotton seasons. Further data collection is required to establish economic thresholds to enable prediction of potential yield decrease associated with a population density.

Introduction

The reniform nematode, *Rotylenchulus reniformis* Linford and Oliveira, 1940, was associated with 193 900 bales of yield loss in the 2013 USA cotton crop. In certain states, the proportion of disease-related loss associated with reniform nematode was as high as 45% (National Cotton Council of America 2013). In Australia, this species has been documented in horticultural crops in and north of Bundaberg (J. Cobon, pers. comm., February 5, 2013).

On November 11, 2003, the first detection of this plant parasite in Australian cotton was recorded in a single field in Emerald. No further detections were made until an investigation of stunted plants led to the identification of reniform nematode in Theodore on November 23, 2012. A comprehensive soil survey of Theodore cotton fields was commissioned to map distribution of the pathogen with ongoing data collection to gain an understanding of population dynamics.

This research included a return to Emerald to investigate the current incidence and density of populations at the original site of detection and in surrounding fields. Although the potential for cotton crops outside of Central Queensland to support populations of this tropical/subtropical species is currently unknown, some routine sampling in other Queensland cotton-growing districts will be conducted during cotton disease surveys.

Methodology

A soil survey of all fields used for cotton production in the Theodore district commenced directly after picking of the 2012-2013 crop. As soon as practical following root-cutting and mulching, 100 soil cores were collected per 10 ha of field, using corers with an internal diameter of 17 mm. Cores were extracted from cotton rows to a depth of 15 cm, following a uniform pattern to cover representative areas in each field. For each 10 ha field section, cores were mixed thoroughly and approximately 400 g of soil was sub-sampled into plastic bags for transport at moderate temperature to a nematology laboratory. Extraction of nematodes was achieved through incubation of 200 mL of soil from each sample over 3 days using the Whitehead tray technique (Whitehead and Hemming, 1965). The extract was then examined under a light microscope to identify and count individuals within each plant-parasitic nematode species.

At planting of the following cotton crop (2013-2014 season), a selection of fields across Theodore's central cotton-producing areas (Theodore East, Theodore West and Gibber Gunyah) was sampled again, following the same protocols used in the original postharvest survey (2013). These fields were chosen to obtain a range of reniform nematode population densities (including nil populations) as well as a representation of the local soil types and cultural practices. These fields were sampled for the third time at the end of the season (postharvest 2014).

The same methodology was employed in postharvest sampling in Emerald in 2013 and 2014 and in fields selected because of poor yields in St George, Dirranbandi and

the Darling Downs in the early stages of the 2013-2014 season.

Results and Discussion

Samples for the initial postharvest 2013 survey were collected in order to maximise the probability of detection in fields with relatively small populations, as nematode density will peak at the termination of a host crop (Stetina et al., 2007). Weather-related harvest delays prevented access to 25 fields on properties along the Dawson River (Theodore South). Data collected from accessible fields illustrates a widespread distribution of reniform nematode with 72%, 75%, 72% and 49% of sampled fields infested in Gibber Gunyah, Theodore West, Theodore East and Theodore South respectively.

Figure 1 depicts the number of samples (10 ha field sections) associated with nil detections and with two broad nematode density categories for the four production areas in Theodore. These density categories are used to arbitrarily convey some range of the nematode densities measured and are not associated with a particular level of crop damage. There is a general increase in incidence (decreasing proportion of nil detections) in order of Theodore South, Gibber Gunyah, Theodore West and Theodore East. Although incidence in Theodore South was comparatively low, it should be noted that relatively high densities were detected throughout all four production areas.

The subsequent surveys (pre-plant and postharvest of the 2013-2014 season) were associated with a focus on population dynamics. Figure 2 illustrates the decline and growth of reniform populations observed in Theodore West and Theodore East over the 12 month period of the three surveys. Gibber Gunyah population data (one farm only) is not displayed due to unsatisfactory sampling. The population decline that is seen through winter (from postharvest to pre-plant in 2013) and the sharp rate of increase shown through the following cotton season (2013-2014) is consistent with population flux described

Figure 1. Proportion of soil samples that represent, for each of the four main production areas, a nil presence or populations of less/more than 500 nematodes per 200 mL of Relative Reniform Nematode Incisoil.

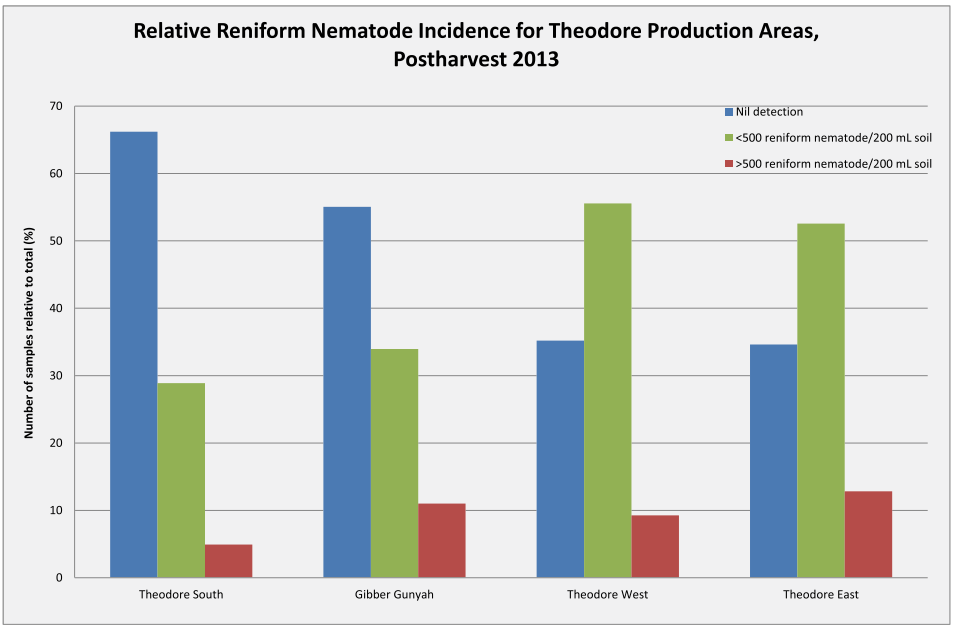
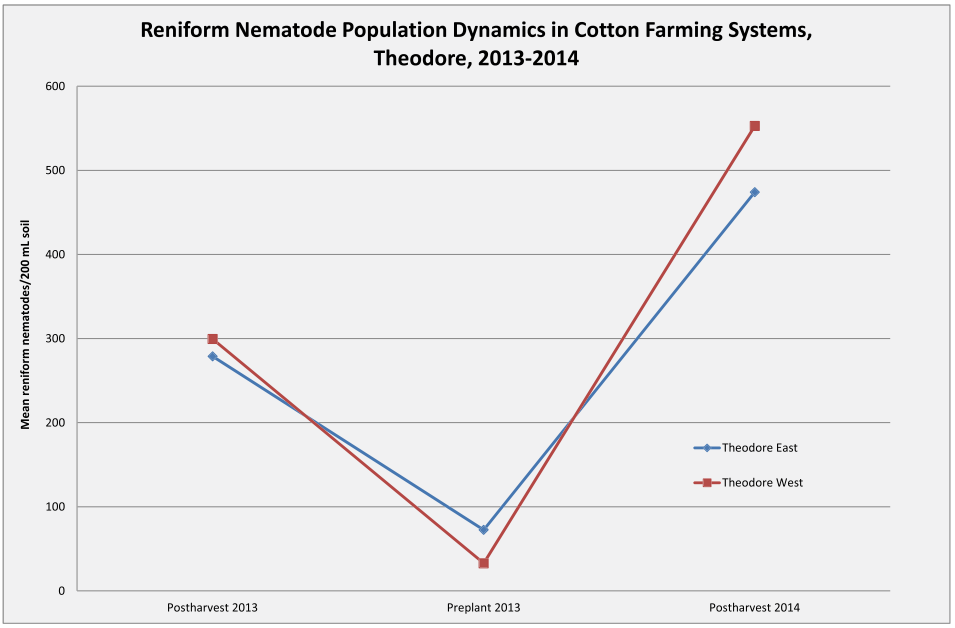


Figure 2. Reniform nematode population decline through the 2013 winter and subsequent increase in the following cotton season.



in the absence and presence of a host crop in USA studies (Davis et al., 2003).

During the winter of 2013, some of the surveyed fields were maintained as bare fallow while others were planted to wheat or chickpea. Although chickpea is generally described as a host and wheat as a non-host crop (Mahapatra and Padhi, 1986; Birchfield, 1983), the difference in population decline between fallow (73.11%), chickpea (74.05%) and wheat (77.04%) was not statistically significant. The lack of reproduction observed on chickpea poses the question: do winter soil temperatures in Theodore restrict the nematode from infesting a host crop? This will be investigated in future research.

A comparison of postharvest sampling results between years is relevant in understanding the long-term trend in population dynamics. Although significant, annual fluctuations are evident in Figure 2; the increase between postharvest values for 2013 and 2014 (approximately 77%) indicates a potential trend of increase in a larger time-frame.

Reniform nematode populations have been confirmed in a relatively small number of fields in Emerald. Further survey work is required in this district to define the extent of distribution. At the time of submitting this paper, none of the diagnostic samples provided from fields outside of Central Queensland have tested positive for reniform nematode.

Conclusion

Future research will focus on management strategies. Collection of population data and correlation with yield data will enable the generation of population thresholds as a tool for effective, economic management. The tolerance/resistance of cotton and rotation crop cultivars will be examined and the industry value of crop rotation and various other treatments will also be assessed.

While further recommendations are pending, best practice management should primarily minimise nematode movement in transported soil and exposure to host plants. This can be achieved by following the measures outlined in industry's "Come Clean, Go Clean" campaign and farm hygiene recommendations, including timely and effective postharvest root-cutting and control of volunteer cotton plants.

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