Using rotations to reduce black root rot

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Black root rot of cotton has been observed on most farms in the Macquarie, Namoi, Gwydir and Macintyre valleys. It is causing high yield losses in the cooler areas where continuous cultivation of cotton is followed.

The disease develops over time when the fungus Thielaviopsis basicola is present in adequate amount where cotton is grown in an environment favorable for infection.

There are various management options including crop rotation that when integrated can reduce the disease severity to a large extent.

Recent drought conditions and water constraints are compelling growers to reschedule cropping sequences on cotton farms. In light of these constraints, it is possible that many growers would be planning rotations with low water-use crops. In such a situation, it would be worth trying crops which can reduce T.basicola spore population and disease severity.

Most winter legumes are known to be host for T. basicola and cotton growers should avoid planting these crops in severely infested fields. Summer legumes are also host for the pathogen but can escape infection if planted late in the season in warmer conditions.

Cereal crops are not host for the black root rot fungus and will not increase the disease severity. But rotation with cereal for a single season will not reduce the pathogen population enough to reduce disease severity in the following cotton crop.

This is mainly because resting spores close to the roots of cotton can infect and produce microconidia for secondary infection within 2.5 days. So infection can soon return to the level that would occur under continuous cotton growing.

In preliminary research, the population of T. basicola in a severely infested field was reduced dramatically by three consecutive years of wheat, but a single rotation had no effect. The disease severity was very low in three years of continuous wheat even after two years of continuous cotton (Figure.1). But it is not yet

FIGURE 1: Cotton rotated with three years of continuous wheat has significantly low disease severity in second year of continuous cotton

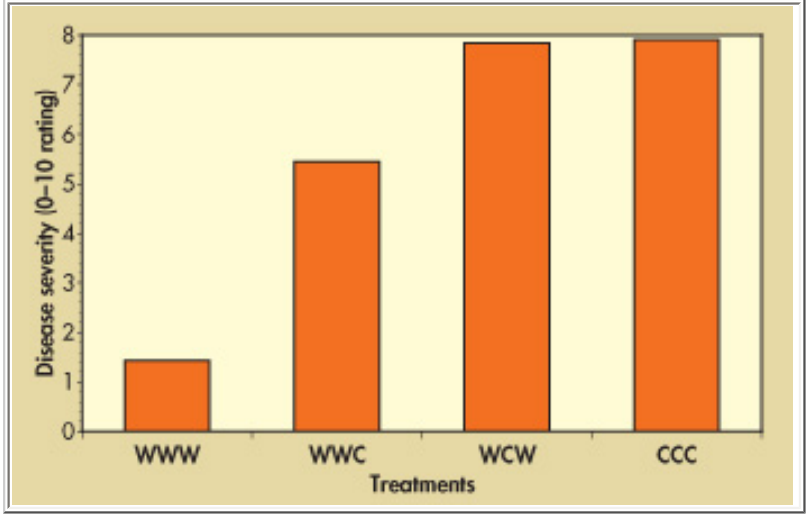
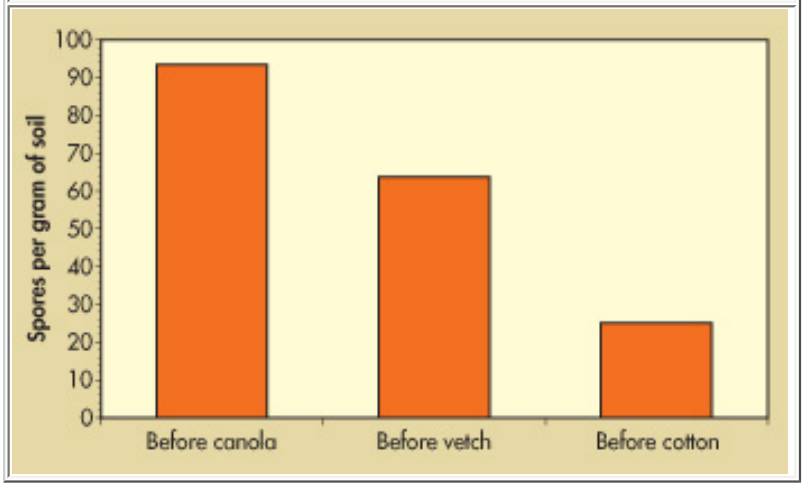


FIGURE 2: Rotation with canola followed by vetch biofumigation has reduced T. basicola spore population



known whether the effect is similar for all soil types.

Biofumigation

Biofumigation involves growing crops that release substances that are toxic to the pathogen. These crops are incorporated into the soil and produce volatile substances that either kill or suppress the fungus. Canola, vetch or mustard can be used as biofumigants for T. basicola.

Mustard and canola release isothiocyanates that may decrease the population of soilborne pathogens. When vetch is incorporated into soil, its breakdown can release ammonia levels sufficient to kill T. basicola while it also provides nitrogen to the subsequent cotton crop. In a preliminary study on one-year rotation with canola followed by vetch, T. basicola spore population was reduced to very low level (Figure 2).

Growing rotation crops like canola that also have a biofumigation effect followed by a cereal crop would additionally increase the time that the remaining spores of T. basicola would have to survive until the next cotton crop and provide good soil structure and microbial diversity in addition to economic yield. Growing biofumigation crops for two years followed by a winter cover crop in a severely infested field may reduce the T. basicola population to a large extent.

Solarisation using polyethylene sheets can also reduce the spore population. Clear polyethylene can increase the soil temperature up to 10°C during daytime.

There is biodegradable polyethylene available in the market that would be easy to handle. When applied in conjunction with incorporation of biofumigation crops, it could accelerate anaerobic reactions and produce gases that may be toxic to the pathogen.

This practice can be adopted in fields where growers do not want a long-term rotation. This technique has been tried elsewhere for other crops — but the polyethene sheets are expensive and the system needs testing for its feasibility and affordability to control T. basicola in Australian conditions.

Adopting these practices this winter would certainly be a step towards reduced black root rot severity and increased cotton production with additional income from rotation crops.

Severity of black root rot was reduced dramatically after three years of wheat, but a single rotation had no effect.