Necrotrophic News 1

An occasional newsletter from the Australian Centre for Necrotrophic Fungal Pathogens.

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The purpose of this newsletter is to optimise communication between the ACNFP and the user community. To avoid clogging up in-boxes unnecessarily, I will endeavour to send only to those people with a direct interest in the current material. You are welcome to forward to anyone interested. We are also interested to have any feedback.

100,000 doses of ToxA distributed to breeders

ToxA is a small protein produced by the fungus *Stagonospora nodorum* (cause of Stagonospora nodorum blotch/SNB, a.k.a Glume Blotch and Septoria nodorum blotch) as well as the fungus *Pyrenophora tritici-repentis*, cause of Yellow (Leaf) Spot. The protein interacts with wheat lines that express the gene *Tsn1.* ToxA-sensitive wheat lines are significantly more susceptible to both diseases. Dominant *Tsn1* alleles are normally highly significant for both SNB and Yellow Spot in both the seedling and adult plant stages. The degree of variance associated with *Tsn1* ranges from undetectable in some studies, to up to 68% or more (Faris and Friesen, 2009; Lamari and Bernier, 1989, 1991; Friesen *et al*., 2003; Cheong *et al*., 2004) indicating that host background is important.

It seems that all Australian isolates of both these pathogens produce ToxA. Studies in Australia involving isolate samples greater than 100 of both species have shown that all produce ToxA, whereas many populations overseas have a very low prevalence of ToxA. The worldwide average is 40% for SNB and 70% for YS. Therefore, the ToxA-Tsn1 system is likely to be a highly significant factor in both wheat diseases in all affected areas.

Although SSR markers closely linked to Tsn1 have been available for some time, the use of ToxA has several advantages. The test is easy to perform; staff can infiltrate several hundred wheat lines each day; the plants can be infiltrated in the lab, glasshouse or field; the age of the plant is not important as long as recently emerged leaves are used; the test is non-destructive; affected leaves are easily identified and can be removed or marked as appropriate. Sensitivity to ToxA can be thought of as a perfect, albeit phenotypic marker for Tsn1.

ToxA is being made freely available to wheat breeders and pre-breeders as part of a joint project with the ACNFP to determine the effect that removal of sensitive alleles of *Tsn1* has on the susceptibility of new breeding lines.

Will SNB and YS evolve to outflank the use of ToxA in breeding programs?

Biotrophic pathogens such as rusts and mildews readily evolve to overcome new resistance genes in cultivars – the familiar boom and bust cycle. Will SNB and YS likewise evolve to lose ToxA? We don't know. Unlike the situation with biotrophs, where losing a gene that causes resistance allows it to flourish on lines carrying that resistance gene, loss of ToxA would be expected to have a negative effect on wheat lines carrying *Tsn1* and a neutral effect on other wheat lines. Nonetheless there are many isolates that cause disease but lack ToxA. Therefore, we are testing the ToxA genotype of SNB and YS isolates. We are doing this in collaboration with Geoff Thomas. He has a trial in which he grows Wyalkatchem (insensitive) and Yitpi (sensitive) on infected straw of both cultivars. Pathogens isolated from Wyalkatchem grown on Wyalkatchem would be expected to have the highest selection pressure to evolve loss of ToxA if such a loss conferred any benefit.

ToxB appears to be absent in Australian YS isolates

Research from North America has identified three host-specific toxins produced by isolates of YS; ToxA and ToxB are both small proteins and their genes have been identified; ToxC is a low molecular weight compound and not well characterized. ToxB interacts with a wheat gene called Tsc2, in a manner analogous to the interaction of ToxA and the product of Tsn1. Markers for Tsc2 are known and the ToxB protein can be produced in yeast cells. Thus it would be straightforward to implement a strategy to identify Tsc2-expressing wheat lines and eliminate them from breeders' populations. To determine whether this was worth doing, we assayed over 100 YS isolates from QLD, VIC, NSW and WA for ToxB. None had the gene, so we can be confident that ToxB is rare or even absent. There is no current need implement this strategy, though we have the reagents ready to deploy. This does mean however, that ToxB-containing YS represents a significant incursion threat and should be regarded as a quarantine risk.

The ACNFP is prioritizing the isolation of further toxins from both YS and SNB. Isolates with new specificities and wheat lines segregating for sensitivities have been found, and appear to correlate well with overall YS and SNB resistance scores.

Which current cultivars are sensitive to ToxA?

We have screened a large number of wheat cultivars used in WA and elsewhere in Australia. The table overleaf lists the reaction to ToxA (1 = sensitive; 0 = insensitive; 0/1 indicates the variety is mixed; ? = unknown). We also list the numerical cultivar score given by DAFWA (1 = VS; 9 = immune). We would urge growers to avoid the use of cultivars that are resistant to SNB or YS if the pathogen is prevalent in their area. Furthermore, we would suggest that growers avoid the use of ToxA sensitive cultivars as we expect this would exert a strong downward pressure on the over-summering inoculum levels of both pathogens.

Nomenclature issues

Both diseases and the pathogens have a bewildering number of names. Australia is the only country that has used the name Yellow Spot for Pyrenophora's disease, and even then, some pathologists call it Yellow Leaf Spot. Our suggestion that it be referred to as Tan Spot has accepted by the Australasian Society for Plant Pathology and so that's the name we will use from now on. It makes sense when the resistance genes are abbreviated Tsn (Tan spot necrosis) and Tsc (Tan spot chlorosis).

Variety	Sn Resist. Score	YS Resist. Score	ToxA Sensitivity
AGT Scythe	5	3	1
Annuello	5	5	1
Arrino	4	3	0/1
Axe	3	1	1
Binnu	3	2	0/1
Blade	6	5	0
Bolac	5	2	1
Braewood	4	3	0/1
Bullaring	4	2	1
Bumper	4	5	0
Cadoux	6	3	1
Calingiri	4	5	0/1
Camm	5	3	1
Carinya	4	5	1
Carnamah	5	6	0
Cascades	4	6	0
Catalina	4	4	1
Clearfield JNZ	5	5	1
Clearfield STL	3	3	1
Correll	4	2	0/1
Datatine	4	3	1
Derrimut	2	3	1
EGA 2248	4	2	1
EGA Bonnie Rock	4	6	0
EGA Bounty	?	7	0
EGA Eagle Rock	6	3	0
EGA Gregory	5	2	1
EGA Jitarning	6	2	1
EGA Wentworth	4	3	1
Ellison	?	6	0
Endure	?	1	1

Variety	Sn Resist. Score	YS Resist. Score	ToxA Sensitivity
Eradu	3	3	1
Espada	3	4	1
Fang	6	2	0
Fortune	5	4	0
Frame	5	3	1
GBA Ruby	?	7	0
GBA Sapphire	5	3	1
Gladius	5	6	1
Guardian	?	6	1
H45	3	7	0
H46	5	6	0
Halberd	2	2	0/1
Jandaroi	2	6	0
Janz	5	2	0/1
Lincoln	3	4	0
Mace	?	6	0
Machete	5	3	0
Magenta	6	7	0
Mitre	4	2	1
Sentinel	5	5	1
Spear	5	2	1
Stiletto	5	3	1
Tammarin Rock	3	2	1
Tincurrin	3	2	1
Westonia	3	4	0
Wilgoyne	3	3	1
Wyalkatchem	3	7	0
Yandanooka	5	3	0
Yitpi	6	3	1
Young	3	4	0
Zippy	2	2	1