# *Living with the cereal killers of New South Wales*

*A four-year journey with NSW-DPI Wagga Wagga*


Dante L. Adorada
Research Plant Pathologist

# Research Plant Pathologist (PO 1)

1. Summaries for irrigated winter cereals
   G x E trials (BIO FIRST project):
   Triticale, Barley, Wheat, Durum
2. Winter cereals plant disease diagnosis
3. Septoria tritici blotch (STB) fungicide resistance project (*RDE120-2*)

# PO 1: Output (publications)

**CSIRO** PUBLISHING

*Crop & Pasture Science*, 2014, **65**, 411–422
http://dx.doi.org/10.1071/CP13431

## Durum wheat quality in high-input irrigation systems in south-eastern Australia

*Mike Sissons*[A,D], *Ben Ovenden*[B], *Dante Adorada*[C], *and Andrew Milgate*[C]

**CSIRO** PUBLISHING

*Crop & Pasture Science*, 2015, **66**, 782–792
http://dx.doi.org/10.1071/CP14357

Profesional Officer 1

## Genetic improvement of triticale for irrigated systems in south-eastern Australia: a study of genotype and genotype × environment interactions

*Andrew Milgate*[A,E], *Ben Ovenden*[B], *Dante Adorada*[A], *Chris Lisle*[C], *John Lacy*[B,D], *and Neil Coombes*[A]

# PO 1: STB fungicide resistance bioassay

Editor-in-Chief: Alison E. Robertson
Published by The American Phytopathological Society



February 2016, Volume 100, Number 2
Page 522

http://dx.doi.org/10.1094/PDIS-06-15-0704-PDN

DISEASE NOTES

## First Report of Resistance to DMI Fungicides in Australian Populations of the Wheat Pathogen *Zymoseptoria tritici*

**A. Milgate**, **D. Adorada**, and **B. Orchard**, Department of Primary Industries, Wagga Wagga Agricultural Institute, Wagga Wagga 2650, NSW, Australia; and **J. Pattemore**, Graham Centre for Agricultural Innovation, School of Agricultural and Wine Sciences, Charles Sturt University, Wagga Wagga 2650, NSW, Australia.

Paper (2nd draft):
Can optical density estimate (OD) *Zymoseptoria tritici* spore concentration?

# Research Plant Pathologist (PO 2)

National Variety Trials (NVT) for Wheat and Barley - *RDE181-1*

National Barley Foliar Pathogen Variety Improvement Programme (NBFPVIP) - *RDE122-1*

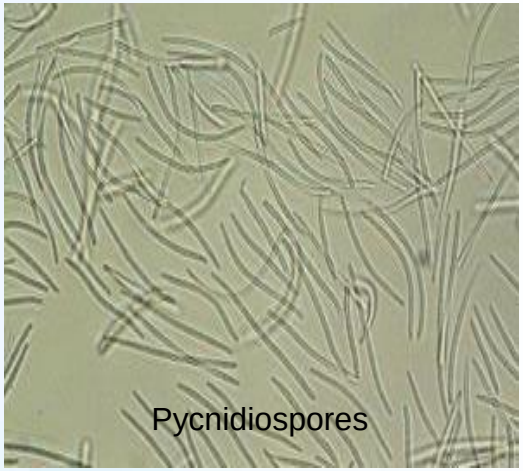
Integrated Disease Management (IDM): Plant Disease Surveillance and Diagnosis - *RDE 120-1*

# NVT Wheat

Objective: Generate knowledge/information on the phenotypes of nominated wheat lines for **adult plant resistance** to major foliar diseases naturally occurring in different regions of NSW

Pycnidia

Septoria tritici Blotch (STB) *(Zymoseptoria tritici)*



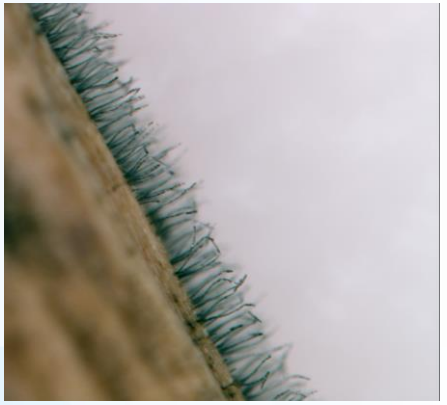
Pycnidiospores

# NVT Wheat

*Source: H. Wallwork*

Yellow leaf spot
*Pyrenophora tritici-repentis*





# NVT Wheat

Stripe rust (Yr)
*P. striiformis* var. *striiformis*



https://en.wikipedia.org/wiki/Stem_rust

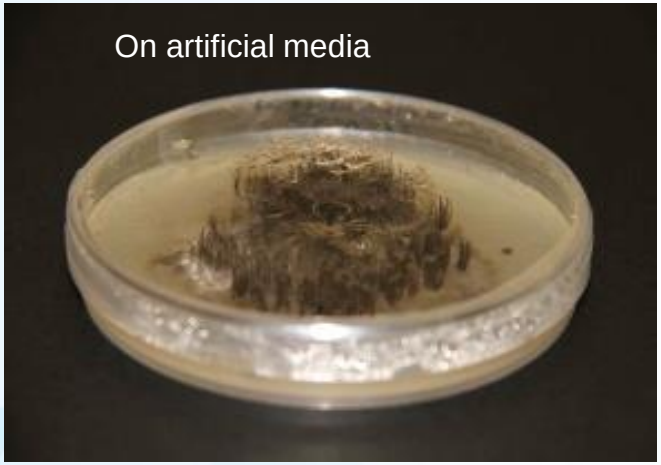
# NVT Barley

Objective: Generate knowledge/information on the phenotypes of nominated barley lines for **adult plant resistance** to major foliar diseases naturally occurring in different regions of NSW

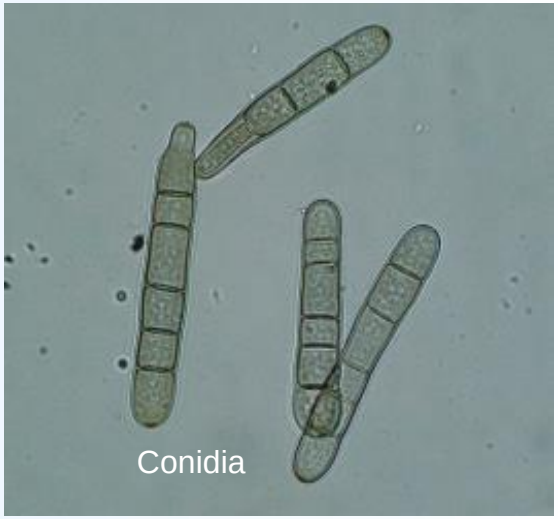
Leaf scald
*Rhynchosporium commune*


# NVT Barley

Spot-form of net blotch (SFNB)
*Pyrenophora teres* f. sp. *maculata*



# NVT Barley




Net-form of net blotch (NFNB)
*Pyrenophora teres* f. sp. *teres*

# NVT Barley

www.google.com

Leaf rust
*Puccinia hordei*


Powdery mildew
*Blumeria graminis* f. sp. *hordei*

# NBFPVIP

Objective: To identify sources of resistance from breeder lines to major barley diseases

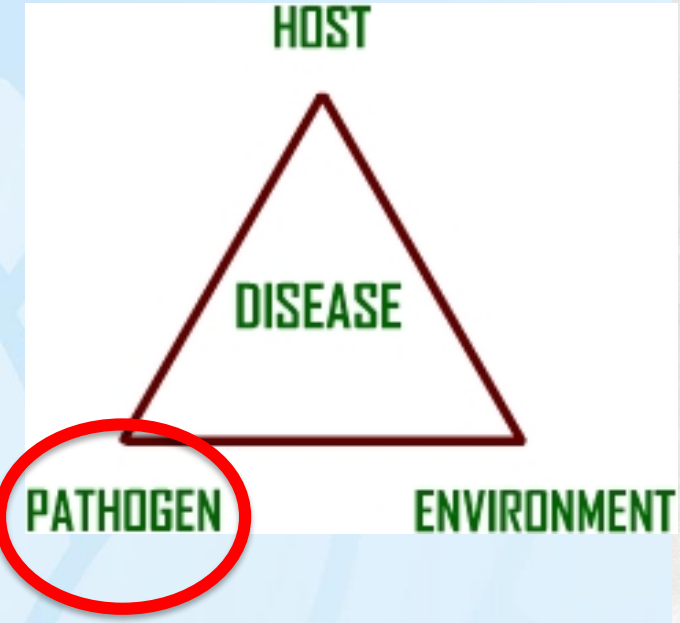
- EBDSN (Elite Barley Disease Nurseries)
- CAIGE (CIMMYT Australia ICARDA Germplasm Evaluation) Project
- Mapping populations (Uni of Syd DH, Qld S2 population)

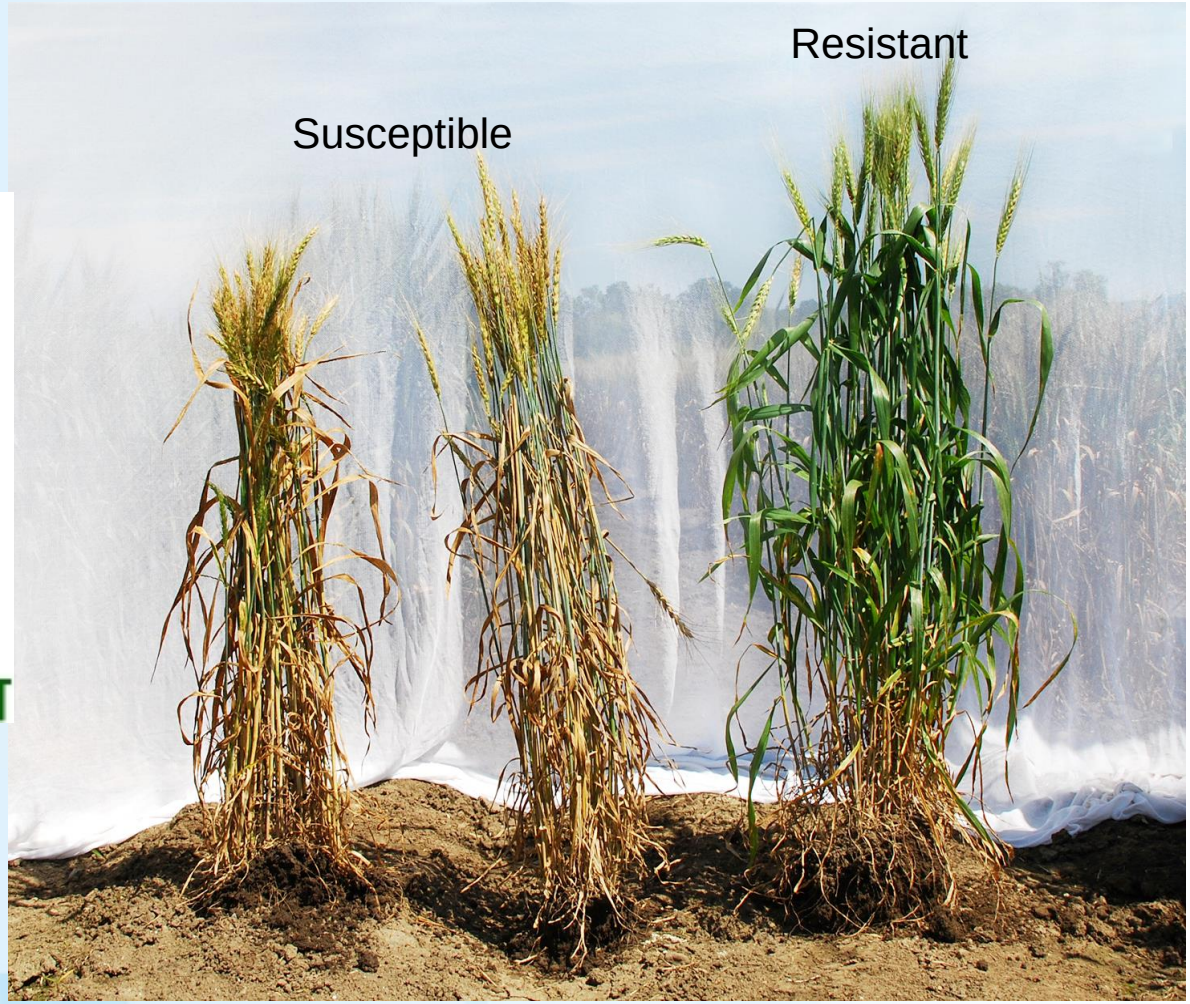
# Miscellaneous entries

“Fee for service” disease evaluation for private breeding companies:

- Seedforce
- Intergrain
- Dow
- AGT
- Longreach

# Disease nursery establishment



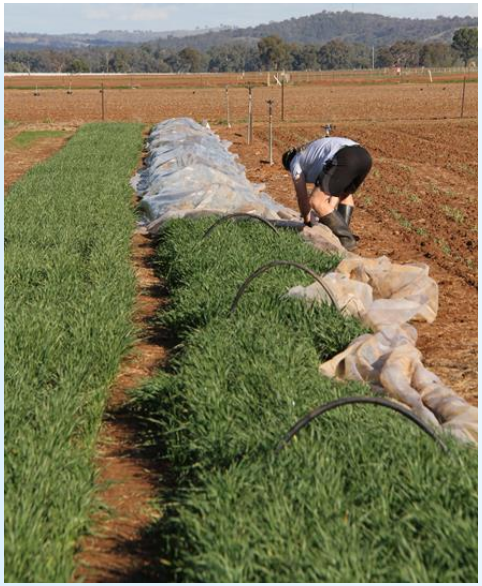




https://www.flickr.com/photos/cimmyt/6508078617/in/photostream/

# Wheat STB inoculation

# Wheat YLS nursery

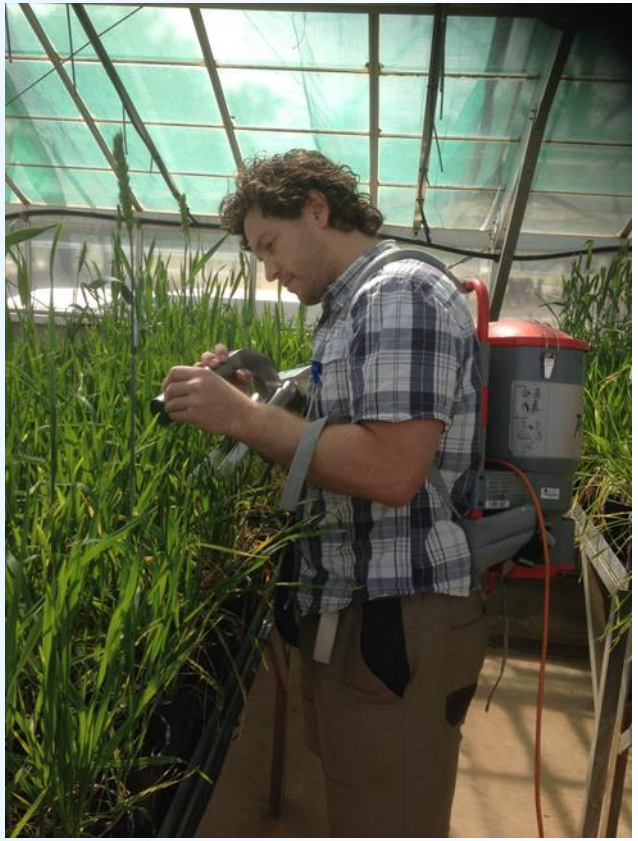
# Barley SFNB & NFNB inoculation



# Barley scald nursery

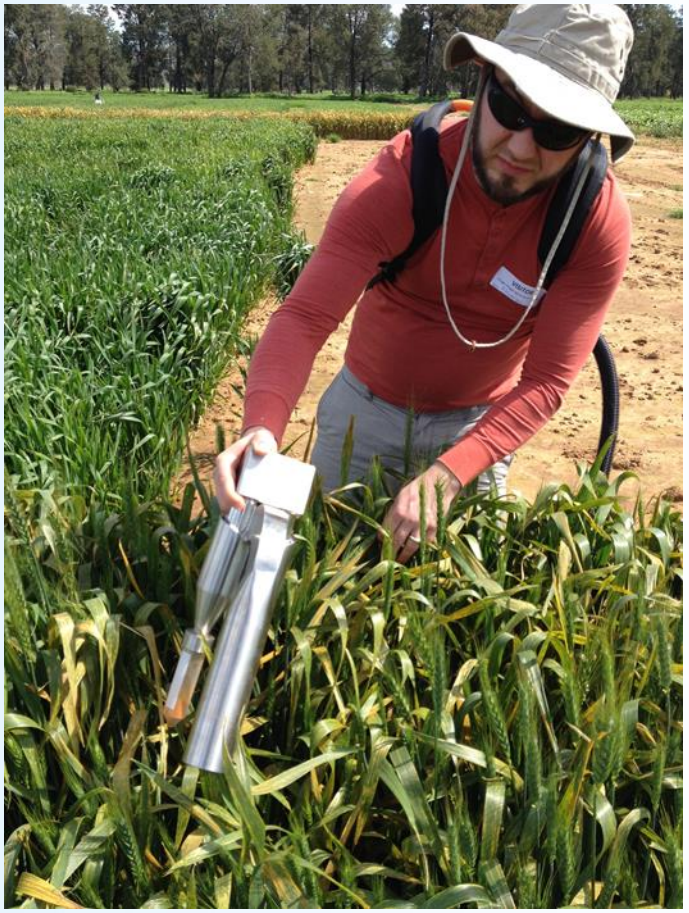
# WLr and BLr spore multiplication

Inoculation



Spore collection

# Wheat Yr spore collection



Benjamin (PostDoc, ANU)

# Materials sown for evaluation in 2016

| Program | Location | Paddock Loc | Crop | Trial type | DATE SOWN | Entries Received | replicates | Number plot (excl buffers)Total Plots | |
|---|---|---|---|---|---|---|---|---|---|
| NVT Wheat LR | WWAI | Birdcage | Wheat | LR | | 186 | 3 | 558 | |
| NVT Barley Lr | WWAI | Birdcage | Barley | LR | | 72 | 3 | 216 | |
| Seedforce Wheat | WWAI | Birdcage | Wheat | LR | | 9 | 3 | 27 | |
| Seedforce Barley | WWAI | Birdcage | Barley | LR | | 7 | 3 | 21 | |
| | | | | | | | | | |
| Pathology Seed Increase Barley | WWAI | 6-West | Barley | Seed Increas | 2.6.16 | 42 | 3 | 126 | |
| | | | | | | | | | |
| NFNB DIFF SET | WWAI | 6-West | Barley | NFNB | 16.5.16 | 31 | 3 | 93 | |
| NVT NFNB | WWAI | 6-West | Barley | NFNB | 16.5.16 | 72 | 3 | 216 | |
| Seedforce | WWAI | 6-West | Barley | NFNB | 16.5.16 | 7 | 3 | 21 | |
| EBDSN NFNB | WWAI | 6-West | Barley | NFNB | 16.5.16 | 136 | 3 | 408 | |
| | | | | | | | | | |
| Patty/Tallon DH | WWAI | Pivot | Barley | Scald | 4.5.16 | 99 | 3 | 300 | |
| Yerong/Franklin D.H | WWAI | Pivot | Barley | Scald | 4.5.16 | 189 | 3 | 567 | |
| Tallon/Scarlett D.H | WWAI | Pivot | Barley | Scald | 4.5.16 | 182 | 3 | 552 | |
| SCALD DIFF SET | WWAI | Pivot | Barley | Scald | 4.5.16 | 34 | 3 | 102 | |
| NVT Scald | WWAI | Pivot | Barley | Scald | 4.5.16 | 72 | 3 | 216 | |
| Seedforce | WWAI | Pivot | Barley | Scald | 4.5.16 | 7 | 3 | 21 | |
| Intergrain | WWAI | Pivot | Barley | Scald | 4.5.16 | 983 | 1 | 983 | |
| EBDSN Scald | WWAI | Pivot | Barley | Scald | 4.5.16 | 136 | 3 | 408 | |
| QLD S2 Scald | WWAI | Pivot | Barley | Scald | 4.5.16 | 230 | 2 | 460 | |
| | | | | | | | | | |
| STB Association Population | WWAI | Pivot | Wheat | STB | 28.4.16 | 336 | 3 | 1008 | B |
| Diamondbird/Janz Pop | WWAI | Pivot | Wheat | STB | 28.4.16 | 240 | 3 | 720 | B |
| Caige | WWAI | Pivot | Wheat | STB | 28.4.16 | 292 | 3 | 876 | B |
| AGT | WWAI | Pivot | Wheat | STB | 28.4.16 | 649 | 1 | 649 | B |
| NVT STB | WWAI | Pivot | Wheat | STB | 28.4.16 | 186 | 3 | 558 | B |
| STB DIFF SET | WWAI | Pivot | Wheat | STB | 28.4.16 | 18 | 3 | 54 | B |
| Dow STB | WWAI | Pivot | Wheat | STB | 28.4.16 | 24 | 3 | 72 | B |
| Seedforce | WWAI | Pivot | Wheat | STB | 28.4.16 | 9 | 3 | 27 | B |
| | | | | | | | | | |
| SFNB DIFF SET | WWAI | G-Block | Barley | SFNB | 16.5.16 | 38 | 3 | 114 | |
| NVT SFNB | WWAI | G-Block | Barley | SFNB | 16.5.16 | 72 | 3 | 216 | |
| Seedforce | WWAI | G-Block | Barley | SFNB | 16.5.16 | 7 | 3 | 21 | |
| EBDSN SFNB | WWAI | G-Block | Barley | SFNB | 16.5.16 | 136 | 3 | 408 | |
| | | | | | | | | | |
| NVT YLS | WWAI | G-Block | Wheat | YLS | 16.5.16 | 186 | 3 | 558 | |
| Dow YLS | WWAI | G-Block | Wheat | YLS | 16.5.16 | 24 | 3 | 72 | |
| Seedforce | WWAI | G-Block | Wheat | YLS | 16.5.16 | 9 | 3 | 27 | |
| | | | | | | | | | |
| NVT TOS1 | WWAI | Lateral | Wheat | YR | 4.5.16 | 186 | 3 | 558 | |
| NVT TOS2 | WWAI | Lateral | Wheat | YR | 2.6.16 | 186 | 3 | 558 | |
| Seedforce | WWAI | Lateral | Wheat | YR | 16.5.16 | 9 | 3 | 27 | |
| | | | | | | 5101 | | 11818 | |

Name of program

# Centre Pivot – STB & Scald Nursery 2015

# Disease monitoring & scoring

- Start monitoring on 1st week of Sept (Zad31)
- Start scoring approx. 4.5 mo. after sowing (Zad49)
- NVT & Differential lines (3 rdgs)
- Other nurseries (2 rdgs – Sept & Oct)
- Scald scoring in Oct. & Nov.
- August or September, rusts can be put out in the field, evaluated in Nov & Dec

# Disease rating scale (1-9):

| Disease Level | Score |
|---|---|
| Flagleaf | 7, 8, 9 (7=5%, 8=20%, 9=≥60%) |
| Flagleaf (-1) | 6, 7 |
| Flagleaf (-2) | 5, 6 |
| Flagleaf (-3) | 4, 5 |
| Flagleaf (-4) | 3, 4 |
| Flagleaf (-5) | 1, 2, 3 |

# Rating

1 - Resistant (R)
2 - Resistant to Moderately Resistant (RMR)
3 - Moderately Resistant (MR)
4 - Moderately Resistant to Moderately Susceptible (MRMS)
5 - Moderately Susceptible (MS)
6 - Moderately Susceptible to Susceptible (MSS)
7 - Susceptible (S)
8 - Susceptible to Very Susceptible (SVS)
9 - Very Susceptible (VS)

# NVT Data management

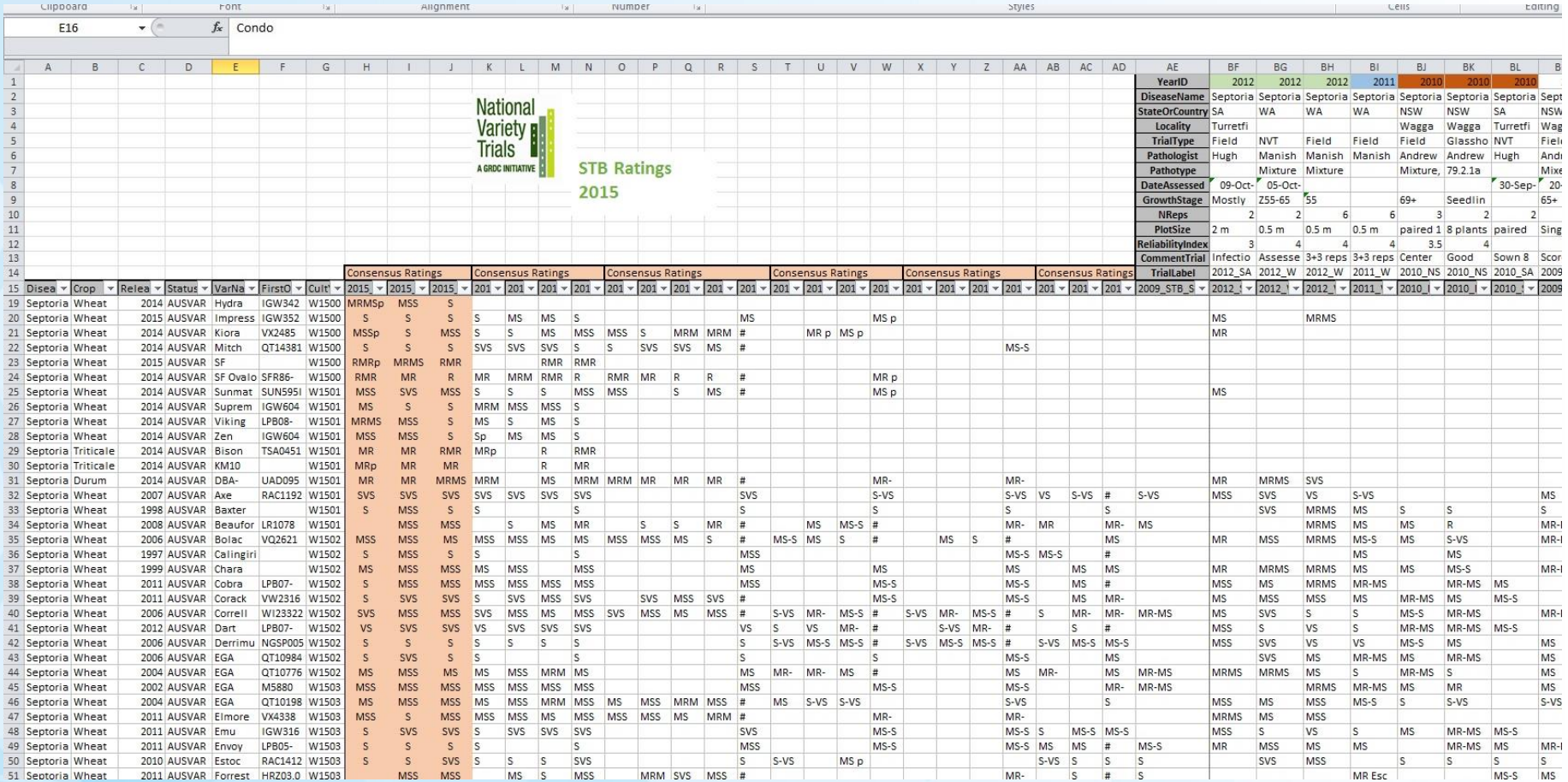
- Summary of data is submitted to NSW NVT coordinator by **30th of November**

P185

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | State/location | | NSW | NSW | NSW | | NSW | NSW |
| 2 | | See Example spreadsheet on how to layout results. In most cases two tabs need to be completed: 1. Raw data 2. Summary data | | | | | Details of trial location, disease development, Assessor | | Centre Pivot Wagga Wagga STB nursery, early score on good epidemic, scored 22/09, D. Adorada and A. Milgate | Centre Pivot Wagga Wagga STB nursery, Good epidemic, scored 16/10/15, D. Adorada and A. Milgate | Centre Pivot Wagga Wagga STB nursery, Excellent epidemic, scored 30/10/15, D. Adorada and A. Milgate | | Seedling stage evaluation, Trial1, Glasshouse WWAI, 24/06/15, 1-5 scale, 2 replication, D. Adorada & A. Milgate | Seedling stage evaluation, Trial2, Glasshouse WWAI, 03/08/15, 1-5 scale, 2 replication, D. Adorada & A. Milgate |
| 3 | | | | | | | Strain: | | 79.2.1a (WAI332) | 79.2.1a (WAI332) | 79.2.1a (WAI332) | | 79.2.1a (WAI332) | 79.2.1a (WAI332) |
| 4 | | | | | | | Growth stage: | | 32-59 | 46-74 | 67-74+ | | Seedling | Seedling |
| 5 | | | | | | | No of reps: | | 3 | 3 | 3 | | 2 | 2 |
| 6 | | | | | | | Plot/row size: | | 1.2m paired row | 1.2m paired row | 1.2m paired row | | 4 plants per rep | 4 plants per rep |
| 7 | | | | | | | Reliability Index | | 3 | 4 | 4 | | 4 | 4 |
| 8 | Crop | Variety Name | Other Name | Year | NVT/AUSVAR | 2013Pathology | | | Summary (1st Eval'n) | Summary (2nd Eval'n) | Summary (3rd Eval'n) | | Summary (Trial1) | Summary (Trial2) |
| 9 | Wheat | Condo | VX1634 | 2014 | AUSVAR FIRST | W15001 | | | MSS | MSS | S | | MR | MR |
| 10 | Wheat | Cosmick | IGW3423 | 2014 | AUSVAR FIRST | W15002 | | | MSS | MSS | MSS | | MS | MR |
| 11 | Wheat | Einstein | | 2012 | AUSVAR FIRST | W15003 | | | MS | MR | MS | | R | R |
| 12 | Wheat | Hydra | IGW3422 | 2014 | AUSVAR FIRST | W15004 | | | MSS | MSS | S | | S | MS |
| 13 | Wheat | Impress CL plus | IGW3526 | 2014 | AUSVAR FIRST | W15005 | | | MS | MS | MSS | | R | MR |
| 14 | Wheat | Kiora | VX2485 | 2014 | AUSVAR FIRST | W15006 | | | MRMS | RMR | MRMS | | R | MR |
| 15 | Wheat | Mitch | QT14381 | 2014 | AUSVAR FIRST | W15007 | | | MS | MRMS | MSS | | MS | MR |
| 16 | Wheat | SF Hekto | | | AUSVAR FIRST | W15008 | | | MRMS | RMR | MR | | R | R |
| 17 | Wheat | SF Ovalo | SFR86-016 | | AUSVAR FIRST | W15009 | | | RMR | RMR | RMR | | R | MR |
| 18 | Wheat | Sunmate | SUN595I | 2014 | AUSVAR FIRST | W15010 | | | MSS | MRMS | MS | | MR | MR |
| 19 | Wheat | Supreme | IGW6042 | 2014 | AUSVAR FIRST | W15011 | | | MS | MS | S | | R | MR |
| 20 | Wheat | Viking | LPB08-0079 | 2014 | AUSVAR FIRST | W15012 | | | MS | MS | MS | | S | MS |
| 21 | Wheat | Zen | IGW6046 | 2014 | AUSVAR FIRST | W15013 | | | MS | MS | MS | | R | MS |
| 22 | Triticale | Bison | TSA0451 | 2014 | AUSVAR FIRST | W15014 | | | MR | RMR | RMR | | R | R |
| 23 | Triticale | KM10 | | 2014 | AUSVAR FIRST | W15015 | | | MRMS | MS | MSS | | MR | R |
| 24 | Durum | DBA-Aurora | UAD0951096 | 2014 | AUSVAR FIRST | W15016 | | | MRMS | RMR | MS | | MR | MR |
| 25 | Wheat | Axe | RAC1192 | 2007 | AUSVAR | W15017 | | | MSS | MSS | S | | MR | MR |

# NVT Data Reporting

- NVT data summary by coordinator sent back to collaborators for review and deliberation via email and/or teleconference



# NVT Data Publication

# NBFPVIP Data Management

- Data for sharing archived in NBFPVIP\(MasterFile)_Dante.xlsx

  - Mapping populations
  - DH populations
  - BLR Diverse set
  - Ethiopian lines
  - EBDSN
  - Backcross LR
  - Differential lines

  } Scald, NFNB, SFNB

- Data submitted to coordinator on or before **30th of December**

# NBFPVIP Field Evaluation Publication

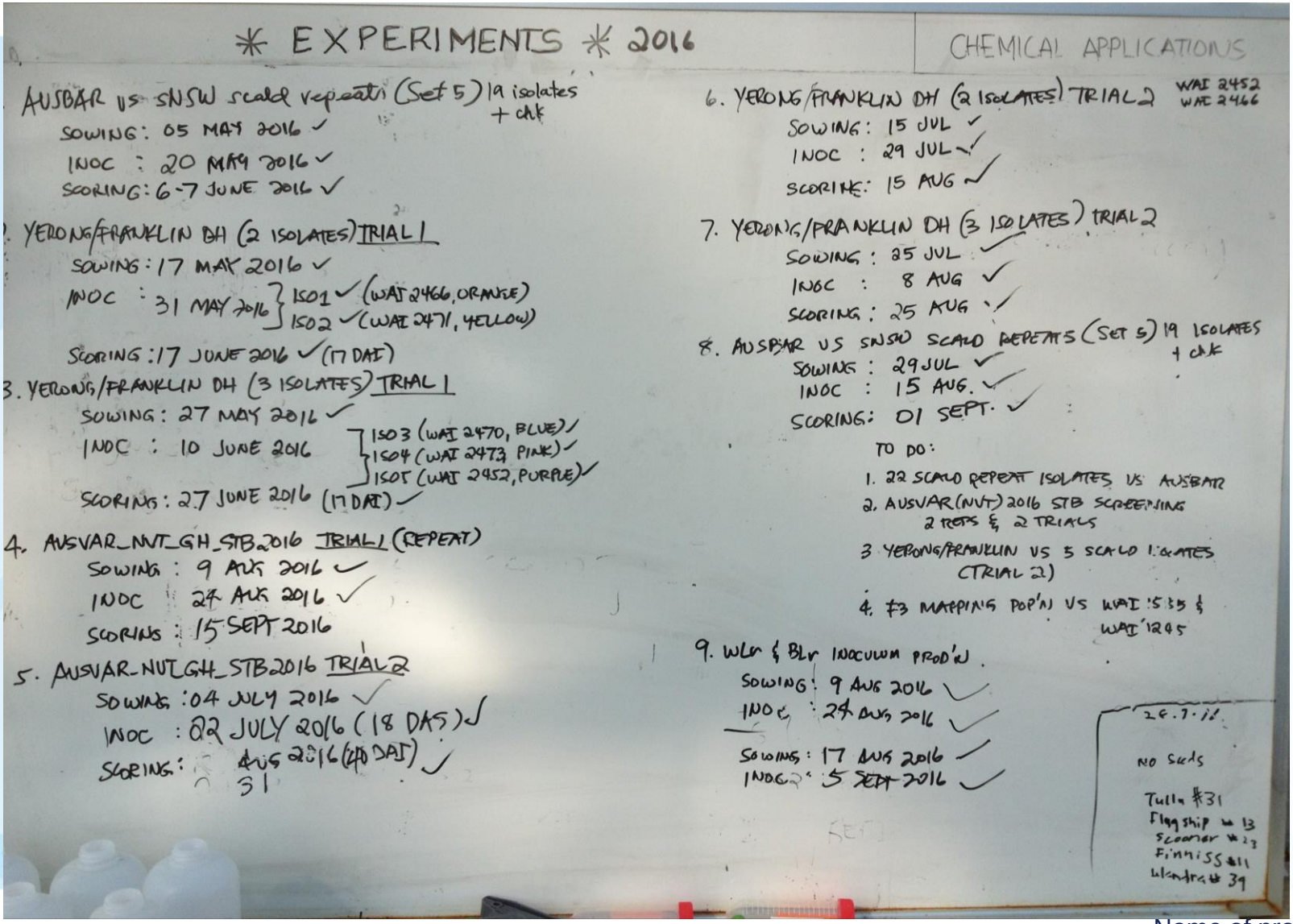
## Tapping into ancient sources of disease resistance to protect our modern barley cultivars – barley scald 2015

**Dr Dante Adorada** and **Dr Andrew Milgate** NSW DPI, Wagga Wagga

### Key findings

- Ancient barley germplasm from Ethiopia harbours resistance to scald and other diseases.
- Twenty-eight out of 355 Ethiopian lines were moderately resistant to scald.
- Careful selection for disease-resistant lines is important to retain other desirable traits.

# NBFPVIP Glasshouse Expt (Scald)



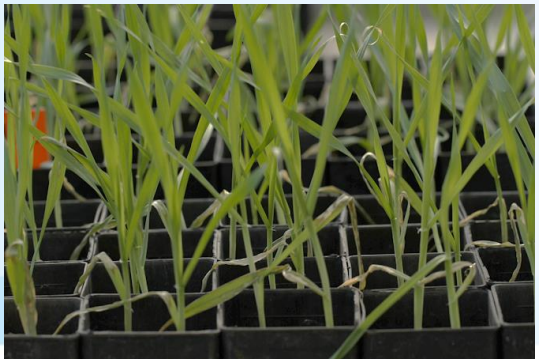
# NBFPVIP Glasshouse Scald Experiments – seedling resistance

1. AUSBAR vs sNSW scald
- 56 sNSW scald isolates
- 40 AUSBAR varieties
- 3 replications
- 2 trials

2. Yerong/Franklin DH mapping population
- 189 lines
- 5 scald isolates
- 3 replications
- 2 trials

3. BLR Diverse Set from Uni of Syd
- 184 lines
- 2 isolates
- 3 replications

4. Uni of Syd mapping populations
- 2 $F_2$ populations (Pickering6/ Baudin & Pickering6/Fitzroy)
- 2 isolates
- 200 lines each population
- F3 seeds harvested and ready for further evaluation



# Scald GH experiment publication

## Reaction of Australian barley varieties to scald from southern NSW 2015

**Dr Dante Adorada** and **Dr Andrew Milgate** NSW DPI, Wagga Wagga

### Key findings

- There are large differences in virulence at the seedling stage in southern NSW (sNSW).
- The variety grown in a region influences time-based changes in virulence.
- Strategic variety choice can affect the existence of virulent pathotypes.

### Introduction

Successful disease management requires an in-depth understanding of the pathogens present in a region. Barley scald is a highly variable disease. Changes in virulence have been observed in a

Table 1. Australian barley varieties (AusBar) used in glasshouse trials and their adult plant reaction to scald.

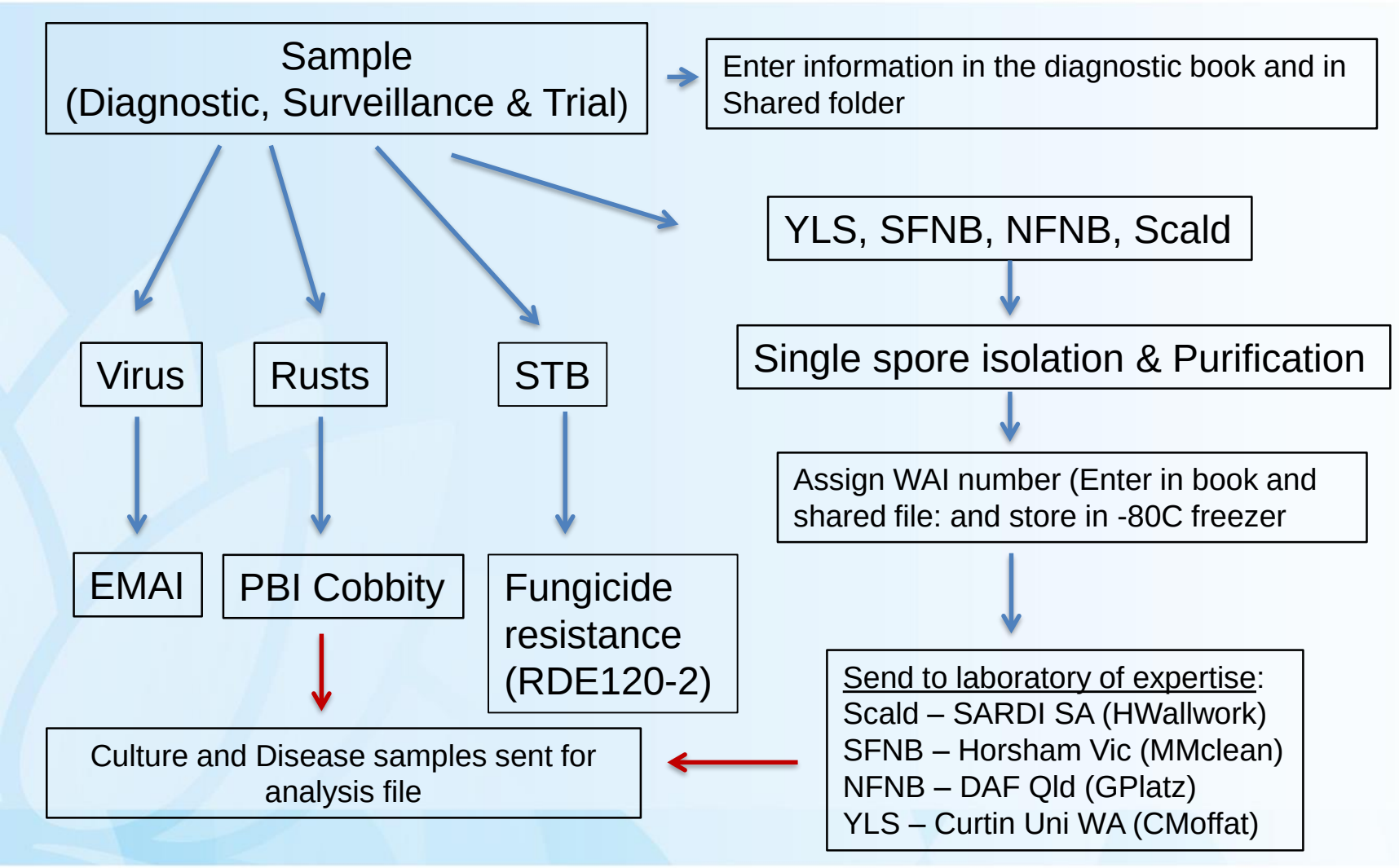
| Cultivar | Scald rating 2014* | Scald rating 2015* |
|---|---|---|
| Barque | nd** | nd |
| Bass[◊] | MR-MS | S-VS |

Southern NSW Research results 2015

# Reports and Meetings

- Annual Progress Report NSWDPI component National Barley Foliar Pathogen Variety Improvement Program (NBFPVIP) DAQ187
- NVT Trial Results – Annual Winter Crop Variety Sowing Guide
- National Project Meeting held annually:
    - Pathology Working Group meeting*
    - Australian Cereal Rust Control Program (ACRCP) Consultative Committee meeting*
    - NBFPVIP meeting*
    - CAIGE
    - Yellow leaf spot project

# Integrated Disease Management (Plant Disease Surveillance and Diagnosis)



# RDE120-1 – Integrated Disease Management (Plant Disease Surveillance and Diagnosis)

| Year | Samples Received & Processed* | Suspected Virus** |
|---|---|---|
| 2014 | 255 | 89 |
| 2015 | 205 | 56 |
| 2016 (as of 12.09.16) | 103 | 14*** |
| | | |

*Mix of diagnostic, surveillance & yield trial samples.

** Sent to EMAI, Menangle NSW

***Does not reflect 72 BYDV Yield trial samples for each of the 5 trial sites (+ 360)

# RDE120-1 – Integrated Disease Management (Plant Disease Surveillance and Diagnosis)

## Occurrence of Winter Cereal Viruses in New South Wales, Australia, 2006 to 2014

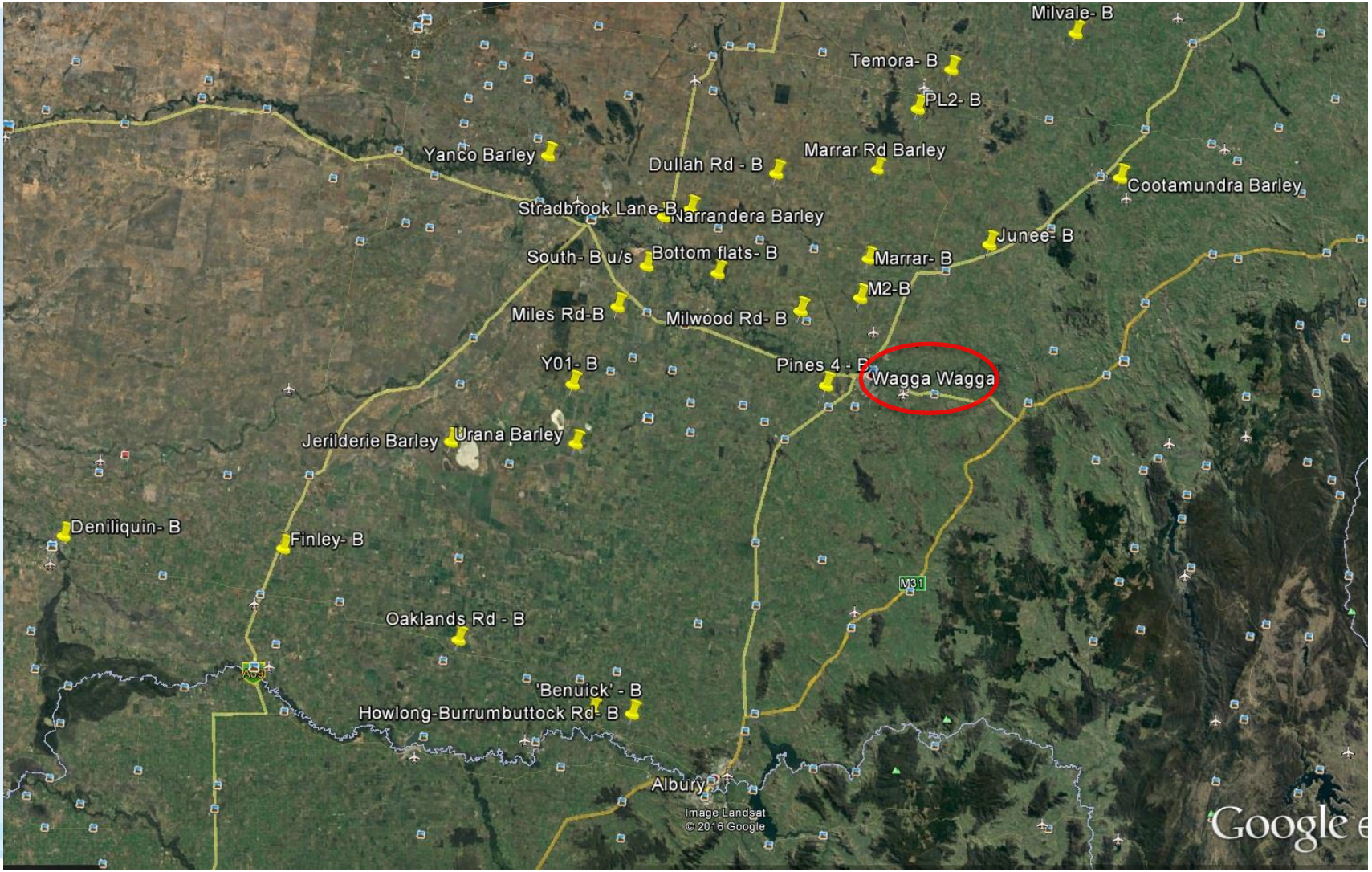
**Andrew Milgate** and **Dante Adorada,** New South Wales (NSW) Department of Primary Industries, Wagga Wagga Agricultural Institute, Wagga Wagga NSW 2650 Australia; and **Grant Chambers** and **Mary Ann Terras,** NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute, Menangle, NSW 2568 Australia

**Abstract**

Milgate, A., Adorada, D., Chambers, G., and Terras, M. A. 2016. Occurrence of winter cereal viruses in New South Wales, Australia, 2006 to 2014. Plant Dis. 100:313-317.

Winter cereal viruses can cause significant crop losses; however, detailed knowledge of their occurrence in New South Wales, Australia is very limited. This paper reports on the occurrence of *Wheat streak mosaic virus* (WSMV), *Wheat mosaic virus* (WMoV), *Barley yellow dwarf virus* (BYDV), *Cereal yellow dwarf virus* (CYDV), and their serotypes between 2006 and 2014. Detection of WMoV is confirmed in eastern Australia for the first time. The BYDV and CYDV 2014 epidemic is examined in detail using 139 samples of wheat, barley, and oat surveyed from southern New South Wales. The presence of virus was determined using enzyme-linked immunosorbent assays. The results reveal a high frequency of the serotype *Barley yellow dwarf virus* - MAV as a single infection present in 27% of samples relative to *Barley yellow dwarf virus* - PAV in 19% and CYDV in 14%. Clear differences emerged in the infection of different winter cereal species by serotypes of BYDV and CYDV. These results are contrasted to other Australian and international studies.

# Map of barley paddocks surveyed, 2016



# Summary

- Wheat and barley varieties with disease resistance (NVT) are available
- Barley lines as sources of resistance are available (NBFPVIP)
- IDM activities in the Southern cropping region are the same in the Northern cropping region.
- Learn about the summer crops and their diseases


UNIVERSITY OF SOUTHERN QUEENSLAND

# Acknowledgement

Deb Slinger (NSW-DPI, Director)
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Andrew Milgate (Snr. Res. Sci.)

Cereal Pathology Team

- Michael McCaig (TO)
- Tony Goldthope (TO)
- Brad Baxter (TO)
- Nannan Yang (PO)
- Melanie Renkin (TO)
- Merrin Spackman (TO)
- Emily Green (TO)

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- Rosie Heath
- Aurelie Quade
- Joel Gray
- Encarnacion Adorada
- Sujeewa Rathnayake