FUNGICIDE MANAGEMENT OF STRIPE RUST IN WHEAT: UP-FRONT vs IN-CROP OPTIONS IN 2011

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Key words
Stripe rust, fungicide management, up-front, in-crop

GRDC code
DAN00143: Northern NSW integrated disease management

Take home messages

In the moderately susceptible (MS) variety Ellison:

1. Flutriafol (Intake®) in-furrow was the best of the up-front options when **not** backed up by an in-crop fungicide application.
3. Similar levels of disease control and yield benefit were obtained with in-crop sprays at GS32 + GS39.
4. A single in-crop spray at GS32 appears to be a reasonable option under moderate stripe rust pressure but was significantly poorer than a GS32 + GS39 strategy under high disease pressure.
5. In a two spray strategy (2nd spray at GS39), delaying the first spray from GS25 until GS32 provided greater protection of the mid canopy and had an improved net benefit under both high and moderate disease pressure.

In the moderately resistant (MR) variety EGA Gregory:

1. **No** significant yield benefit was obtained with any of the stripe rust treatments at the 13 sites in 2011.

Background

Stripe rust, caused by the fungus *Puccinia striiformis*, has re-emerged as a significant issue to wheat production in eastern Australia since 2002. Yield and quality losses are related to reductions in green leaf area resulting from pustule formation on infected leaves. Variety resistance is ultimately the best option for managing stripe rust in the long term. However, in the short to medium term growers planting moderately susceptible varieties are reliant on the use of fungicides either at sowing (in-furrow on fertiliser or seed treatments) or in-crop (application of foliar fungicides), or a combination of both options. The development of new pathotypes of the stripe rust fungus, which reduce the resistance of selected commercial varieties, can make fungicide intervention necessary in other situations.

This study evaluated a range of at sowing and in-crop fungicide strategies on the control of stripe rust in a moderately susceptible (MS) bread wheat variety, Ellison and a moderately resistant (MR) variety, EGA Gregory. The trials were conducted at 13 sites across central and northern NSW in 2011 to examine management options under varying scenarios of stripe rust pressure and seasonal conditions.

Trial details

Eleven of the 13 trials were conducted at National Variety Trial (NVT) sites in central and northern NSW and were sown, managed for weeds and harvested by the NSW DPI mobile units. Two additional sites were conducted at Tamworth and managed by the Cereal Disease Management group. Trial sites are outlined in Table 1.

How was it done?

- Two bread wheat varieties EGA Gregory which is moderately tolerant (MT) and Ellison which is moderately susceptible (MS) to dominant (Yr17+) pathotype of stripe rust.
- 1. Nil control treatment with no fungicide application either at sowing or in-crop.
- Seven at sowing (up-front) fungicide options for controlling stripe rust of:
  2. Fluquinconazole (Jockey Stayer®) on seed (300mL/100kg seed) (8 sites only)
  3. Fluquinconazole (Jockey Stayer®) on seed (450mL/100kg seed)
  4. Triadimefon (Triad®500WP) on Granulock® 12Z (200g/ha)
  5. Flutriafol (Intake®) on Granulock® 12Z (400mL/ha)
  6. Experimental 1 on Granulock® 12Z (IF#1)
  7. Experimental 2 on Granulock® 12Z (IF#2)
  8. Experimental 3 on Granulock® 12Z (IF#3) (5 sites only)
- Three in-crop foliar fungicide options of:
  9. Tebuconazole (Folicur®, 145mL/ha) at Z32
  10. Tebuconazole (Folicur®, 145mL/ha) at Z32 + Z39
  11. Tebuconazole (Folicur®, 145mL/ha) at Z25 + Z39
- Two up-front + in-crop treatment combinations of:
  12. Flutriafol on Granulock® 12Z (400mL/ha) + Tebuconazole (145mL/ha) at Z39
  13. Full disease control treatment of Flutriafol on Granulock® 12Z (400mL/ha) + Tebuconazole (145mL/ha) at Z32 + Z39

Granulock® 12Z was added to all plots at sowing at a rate of 50kg/ha either untreated or treated as above for in-furrow treatments (4, 5, 6, 7, 8, 12 and 13).

Trial sites and impact of stripe rust on yield

Seasonal conditions and pressure from stripe rust infection varied markedly across the 13 trial sites. Consequently, the trials have been divided into three varying outcomes for interpretation of the results as outlined in Table 1.

Table 1: Trial locations, average yield and stripe rust pressure at 13 trial sites conducted in 2011

*determined from comparing Ellison in untreated plots (T1) at each site with full disease control trt (T13).

ns = yield difference not significant at 95% confidence level

Trial outcome 2011	Location	Average yield (t/ha)	Yield loss from stripe rust*
High disease pressure	North Star	4.73	45%
	Spring Ridge	6.89	31%
	Tamworth 1	3.39	31%
Moderate disease Pressure	Bullarah	4.47	22%
	Wongarbon	3.65	22%
	Tamworth 2	2.87	19%
	Trangie	3.15	18%
Low disease pressure	Somerton	6.43	ns
	Coolah	5.10	ns
	Nyngan	3.03	ns
	Burren Junction	2.67	ns
	Gilgandra	2.22	ns
	Coonamble	1.53	ns

High disease pressure sites had even infection levels across plots with around 50% or more of the top three leaves covered in pustules at flowering in untreated Ellison plots. This resulted in 31-45% yield loss from stripe rust infection. The moderate disease pressure sites again had even infection across the site with around 20% of the top three leaves of untreated Ellison covered in pustules at flowering resulting in 18-22% yield loss. The low disease pressure sites tended to have patchy infection in plots with <5% of the top three leaves in untreated Ellison plots covered in pustules when averaged across the entire plot. That is, individual plants may have had much higher infection levels but were only distributed in small patches. This resulted in yield losses in Ellison of between 0-8% which were not significant.

Stripe rust management options in a moderately susceptible variety: Ellison

At the three high disease pressure sites (North Star, Spring Ridge and Tamworth 1) yield responses to the various fungicide strategies clearly reflected the impact of each treatment on stripe rust levels within the canopy. With the up-front options, Flutriafol (Intake®) on starter fertiliser provided the longest protection with only low levels of infection (<5%) evident on the flag leaves of Ellison at North Star during flowering. The IF1 experimental treatment also had good activity with around 5-10% infection of flag leaves on Ellison during flowering. Stripe rust activity under high disease pressure was broadly Intake®>IF1>Triad®>IF2>Jockey Stayer® at 450mL=IF3.

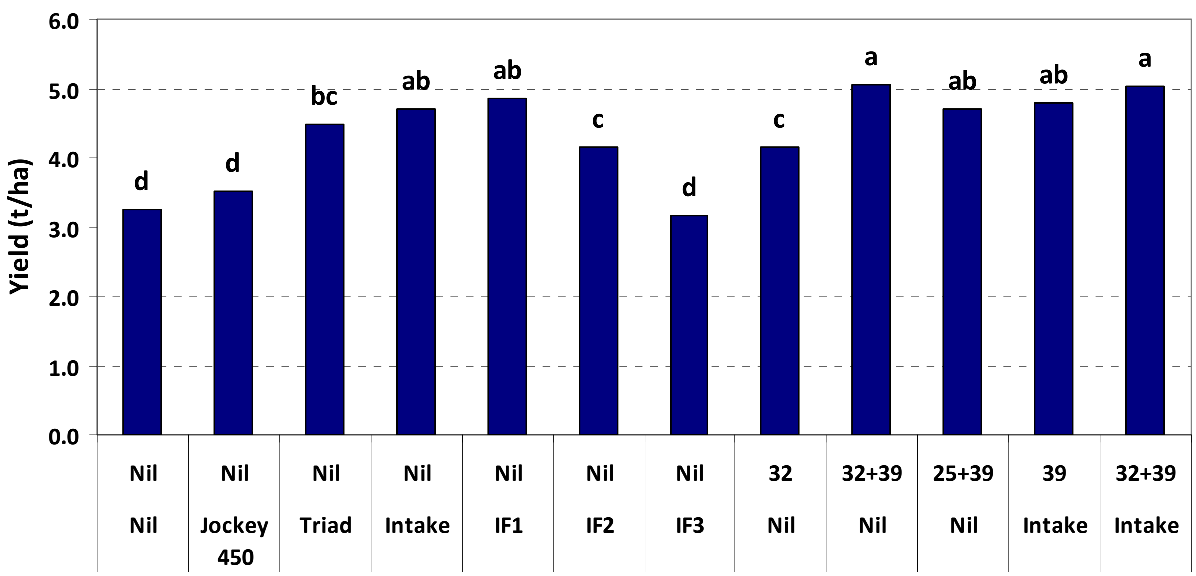

Figure 1: Effect of up-front (bottom line) and in-crop (top line) fungicide treatments on yield of the MS wheat variety Ellison : average of **high** disease pressure sites in 2011

The impact of stripe rust on Ellison averaged a yield loss of 1.8t/ha (35%) when comparing the full disease control treatment (Intake® + 145mL/ha of tebuconazole at GS32 + GS39) to the nil control (Figure 1). Up-front treatments alone of Intake® and IF1 provided yields equivalent to the full disease control. The lowest yields from up-front options alone came from the Fluquinconazole (Jockey Stayer® at 450mL) seed treatment and the IF3 experimental treatment (Figure 1). Note, the IF3 experimental treatment had little to no stripe rust activity but also caused issues with emergence.

All in-crop fungicide sprays were a 145mL/ha rate of tebuconazole (Folicur®). Stripe rust in the MS variety Ellison, even under high disease pressure, was effectively controlled with a fungicide application at GS32 (2nd node) followed by a second application at GS39 (full flag leaf emergence). This provided yield equivalent to the full disease control (Figure 1). Under high disease pressure a single application at GS32 provide half the benefit (+0.9 t/ha) of a GS32 + GS39 (+1.8 t/ha) spray program (Figure 1). On average the GS25 + GS39 treatment was 0.35 t/ha lower yielding than the GS32 + GS39 treatment but was not significant. However, this was biased by the Spring Ridge site which had a late onset of stripe rust infection (post GS32) resulting in no difference in yield between these two treatments. Under earlier disease onset (<GS25) the GS25 + GS39 was significantly lower yielding at both North Star (-0.55 t/ha) and Tamworth 1 (-0.50 t/ha) than the GS32 + GS39 strategy. The GS25 spray provided early protection but significant levels of rust developed on the Flag-1 and Flag-2 leaves which were not emerged at GS25 and hence were unprotected until the second application at GS39. Although there was a trend towards an increased yield benefit when combining the up-front Intake® treatment with an in-crop fungicide application at GS39 or GS32 + GS39 the difference was not significant from the Intake® only treatment at any of the three high disease pressure sites.

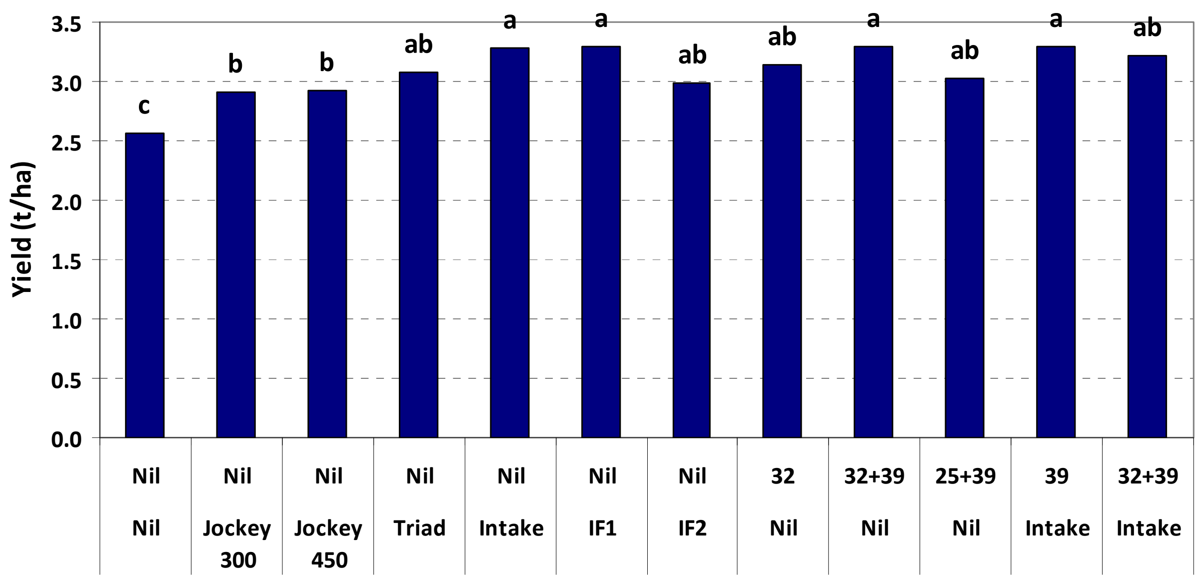

Figure 2: Effect of up-front (bottom line) and in-crop (top line) fungicide treatments on yield of the MS wheat variety Ellison : average of **moderate** disease pressure sites in 2011

The moderate disease pressure sites (Bullarah, Wongarbon, Tamworth 2 and Trangie) in 2011 resulted in an average yield loss from stripe rust infection of 20% in the MS variety Ellison (Figure 2). Under lower disease pressure the various fungicide treatments provided greater protection of green leaf area resulting in smaller differences in yield between treatments compared to the high disease pressure sites. All fungicide strategies examined significantly increased the yield of Ellison compared to the nil control treatment. Of the up-front options, Intake® and IF1 were superior to the two rates of fluquinconazole (Jockey Stayer®) with Triad® intermediate. Under moderate disease pressure the GS32 in-crop fungicide application alone provided an average 0.58 t/ha benefit which was not significantly different from the benefit (0.74 t/ha average) provided by the GS32 + GS39 spray treatment at any of the four sites. The GS25 + GS39 treatment trended towards lower yield than the GS32 + GS39 spray strategy but was not significant when averaged across sites. The exception was at Bullarah where the GS25 + GS39 treatment was significantly lower yielding (-0.64 t/ha) than the GS32 + GS39 application.

At the remaining low disease pressure sites none of the fungicide strategies (up-front, in-crop or combination of both) significantly increased the yield of the MS variety Ellison at any of the sites. However, the experimental IF3 treatment did significantly reduce the yield of Ellison at the Somerton and Coolah sites, where this treatment was examined, compared to the nil control. This was related to a detrimental effect of IF3 on emergence rather than stripe rust infection as only low levels of disease were present at these sites.

Stripe rust management options in the moderately resistant variety: EGA Gregory

None of the fungicide treatments, including the full disease control treatment (Intake® + 145mL/ha of tebuconazole at GS32 + GS39) provided a significant yield benefit over the nil fungicide control in the MR variety EGA Gregory at any of the 13 trial sites in 2011. Even at North Star, the site with the highest pressure from stripe rust in 2011, no pustules were evident on EGA Gregory. The only site which had any level of yellow spot infection was Tamworth 2 but lesions remained confined to the lower canopy in all treatments and did not impact on yield outcomes.

Economics

The following values have been used fluquinconazole (Jockey Stayer®) at $50/L with a 55kg/ha sowing rate, triadimefon (Triad®500WP) at $4.95/ha, Intake at $20/L, tebuconazole (Folicur®) at $15/L with a 75L/ha in-crop spray application rate by ground-rig at an application cost of $8/ha. Note: no application cost has been applied with GS25 spray as it was assumed that it was applied with an in-crop herbicide spray at this growth stage. An APW grade at $180/t has been assumed as the grain price as grain quality data was not available at the time of writing this paper. Obviously costing and resulting economics will vary dramatically e.g. using own ground rig or cheaper fungicide pricing for bulk purchases, differences in grain quality, grain price etc. Hence, the following is a guide only and growers/advisers should do their own sums based on their individual pricings.

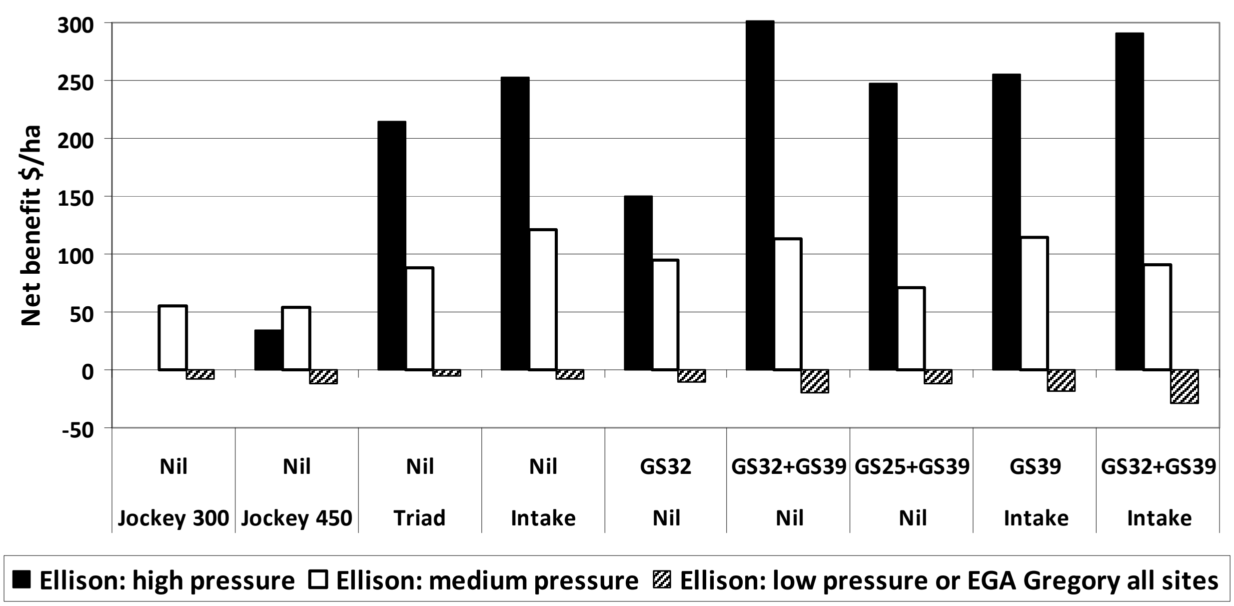

Figure 3: Net benefit from various fungicide treatments under different variety and disease pressure situations in 2011

The best returns under high and medium stripe rust pressure in the MS variety Ellison were obtained from Intake®, the GS32 + GS39 in-crop fungicide applications or a combination of these treatments (Figure 3). A GS32 spray alone in Ellison lost $152/ha if not followed by an additional application at GS39 (i.e. GS32 + GS39) under high disease pressure. However, under moderate disease pressure the loss from not doing the second spray in Ellison at GS39 was only $19/ha. In a two spray strategy delaying the first spray until GS32 returned an additional $55/ha under high disease pressure and $42/ha under moderate disease pressure in Ellison compared to doing the first application at mid-tillering (GS25). Both treatments then require a second spray at GS39.

Under low stripe rust pressure in Ellison the net benefit was basically the cost of the various fungicide strategies as no significant yield benefit was associated with the various treatments under these conditions. The situation was the same for the MR variety EGA Gregory under all disease levels in 2011 as similarly no significant yield benefit was associated with any of the fungicide treatments (Figure 3).

Varying costs are associated with the different fungicide strategies examined that are not reflected in a net benefit analysis. Therefore a return on investment assessment examining the $return on each $spent on the various options is an important risk consideration for growers and advisers.

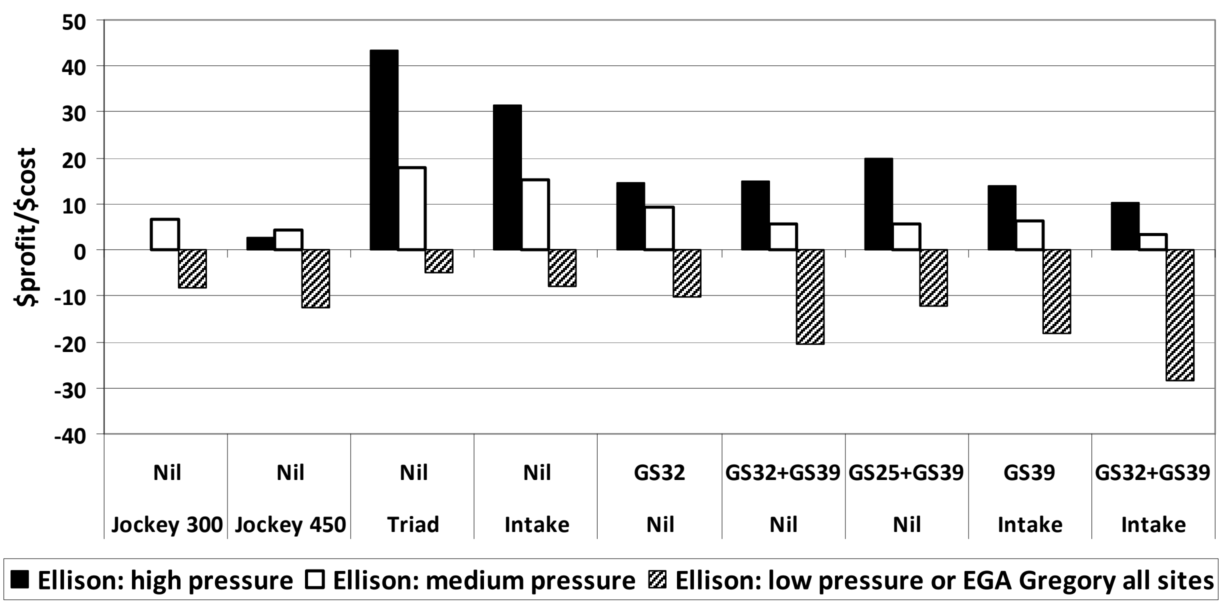

Figure 4: Return on investment from various fungicide treatments under different variety and disease pressure situations in 2011

In these trials the Triad® and Intake® up-front options alone had the highest return on investment under both high and medium disease pressure (Figure 4). Note, this approach is very sensitive to individual pricing situations e.g. if a grower had their own ground rig (assume cost of application $4/ha rather than $8/ha with contractor) then the GS32 + GS39 strategy would have returned $25 per $1 spent under high disease pressure and $10 per $1 spent under moderate disease pressure.

Conclusions

Inclusion of a fungicide when performing an in-crop weed spray around mid-tillering (GS25) in wheat crops has become a fairly common practice commercially in much of northern NSW for managing stripe rust. The top three leaves in wheat are the highest yield contributors so the aim of any stripe rust management strategy in susceptible varieties is to keep these leaves largely clean of infection. However, when applying a fungicide at GS25 none of these important leaves have emerged so they are unprotected by fungicide once they do come out. Delaying the first fungicide application to GS32, when the Flag-2 leaf has emerged, protects this leaf from infection plus reduces the time and subsequent disease build-up until the second spray is applied at full flag leaf emergence (GS39). Delaying the first spray from GS25 until GS32 returned an additional $55/ha under high disease pressure and $42/ha under moderate disease pressure in the MS variety Ellison.

Up-front options are not used widely in central and northern NSW. In particular the use of flutriafol (Intake®) on starter fertiliser and to a lesser extent Triad® in-furrow provided good levels of disease control and return on investment under both high and moderate disease pressure in 2011. These were the cheaper options examined so also had the lowest risk exposure under low disease pressure where basically due to a lack of significant stripe rust infection none of the fungicide strategies provide a yield benefit. It should be stressed that for these trials we obtained good coverage of the starter fertiliser (Granulock® 12Z) with the various in-furrow treatments due to our ability to rapidly dry the wet fertiliser after treatment due to the small volumes required. This can present a logistical problem commercially but these in-furrow treatments appear worthy of consideration and further evaluation.

Finally, **no** significant yield benefit was obtained at any of the 13 sites in 2011 from any of the fungicide strategies aimed at controlling stripe rust in the MR variety EGA Gregory. Even at North Star, which had the highest pressure from stripe rust in 2011, there was no benefit from even the full disease control (Intake® + GS32 + GS39). None of these sites were complicated by infection from yellow spot, a different stubble-borne leaf disease to which EGA Gregory is susceptible. In terms of just stripe rust, management in the MR variety EGA Gregory was **not** warranted in 2011.

Acknowledgments

This work was partially funded by GRDC under project DAN00143. We thank the collaborating grower at each trial site who allowed access to their properties without which this research would not have been possible. We thank the NSW DPI mobile unit operators Scott Boyd, Gerard Lonergan and Dougal Pottie for sowing and harvesting trials. Assistance of NSW DPI district agronomists Rohan Brill, Greg Brooke, Tim Burley, Rebecca Byrnes, James Fleming, Kathi Hertel, Leigh Jenkins, Tim McNee, Bill Manning, Loretta Serafin and Tim Weaver throughout the year was appreciated. Technical assistance provided by Ben Bowman, Rod Bambach, Paul Nash, Robyn Shapland, Kay Warren, Karen Cassin, Amy Alston, Patrick Mortell and Jayne Jenkins is gratefully acknowledged. Paper reviewed by Richard Daniel (NGA).

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