

Potassium deficiency can make wheat more vulnerable to *Septoria nodorum* blotch and yellow spot

Ciara Beard and Anne Smith, Department of Agriculture and Food WA

Key messages

- Field trials conducted at North Eneabba in 2012 and 2013 have shown that potassium (K) deficient wheat crops are more vulnerable to yellow spot (YS) and septoria nodorum blotch (SNB), collectively referred to as leaf spot diseases. Optimal K nutrition is essential for plant growth and additionally plant health and provides the foundation for subsequent decisions on disease control to be made. That is, K does not control disease but allows plants to perform to meet their actual potential. Then if the season is favourable and disease is present on susceptible varieties, fungicide adds the additional protection required.
- In 2013, addition of 30, 60 and 120 kg/ha of muriate of potash significantly reduced levels of SNB on leaves and heads and increased yield of Mace wheat above the nil K treatment. The 60 kg/ha rate and 120 kg/ha rate increased yield by of 0.5 and 0.6 t/ha respectively which was an increase of around 30% above the nil K treatment. In a similar trial conducted in 2012 at the same location, addition of 50 kg/ha of potash significantly reduced glume blotch infection and increased yield of Wyalkatchem by 15% (0.3 t/ha) infected with late SNB.
- Foliar fungicide application is required in addition to K nutrition where the disease is rapidly moving up the canopy in leaf spot susceptible varieties. This is particularly important when there is risk of glume blotch (due to *septoria nodorum*) late in the season. An unregistered in-furrow fungicide trialled for leaf spot control in 2013 was equivalent in disease control to the Z31 foliar spray. This product has been submitted to the APVMA for this use in Australia so will be available in the future as an option for growers for leaf spot disease control.

Aims

Potassium (K) functions within the plant have been shown to have an important role in improving the ability of plants to combat diseases. DAFWA research in the southern agricultural region has shown that the application of K fertiliser significantly reduces the percent leaf area diseased for spot -type net blotch and powdery mildew of barley in barley grown in marginal soil K conditions (<50 mg/kg in top 10 cm) (Brennan & Jayasena, 2007).

The aim of this research was to investigate how K nutrition (with and without fungicide) affects management of yellow spot (YS) and/or septoria nodorum blotch (SNB) in wheat – does K deficiency make wheat more vulnerable to infection by these diseases?

Method

Trials were conducted in 2012 and 2013, both were sown on the same property at North Eneabba known to have K deficient soil (< 50 mg/kg) and on wheat stubble to increase the disease risk. Soil samples were taken prior to seeding to confirm K deficiency. Disease assessments were done regularly from tillering stage until late grain development. This involved scoring 10 plants per plot for percentage leaf area diseased (LAD) on top 3 leaves. Scores were then averaged to give an average LAD on the top three leaves for each treatment at each assessment date. Plants were sampled from each plot after flag leaf

emergence for K tissue concentration. Head number and seed number and seed weight per square metre, along with crop height for each plot were measured towards the end of the season. Plots were harvested and grain yield determined and quality assessments made.

Property location - North Eneabba

Soil type – grey sand over gravel/clay

2012 Trial details

The trial was established within a grower's wheat crop in a paddock that had not received any potassium fertiliser that year. Each plot was 20 m x 5m, 4 replicates of each treatment, single bank trial, randomised block design. Only 20 m x 1.54 m harvested from each plot.

Wheat variety – Wyalkatchem (MSS to SNB and MR to YS) **Sowing date** - 22 May, 2012

Seeding rate - 90 kg/ha
Wheat

Paddock history – 2011: Wheat, 2010: Lupins, 2009: Wheat

Fertiliser - whole trial received 70 kg/ha MAP (no K) at seeding. All plots in the trial received 200kg/ha of NS41 at Z15 to ensure K was the only nutrient to limit grain yield.

Growing Season rainfall in 2012 (May – October inclusive) – 345 mm

Treatments:

1. +K and Prosaro at 300 mL/ha at Z43*
2. +K and Nil fungicide
3. – K and Prosaro at 300 mL/ha at Z43*
4. – K and Nil fungicide

+K treatments - On 22/6/12 when crop was at Z15 received 50 kg/ha Muriate of Potash

*Timing of fungicide spray depended on disease development (was not much disease early so delayed til Z43, early booting stage on 17 May 2012).

2013 Trial details

Sown individual trial plots with plot size of 20m x 1.54 m, with each treatment replicated 4 times. Barley buffers in between each plot and bank to reduce disease spread between plots. Randomized design in blocks by main treatment (fungicide).

Wheat variety –Mace (MS to SNB and MRMS to YS) **Sowing date** – 23 May 2013

Seeding rate – 80 kg/ha **Paddock history** – 2012 : Wheat, 2011 : Lupins, 2010 : Wheat

Fertiliser– whole trial received 80 kg/ha Agstar (no K) at seeding and 200 kg/ha of NS41 at Z15 to ensure K was the only nutrient to limit grain yield.

Growing Season rainfall in 2013 (May – October inclusive) – 433 mm

Treatments

Main treatment – Fungicide :

1. Nil fungicide
2. Prosaro @ 300 mL/ha at Z59*
3. SYNSIF1[∞] in-furrow + Prosaro @ 300 mL/ha at Z59*
4. Tilt @ 250 mL/ha at Z31 + Prosaro @ 300 mL/ha at Z59*

*Timing of fungicide spray was dependent on disease development at site. Early disease was at low levels so fungicide applied at end of ear emergence (Z59) on 7 August 2013. Z31 spray was applied on 17 July 2013.

∞SYNSIF1 is an unnamed unregistered trial product. It was direct injected in-furrow at seeding at a rate that cannot be documented.

Sub Treatment: Potassium

1. No K
2. Low K (30 kg/ha MOP topdressed at Z15 = 15 kg K/ha)
3. Medium (60 kg/ha MOP topdressed at Z15 = 30 kg K/ha)
4. High K (120kg/ha MOP topdressed at Z15 = 60 kg K/ha)

Results

2012 Trial

Initially there were low levels of both YS and SNB (2% on top 3 leaves at Z31, first node), with YS dominating. For much of the season the disease did not progress much likely due to low rainfall and Wyalkatchem having moderate resistance to YS. At Z43 there was only 3% average disease on the top three leaves across all treatments, however disease levels picked up by the end of the season when septoria nodorum struck late, and upper leaves and heads were infected at Z69 (end flowering). Fungicide treated plots had significantly less disease at Z69 (29% average LAD across top 3 leaves compared to the untreated which had 35%). Addition of 50 kg/ha potash to the nil fungicide treated plots resulted in significantly lower levels of head infection, from 9 to 5%. Addition of potash had no significant effect on leaf or head infection when added to the fungicide treated plots. In K deficient plots, application of fungicide significantly reduced head infection from 9 to 3%. Fungicide application gave no yield benefit but significantly increased hectolitre weight (from 75 to 76 kg/hl) and reduced screenings (from 3 to 2%). Application of 50 kg/ha potash gave a significant yield benefit of 15% (0.3 t/ha) and profit of \$29/ha over the nil K treatment while also significantly reducing screenings, and significantly increasing hectolitre weight (Table 1). There were no significant fungicide by K interactions for disease levels, yield or grain quality in this trial.

Table 1 Yield in t/ha and profit above untreated (Nil K Nil) in \$/ha of potassium treatments in 2012.

K Treatment	Yield	Protein (%)	Hectolitre Weight (kg/hl)	Screenings %
Nil K	2.0	13.7	75.0	2.6
Plus K	2.3 (29)	12.8	76.1	2.1
LSD (5%)	0.141	0.501	0.381	0.428

Profit shown in brackets (). Calculation assumes Wheat price of \$220/t, Plus K treatment (50 kg/ha MOP) costs \$37/ha. Application cost of \$8.50/ha.

2013 Trial

Initially disease levels were very low and a mixture of both YS and SNB (average 3% leaf area diseased on top 3 leaves at Z31). It was only during head emergence that disease ramped up and being predominantly SNB led to heads being infected with glume blotch.

Fungicide treatments: By Z71 (milky dough), all the fungicide treatments were performing the same in terms of reducing disease levels on leaves by approximately 30% and on heads by approximately 64% (data not shown). This indicates that the Z59 foliar spray was really the only fungicide treatment to have a significant impact on long term disease reduction so was

the best strategy in 2013. Out of the fungicide treatments, none resulted in statistically significant yield increases over the nil fungicide treatment.

Potassium treatments: All K treatments significantly reduced leaf disease levels at Z71 by approximately 22% on average, though only the high K (120 kg/ha) and medium K (60 kg/ha) treatments significantly reduced head infection (by approximately 56%). All K treatments significantly increased yield (Table 2) and also increased hectolitre weight and 1000 grain weight and reduced screenings (data not shown). The low and medium K treatments had significantly more heads and seeds per square metre than the nil K treatment (data not shown). The high K treatment increased crop height but did not result in more heads or seeds per square metre than the nil K treatment (data not shown). The medium K (60 kg/ha) treatment was the most profitable and is closest to the standard grower practice for this location (Table 2).

Table 2 Yield of treatments in t/ha and profit above untreated (Nil K Nil fungicide) in \$/ha of each treatment in 2013. LSD of yield results at 10% significance level is 0.529 except when comparing treatments with same fungicide level it is then 0.211.

Treatment (Fungicide/K)	Nil K	Low K (30kg/ha)	Med K (60kg/ha)	High K (120kg/ha)
1. Nil fungicide	1.3	1.6 (74)	1.8 (94)	2.1 (139)
2. Prosaro @ 300 mL/ha at Z59	1.8 (109)	2.2 (204)	2.3 (220)	2.2 (148)
3. Product SYNSIF1in-furrow + Prosaro @ 300 mL/ha at Z59	2.0	2.0	2.3	2.3
4. Tilt @ 250 mL/ha at Z31 + Prosaro @ 300 mL/ha at Z59	1.6 (40)	1.9 (100)	2.1 (155)	2.2 (129)

Profit shown in brackets (). Calculation assumes Wheat price of \$280/t, Prosaro @ 300 mL/ha costs \$21/ha, Tilt @ 250 mL/ha costs \$3/ha, Low K treatment (30 kg/ha MOP) costs \$26/ha, Med K costs \$43/ha and High K costs \$78/ha. Application cost of fungicide \$8.50/ha and of fertiliser \$8.50/ha. No profit calculations for in-furrow fungicide product are possible as its not registered or available yet.

In 2013, the application of fungicide to K deficient plants gave significant yield increases of 30 – 60% above the nil fungicide treatment (this equated to 0.5 – 0.8 t/ha) with the greatest increases being at the lower K levels. On the other hand, addition of fungicide to plants that had received extreme levels of K fertiliser (120 kg/ha muriate potash) did not result in a statistically significant yield response (Table 2).

Conclusion

The 2012 trial had insufficient disease to get a clear answer on the interaction of K nutrition and fungicide for control of SNB. It did clearly show though that addition of 50 kg/ha muriate of potash significantly reduced head infection in the nil fungicide treatment and across all plots resulted in significant yield response and grain quality benefits. This shows the value of optimal soil K for crop yield and grain quality regardless of any potential disease control.

In 2013, when disease levels were higher the value of potassium application at a potassium deficient site was again seen, and was quantified through yield component measurements. Potassium on its own won't provide disease control as such but will enable a crop to have strong growth and better crop health leading to better yield potential. Fungicide was worthwhile when 60 kg/ha potash or less had been applied. Fungicide application is

recommended if disease is present on a susceptible variety to give additional yield and quality benefits and therefore increase profit.

Further research in other seasons and at other locations could assist with determining the optimum K fertiliser rate for use in conjunction with fungicide for SNB and YS control. What is clear is that both K application and fungicide are tools that can be used together to this aim. The focus should be on getting potassium nutrition right, and then make a decision on fungicide application based on seasonal disease developments.

At this point in time the only options for controlling YS and SNB are foliar fungicide sprays with timing and number of sprays dependant on disease levels present. In both trials documented here the in-furrow fungicide product performed as well as a fungicide spray at Z31. It shows great promise for controlling early YS and SNB and when registered will provide an alternative for growers to an early fungicide spray.

References: Brennan, RF and Jayasena, KW (2007) Increasing applications of potassium fertiliser to barley crops grown on deficient sandy soils increased grain yields while decreasing some foliar diseases, **Australian Journal of Agricultural Research** 58(7) 680–689

Key words

potassium, septoria, disease, wheat

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