Grower Summary

FV 341c

Asparagus purple spot: optimising urea application rates and timings to reduce disease on the emerging new crop and ferns

Final 2014

Disclaimer

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of this report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

HDC
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

HDC is a division of the Agriculture and Horticulture Development Board.

Project Number:	FV 341c
Project Title:	Asparagus purple spot: optimising urea application rates and timings to reduce disease on the emerging new crop and ferns
Project Leader:	Angela Huckle, ADAS UK Ltd.
Contractor:	ADAS UK Ltd.
Industry Representative:	Peter Knight (previously Ron Marshall)
Report:	Final report 2014
Publication Date:	18 February 2015
Previous report/(s):	Final report, FV 341 Annual reports, FV 341a, FV 341b
Start Date:	1 January 2014
End Date:	29 January 2015
Project Cost:	£28,994

GROWER SUMMARY

Headline

- In field trials Tech Grade Urea (46% N) applied as a pre-harvest spray application to soil and asparagus debris at 100 kg N/ha in 400 L water/ha gave a significant reduction in spore release of *Stemphylium vesicarium* for up to 14 days post application at one out of the two field sites; *however* there was no subsequent reduction in Stemphylium purple spot on spears or ferns at either site.
- In pot trials Silwett-L77 was the best adjuvant for the urea, the combination resulted in the most spore suppression.

Background

Stemphylium purple spot of asparagus caused by the fungus *Stemphylium vesicarium* occurs on spears during the harvest season, leading to loss in productivity and spear quality. The disease mainly develops on the asparagus ferns after harvest, affecting main stems, secondary branches and needles where survival structures (pseudothecia) of the fungus are produced. These overwinter on fern debris and this is often the initial source of the disease. Once purple spot is present in a crop, asexual spores (conidia) are produced on lesions in wet weather and are readily spread by wind and water splash leading to rapid disease increase, and the disease can be very difficult to control once established.

Fern debris from the previous season is commonly found on the soil surface as spears emerge. Burial of the debris by ridging up after the crop has senesced reduces the risk of *Stemphylium* spore release in the following spring, but in older crops where crowns and roots develop closer to the soil surface this can be difficult due to the risk of damage to the extensive root system and debris may remain on the surface. Heavy rainfall and footfall during harvest can also cause the debris to become exposed again, and this trash will still have viable fruiting bodies which will release spores. Work done in FV 341b showed that the disease can be reduced in the ferns by application of urea pre-harvest to reduce *S. vesicarium* spores being released from asparagus fern debris. An additional application of urea could be useful post-harvest after the debris has been disturbed by machinery and footfall to give a clean up before the ferns develop. The benefit of this extra application was evaluated in the 2014 trial. In addition to granular urea there are liquid urea products available (Nufol20 and Nuram37) which may be more convenient to use than dissolving granular urea on a large scale. A range of commercially available adjuvants were also tested in this trial to determine the best tank mix partner for urea for efficacy against spore release.

The aim of this project was to improve the control of *Stemphylium* purple spot on asparagus by decreasing overwintering inoculum on crop debris. The objectives were to:

- determine the most effective granular urea rate, form and timing for reduction of the level and persistence of spore production from debris;
- determine the most effective granular urea rate, form and timing for reduction of purple spot on the emerging spears and ferns;
- assess whether additional efficacy is gained from addition of adjuvants;
- assess the influence of water volume on efficacy of the urea.

Summary

Objective 1 and 2: Effect of urea rate, form and timing for reduction of spore production from debris and reduction of purple spot on spears and ferns - field trials.

A field experiment was carried out in 2014 using commercial crops of asparagus cv. Gijnlim in Norfolk and Herefordshire. Each field site had a known history of *Stemphylium* purple spot and resting bodies (pseudothecia) of the pathogen were present on the crop debris at each site and at each treatment timing. Nine treatments were applied to the crop over three timings as shown in Table 1 below.

Table 1. Urea and Nufol20 treatments applied – Norfolk & Herefordshire sites, 2014

	Treatment description	Product	Water volume L/ha	Application timing (kg N/ha)	
				T1 Mar/Apr Pre-harvest (post harrowing and ridging)	T2 Post-harvest
1	Untreated control	-	-	0	0
2	Standard pre-harvest (high vol, 100 kg)	Urea*	1000	100	0
3	Pre-harvest only (moderate vol, 100 kg)	Urea*	400	100	0
4	Pre-harvest only (moderate vol, 50 kg)	Urea*	400	50	0
5	Pre-harvest only (low vol, 50 kg)	Urea*	250	50	0
6	Post-harvest only (low vol, 50 kg)	Urea*	250	0	50
7	Liquid urea	Nufol20*	250	50	0
8	Post-harvest app only (moderate vol, 100 kg once)	Urea*	400	0	100
9	Pre and post-harvest (moderate vol, 100 kg as two applications)	Urea*	400	50	50

* applied in mixture with Silwett L77 at 0.15%

There were two application timings for each treatment:

- **Timing 1** – applied after ridging but before the residual herbicide application (April 1st 2014 at the Herefordshire site and April 15th 2014 at the Norfolk site)
- **Timing 2 –** applied after harvesting of the spears had finished (July 3rd 2014 at the Herefordshire site and June 25th 2014 at the Norfolk site)

Assessments were done to determine the effect of treatments on i) the incidence and intensity of *Stemphylium* spore release from debris collected from experimental plots up to 56 days after treatment application and, ii) incidence and severity of Stemphylium purple spot on spears and fern.

Urea applied as a pre-harvest spray significantly reduced spore production at the Norfolk site in 2014 (Figure 1). At 1 day after treatment, urea (100 kg N/ha in 400 L water) significantly reduced spore release from debris compared with the untreated control (Table 2). At 14 days, although spore production was not completely suppressed, all urea treatments significantly reduced the intensity of spore release to the low category (0-50 spores per piece of debris), compared with the untreated which showed approximately 40% spore release in the medium category (50-150 spores per piece of debris). At 28 days after treatment at the Norfolk site, although there were no significant differences in the suppression of spore production, there was a trend for urea applied at 100 kg N/ha in 400 L/ha to give the greatest reduction in spore release of 72% compared to the untreated. At the experimental site in Hereford, there was no significant reduction in spores released from the debris. This differs from the results seen in 2013 where the application of urea at 100 kg N/ha post-ridging gave a significant reduction in spore release for up to 28 days post application at both trial sites in the east and west (Annual Report, FV 341b). In 2014 the treatments were not as effective or persistent, or alternatively the weather may not have been so conducive to ascospore release when the debris was collected for assessment.

Table 2. Summary of the effect of urea treatments on production of *Stemphylium vesicarium* ascospores from asparagus crop debris after pre-harvest applications – 2014

Treatment and application timing				% spore production relative to the untreated (= 100%) at intervals after treatment				
		Water volume (L/ha)	*KgN/ha*	Hereford			Norfolk	
				1 Days after T1	14 Days after T1	56 Days after T1	1 Days after T1	28 Days after T1
1	Untreated	0	0	100	100	100	100	100
2	Urea	1000	100	73	100	233	100	57
3	Urea	400	100	45	100	166	**63**	28
4	Urea	400	50	100	135	266	105	100
5	Urea	250	50	82	227	183	89	114
7	Nufol 20	250	50	64	208	166	74	72
9	Urea	400	50	64	112	216	95	100

Values in bold are significantly different from the untreated.
Results for treatments 6 and 8 are not shown as they had not been applied at this point.

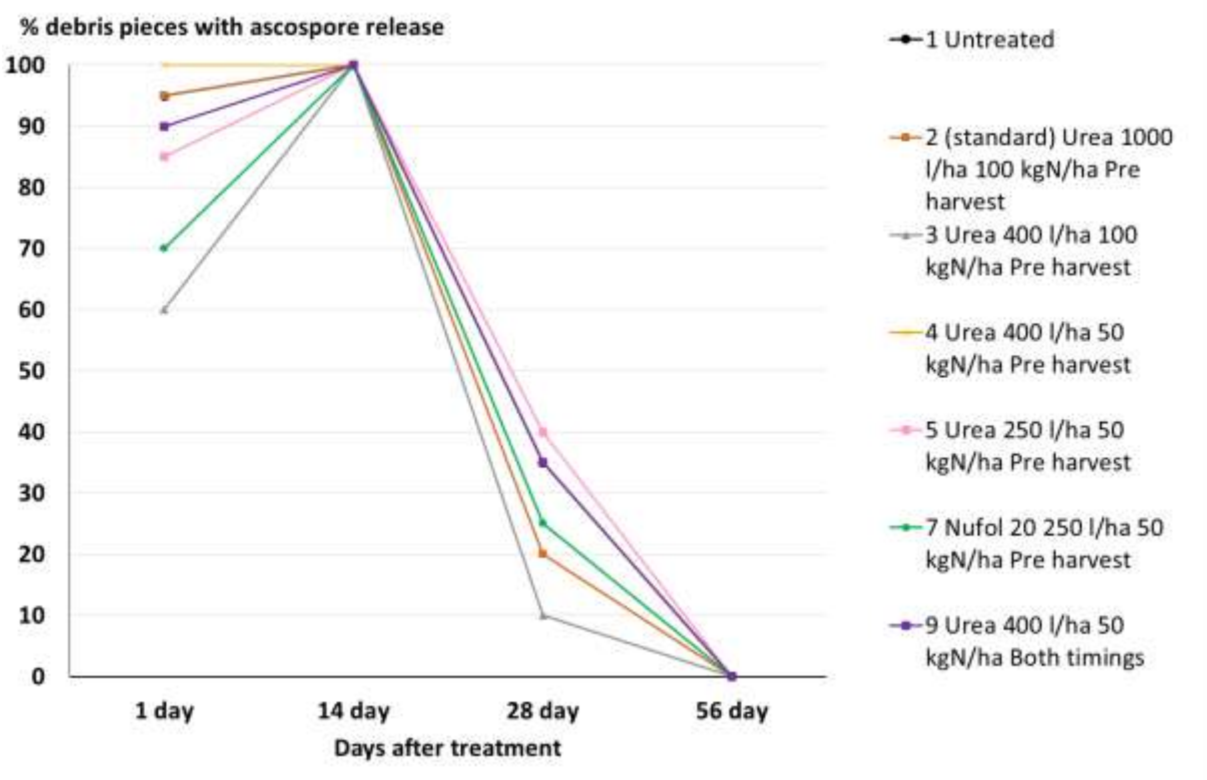

Figure 1. Trend in percentage of ascospores released from resting bodies on debris for a period of 8 weeks after urea treatments applied before harvest at the Norfolk site, April to June 2014 (i.e. after the first treatment application and before the second).
N.B. *The data line for the untreated (treatment 1) tracks that of treatment 4 and after day 14 both these treatments track treatment 9. Results for treatments 6 and 8 are not shown as they had not been applied at this point.*

At both sites, there was low or no spore release from the debris after the 2nd application of treatments was made (post-harvest) and there was no effect of urea treatments on spore release. Results from HDC project FV 341 indicated that *Stemphylium* spores on asparagus debris mature between January and March. Therefore the majority of spores are released from infected crop debris just prior to or during the crop harvest which takes place from April to June.

In the dry summer of 2014, conditions were not conducive to infection and development of Stemphylium purple spot. The disease was at low levels during spear harvest and was well controlled during fern development by the commercial fungicide programmes used. Urea treatments applied did not provide additional control of the disease.

The exact mode by which urea suppresses spore release is unknown. However, it has some effect and is used in other crops for control of pathogens such as in apple orchards where urea has been used for a number of years for control of apple scab (*Venturia inequalis*). Here the main mode of action is to hasten the breakdown of leaves, and so destroy the host on which the pathogen needs to survive, it is also acknowledged that the urea changes the microbial and chemical populations on the leaf which could be affecting ascospore release. Where the exact mode of action is unknown, and a number of unpredictable biological factors could be contributing to spore reduction, it is more difficult to reliably predict the efficacy of urea for management of Stemphylium purple spot.

Objective 3: Effect of adjuvants on efficacy of urea in suppressing S.vesicarium spore release.

A pot trial was completed to test a range of adjuvants for their influence on the efficacy of urea against *Stemphylium* spore release from asparagus debris, as well as to consider other forms of nitrogen that could be substituted for urea (which may be more convenient for the grower to use). Eleven treatments were applied to the debris on 28 April as below (Table 3).

Table 3. Fertiliser treatments applied, tank mixed with a selection of adjuvants – ADAS Boxworth, 2014

Treatment number	Treatment	Active Ingredient	Rate N (rate adjuvant)	Water volume
1	Untreated			
2 (standard)	Urea + Silwett – L77	46% N + silicone based adjuvant	50 kg N/ha 0.15%	400 L/ha
3	Urea + Tween 20	46% N + surfactant (polyoxyethylene (20) sorbitan monolaurate)	50 kg N/ha 0.1 - 0.5%	400 L/ha
4	Urea + Activator 90	46% N + non-ionic wetter	50 kg N/ha 0.1%	400 L/ha
5	Urea + X-change	46% N + water conditioner	50 kg N/ha 0.25%	400 L/ha
6	Urea + Grounded	46% N + petroleum oil	50 kg N/ha 1.0%	400 L/ha
7	Urea + Bond	46% N + sticker/extender	50 kg N/ha 0.1%	400 L/ha
8	Urea + Toil	46% N + methylated rape seed oil	50 kg N/ha 1.5 L/ha	400 L/ha
9	Ammonium nitrate+ Silwett – L77	34% N + silicone based adjuvant	50 kg N/ha 0.15%	400 L/ha
10	Nuram37+ Silwett – L77	37% N (w/w) + silicone based adjuvant	50 kg N/ha 0.15%	135 L/ha
11	Nufol20+ Silwett – L77	20% N (w/w) + silicone based adjuvant	50 kg N/ha 0.15%	250 L/ha
12	Ammonium sulphate+ Silwett – L77	21% N + silicone based adjuvant	50 kg N/ha 0.15%	400 L/ha

In the pot experiments carried out at ADAS Boxworth significant differences could be seen at 14 days after application between the adjuvants used. Of the adjuvants trialled with the urea, Silwett-L77 facilitated the greatest spore suppression, and Activator-90, X-change, Grounded and Bond also significantly reduced the spore release at 14 days after application. This result provides a range of choices to the grower of products available in the chemical store which could be substituted for Silwett-L77 if more convenient. Alternative forms of nitrogen were also evaluated for their effects on spore release in the trial and ammonium nitrate, ammonium sulphate and Nufol20 also significantly reduced spore release but did not perform as well as the urea and Silwett-L77 combination. In the field experiments, Nufol20 did not give a significant reduction in spore release as it did in the pot experiments (Table 2, p4).

Objective 4: Effect of water volume on efficacy of urea in suppressing S.vesicarium spore release.

A pot trial was completed to test the influence of a range of water volumes on the efficacy of the urea against *Stemphylium* spore release from asparagus debris. Eleven treatments were applied to the debris on 28 April as below (Table 4).

Table 4. Urea treatments applied at different water volumes per hectare – ADAS Boxworth, 2014

Treatment	Product	Water volume L/ha	Rate (kgN/ha)
1	Untreated control	-	0
2 (standard)	Urea + Silwett – L77*	1000	50
3	Urea + Silwett – L77*	800	50
4	Urea + Silwett – L77*	600	50
5	Urea + Silwett – L77*	400	50
6	Urea + Silwett – L77*	200	50

* wetter applied at 0.15%

The influence of water volumes on spore release was also tested in an adjacent experiment to the adjuvants trial with significant differences seen between treatments at 1 day and 14 days after application. The greatest reduction in spore release compared to the untreated was at 14 days after application when urea was applied in 1000 L/ha. There was no significant difference between treatments from 200 to 800 L/ha in the experiment, suggesting that once volume is reduced below 1000 L/ha then the choice of volume used does not have a large influence on increasing efficacy.

Financial Benefits

The project shows that urea reduced spore release from debris for 14 days post application at one field site only. When applied instead of or as an additional fertiliser application after ridging and prior to spear emergence, urea has potential to reduce the inoculum pressure during harvest. The urea spray would most likely be best used as part of an integrated approach to disease control alongside existing fungicide and fertiliser programmes. It could be argued that with reduced inoculum pressure post-harvest, the first spray application could be delayed and numbers of sprays reduced. However since most available fungicides are primarily protectant in activity, then this would probably be inadvisable. The use of urea for *Stemphylium* control therefore represents an additional input on top of any fungicide programs.

Applying an extra urea spray as well as ammonium nitrate and alongside a fungicide programme may add to input costs for disease control by c. £60/ha using current urea costs of £280/tonne. However urea application seems to contribute to management of *Stemphylium* by reducing spore release near the stem bases, in turn possibly reducing the risk of infection, in an area which is difficult to reach with fungicide sprays when the canopy is closed. Assuming an average yield of 2.5 tonne/ha and a farm gate price of £5,500/tonne, a yield loss of only 0.45 % represents a reduction in sales equivalent to the cost of the additional urea input. Therefore if urea provides a following year yield benefit greater than 0.45 % by additional control of *Stemphylium*, it is worth considering as part of an integrated programme of *Stemphylium* control in asparagus at current urea prices.

Action Points

- Asparagus fields with high infection pressure from Stemphylium purple spot may benefit from a pre-harvest treatment of urea to suppress spore release from crop debris. Of the treatments tested in this project, urea (combined with Silwett-77) at the rate of 100 kg N/ha in 400 L/ha water gave the most consistent suppression of spore release, up to 14 days after treatment. This finding was supported by results from similar field trials in 2013 (FV 341 b).

- To reduce spore release and possibly purple spot in the emerging crop without compromising crop nutrition or environmental risk, consider applying urea twice as 50 kg N/ha prior to and during harvest instead of nitrogen as a fertiliser. Applying the majority of the asparagus crop’s nitrogen requirement, (bearing in mind the NMax in an NVZ is 180 kg N/ha) as urea at 100 kg N/ha just prior to spear growth is not environmentally advisable given that N offtake by the spears at this point in growth is very low, and would increase the risk of loss of N to leaching in a wet spring.

- Urea sprays if used are best targeted to a pre-harvest timing. There appears to be no gain from an application of urea between spear harvest and fern growth, as the majority of ascospore release occurs prior to or during spear harvest.

- The timing of spore release from debris indicates that the highest risk of infection by *S. vesicarium* is to the spears during harvest. But ultimately if protectant fungicides are not applied post-harvest early enough before canopy closure to protect stem bases, infection from debris uncovered by footfall during harvest is still a risk during later fern development as it is the initial source of infection as shown in work in FV 341.

- Commence protectant fungicide programmes soon after the end of harvest and prior to canopy closure, in order to protect asparagus stem bases from infection.

- The work indicates that Silwett-L77 is the best tank mix partner for urea for greatest spore suppression, but if this is not conveniently available to the grower, Activator-90, X-change, Grounded and Bond offer viable alternatives.

- Although Nufol20 gave a significant reduction in spore release in the pot experiments, this significant effect was not borne out in the field trials. However, if used this formulation would be a more practical option for larger scale growers.

- Applying urea in 1000 L/ha gives the greatest efficacy for suppressing spore release but this is not practical, especially for larger growers. Once volumes were reduced below 1000 L/ha then the choice of volume used did not have a large influence on increasing efficacy.