UAN – a better way to apply N to crops?

N product comparison

Liquid N application

Liquid N compatibility with pesticides

The aim of this trial was to investigate whether liquid N as UAN is a better and more reliable source of N compared to using granular Urea. The trials included an N product comparison; a liquid N application trial (nozzle set up); and an investigation of liquid N compatibility with herbicides and fungicides.

Summary

Liquid N (UAN as Easy N) was a major focus for trial work on wheat at Birchip and Laen.

UAN was compared to granular N products (urea and ammonium nitrate) and no differences in yield or protein were found between the various products tested, or the timing during the season when the products were applied. The dry seasonal conditions and high soil N contributed to the lack of response from N fertilisers at both sites.

UAN applied with flat fan or streaming nozzles showed no difference in leaf scorch or yield. Conditions at the time of application were relative humid (higher than 50%) which may have had an affect. In addition, UAN was applied in a mix with water (59L UAN and 41L of water) this may have resulted in less crop damage than has been observed in other trial work.

UAN mixed with herbicides or fungicides applied at mid tillering (GS15) or flag leaf emergence (GS39) caused no crop damage and there were no yield differences observed. This may have been because the UAN was mixed with water.

UAN did not mix easily with 2,4D Amine and this herbicide needs to be mixed with water before UAN is added.

The BCG will continue with UAN trial work because we consider this product to have more benefits than spreading urea in crop.

Background

Urea has been the nitrogen fertiliser product of choice for farmers in the Wimmera and Mallee. It has been the cheapest form of N fertiliser and has been commonly pre-drilled prior to seeding. Pre-drilling urea has become less popular in the recent run of dry seasons. Due to the dry conditions applying N pre-seeding has not been required (no return on investment) or in some cases, has resulted in haying-off. Haying-off is a double negative because the costs are the urea applied pre-seeding and the lower yield when the crop grew too quickly and ran out of water in spring.

To reduce the risk of N fertiliser not being required or the crop haying off, farmers have been topdressing their crops during the season as the crop has required it. The problem with using urea for topdressing is that urea volatilises rapidly when applied

to highly alkaline soils if it does not rain sufficiently to wash the product into the soil. Estimates from CSIRO (Jeff Baldock) have shown that on our soil types with a pH above 8.0, 35% of the N applied as urea can be lost if it does not rain within 8 days of application.

A better way needs to be found to apply N fertiliser in-crop. If there is to be an alternative to using urea it has to be more reliable in relation to uptake (ie. higher N efficiency) and it has to be cheap and convenient.

Farmers in Western Australia have found a solution by using UAN (Urea Ammonium Nitrate) which is a liquid formulation of N, containing 42% N. Many WA farmers apply UAN when they spray their crops with herbicides or fungicides – and apply the amount as needed for the potential of the crop. UAN is marketed by Incitec-Pivot in Victoria as Easy N. UAN is taken up by the crop both through the leaves and through the soil after rain has washed the product into the soil. It is the uptake through the leaves which may make this product more efficient to use compared to topdressing urea on our highly alkaline soils. Leaf uptake of UAN has been estimated to be as high as 60% (Ian Fillery, CSIRO).

In this trial we compared how efficient UAN is as an N source compared to the granular products urea and ammonium nitrate. We also investigated the compatibility of UAN with herbicides and fungicides – because ultimately it is the in-crop application that may be most convenient and efficient. The concern of UAN in combination with different herbicides and fungicides scorching the crop was also investigated.

Methods

Three trials were undertaken:

- UAN product comparison to granular urea and ammonium nitrate; applied pre-seeding and in-crop
- UAN applied in-crop using flat fan and streaming nozzles (to compare crop damage from potential crop scorching when the product is applied with a flat fan nozzle or streaming nozzle)
- UAN biological compatibility with herbicides and fungicides (to determine whether it is safe to use UAN in combination with herbicides or fungicides)

The trials were conducted using fully replicated (x4) randomised block designs at Birchip and Laen.

Yitpi wheat was sown at 175 plants/m^2 at both sites. The trials were on sown on May 6th at Birchip and June 22nd at Laen.

Available N in the top 70cm of soil at seeding was - Birchip 65 kg and Laen 101 kg N/ha.

Trial 1. N product comparison

Three sources of N fertiliser (granular Urea – 46% N; Ammonium Nitrate – 27% N; and liquid UAN (as Easy N) – 42% N) were applied at 25kg N/ha at three stages: pre-drilled; five leaf stage (GS15) and end of tillering (GS30). UAN was applied at the same rate of N as the other N products (59L/ha of Easy N) and was mixed with water to a total volume of 100L/ha, and applied with XR11002 flat fan nozzles.

Trial 2. UAN application – flat fan vs. streaming nozzles

UAN (as Easy N) was applied at 25kg of N (59L/ha of Easy N) and mixed with water to a total volume of 100L/ha. The product was applied using two types of nozzles: XR11002 flat fan and a SJ3-04VP Streamjet nozzle. The product was applied at both the five leaf stage (GS15) and end of tillering (GS30).

Trial 3. UAN compatibility with herbicides and fungicides

UAN (59L of Easy N) was mixed with water (41L) to make a total volume of 100L/ha to which a range of herbicides and fungicides were added. Treatments were applied pre-seeding; in crop at the five leaf stage (GS15) and at full flag leaf emergence (GS39), using XR11002 nozzles. The UAN / pesticide mixes include the most commonly used herbicides and fungicides – see the results for a list of products used. Weather conditions at the time of spraying and immediately after were recorded. The level of scorching was assessed 5 days after application.

Weather conditions at the time of spraying the UAN (Trials 2 and 3) and spreading the granular urea and ammonium nitrate (Trial 1) are listed in Table 1.

Table 1. Weather conditions at the time of spraying UAN and time in days between the application and rain.

	Pre-sowing		**GS15**		**GS39**	
	Birchip	**Laen**	**Birchip**	**Laen**	**Birchip**	**Laen**
Date	May 6	June 22	July 20	Aug 10	Sep 15	Sep 28
Temp ^{o}C	22	12	11	13	15	15
Humidity %	54	76	55	67	49	82
Delta T	6	2	4	3	5.5	2
Days to rain*	12	8	4	19	14	1

* Days before a minimum of 5mm rain (to wash in N product)

Results

The season was very dry at both trial sites and not conducive to high crop yields. In addition, both sites were relatively high in soil available N at seeding (65 and 101 kg N/ha at Birchip and Laen respectively) – hence for the seasons rainfall and potential yield the crops did not require any additional N.

Trial 1. N product comparison

There were no observable differences in crop performance at Birchip and Laen between the control treatment (no N) and any of the three N products used. In addition, there were no differences in yield between the N products, or in relation to the time they were applied (Table 2). This indicates that UAN did not cause damage to the crop when used at the five leaf stage nor at the end of tillering.

Table 2. N product (Urea; Ammonium Nitrate and UAN) applied at 25kgN/ha at three timings (pre-drill; five leaf (GS15); and end of tillering (GS30).

Timing	**Pre-drill**		**GS15**		**GS30**	
Site	**Birchip**	**Laen**	**Birchip**	**Laen**	**Birchip**	**Laen**
Control (no N)	*0.78*	*2.5*				
Urea	0.80	2.5	0.80	2.5	0.80	2.5
Amm Nit	0.82	2.5	0.84	2.5	0.78	2.4
UAN	0.70	2.5	0.88	2.5	0.90	2.5
Significant difference:	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Trial 2. UAN application – flat fan vs. streaming nozzles

There was no significant difference in yield between applying UAN with a flat fan nozzle compared to using streaming nozzles, at either Birchip (average yield 0.87

t/ha) or Laen (average yield 2.5 t/ha). The time when the product was applied (five leaf compared to end of tillering) was also not significant.

Trial 3. UAN compatibility with herbicides and fungicides

Biological compatibility

The effect of the UAN, as Easy N, applied on its own or mixed with herbicides or fungicides was assessed on the level of leaf scorch. There was a low level of leaf scorch with UAN mixed with MCPA500 plus Diuron applied at the five leaf stage, the crop grew out of the low level damage and within 3 weeks the effects were no longer visible. No other mixes applied at the five leaf stage resulted in leaf scorch (less than 2% damage to the youngest emerged leaf). Fungicides and herbicides applied late post emergent (at full flag leaf emergence) had a higher level of leaf scorch (8% of flag leaf damaged) compared to the application at five leaf. At the late application there was no difference between the products applied in the level of leaf scorch (products compared were: 2,4 D Amine; Bumper, Folicur, Opus and Amistar Xtra).

The effect of UAN as mixed with herbicides or fungicides on crop yield, protein and screenings is presented in Table 3.

Table 3. UAN, as Easy N, applied at 25kg of N/ha (mixed with 41L of water to make 100L/ha of spray solution) mixed with herbicides and fungicides – applied at three stages (IBS, GS30 and GS39).

Product	Timing	Pesticide Rate (/ha)	Yield (t/ha)		Protein (%)		Screenings (%)	
			Birchip	Laen	Birchip	Laen	Birchip	Laen
UAN	IBS		1.0	2.2	15.9	14.4	3	1
+ Triflur480	IBS	0.8L	1.0	2.1	16.1	14.7	3	1
		Significant difference	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
UAN	GS15		1.0	2.1	16.4	14.7	2	1
+ Ally/LVE/ wetter	GS15	3g + 0.4L + w 0.1%	1.1	1.9	15.6	14.8	2	1
+ Ally/LVE/ Lontrel/wetter	GS15	3g + 0.4L + 70ml + w 0.1%	1.0	2.0	16.2	14.7	2	1
+ Tigrex	GS15	0.4L	1.0	2.2	16.3	14.6	3	1
+ MCPA 500/ Diuron	GS15	0.35L + 0.35L	1.0	2.0	16.1	15.0	3	1
+ Topik/uptake	GS15	40ml + 0.5%	0.9	2.2	15.3	14.7	2	1
+ Hoegrass/ wetter	GS15	1.5L+0.25%	0.9	2.2	15.7	14.4	3	1
		Significant difference	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
UAN	GS39		1.0	2.3	15.4	14.2	3	1
+ Amicide625	GS39	1.2L	1.0	2.2	16.3	14.7	3	1
+ Folicur	GS39	0.145L	1.0	2.4	15.9	14.1	3	1
+ Bumper	GS39	0.25L	1.2	2.3	16.5	14.5	2	1
+ Opus	GS39	0.5L	1.1	2.5	16.3	14.4	3	1
+ AmistarXtra	GS39	0.4L	1.3	2.4	16.4	14.5	3	1
		Significant difference	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Interpretation

Soil nitrogen supply at sowing was high and considering the dry conditions throughout the season the N levels in the soil were able to match the crops N requirements. N fertiliser applications did not add to yield. The application of N did add to protein (no N: 15.4% and 14.6% protein; + N: 16.1% and 15.5% protein at Birchip and Laen respectively). Screenings at Birchip ranged between 4 and 6% (no treatment affects) and at Laen screenings were very low at 1%. Generally the late applications of nitrogen fertiliser at flag leaf emergence (regardless of product type) had higher protein levels compared to applications earlier in the season.

There were no differences found in yield between N product (granular: urea, ammonium nitrate; and liquid: UAN). Nor were there differences found in yield between how the UAN was applied (no difference between flat fan or streaming nozzle application).

We recorded no serious scorching effects when UAN was mixed with herbicides or fungicides applied either early (five leaf) or late (flag leaf emergence). There were no significant effects on yield from the application of UAN in mixes with various herbicides and fungicides at either Birchip or Laen. Application conditions were undertaken at relatively low Delta T conditions (reasonably humid) and little or no crop damage was observed. It is possible that little or no damage was observed because the UAN was never applied neat, it was always applied in a mix with water (59L of UAN and 41L of water).

In this trial the UAN was mixed with water first, then the herbicide or fungicide was added. With the 2,4 D Amine mix this resulted in separation. When the 2,4 D Amine was mixed first with water before the UAN there was no separation and the products mixed very well.

The trial work will be repeated this coming season.

Commercial Practice

Following this years trial results we are confident that UAN can have a role as an in-crop N fertiliser.

The benefits of UAN are:

- Ease of use (can be applied with a standard boom)
- Better distribution of N (spreaders rarely spread evenly)
- Lower rates of N can easily be applied (with granular products it is difficult to apply much less than 50kg/ha of product)
- Foliar applied UAN appears to be more efficient in uptake compared to spreading granular products
- Can be mixed with most herbicides and fungicides
- If applied as a UAN and water mix, in the right conditions little or no crop damage is likely
- Possible to mix your own urea with water (needs set up)

The negatives of UAN are:

- Price (in SE Australia the product is 30% more expensive compared to in WA)
- Can be harsh on spraying equipment (UAN is corrosive and precautions have to be taken)
- UAN needs to be stored in special tanks.
- There is no extensive network for delivery of UAN in Victoria.