Fluid Fertilizer Foundation

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THE FLUID JOURNAL

The Fluid Journal is published by the Fluid Fertilizer Foundation. Click on the magazine below to see our current issue.

Why Fluids?

Dale Leikam

What Are The Top 10 Advantages Of Fluid Fertilizers ?

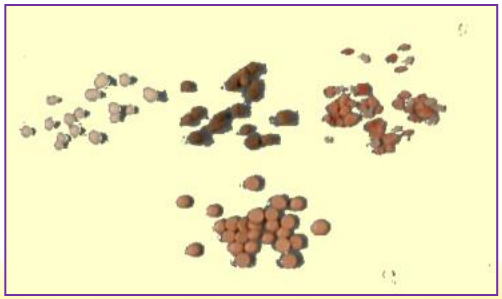
There Are So Many!

Some Benefit Everyone

For others, the relative advantage depends on the specific situation involved.



vs.




Solutions and Opportunities with Fluid Fertilizer

- Improve fertigation injection times, timings
- Lower application costs from fertigation
- Many Liquid CRF materials for soil and foliar
- At high yield levels, placement, timing critical
- Fluids fit the 4 Rs best
  - Right Material
  - Right Rate
  - Right Place
  - Right Time

Tom Gerecke 2011 Workshop

Solutions and Opportunities with Fluid Fertilizer

- Uniformity of application, especially micronutrients
- Soil pH up or down changes with depth, faster
- Uniform blends
- all in 1/ balanced applications
- Better efficiency with no till – even trees and vines
- Dilute-able for crop safety
- No dissolution for fertigation or sprays
- More, varied opportunities for additive inclusion
- Co-application with crop protection chemicals
- Liquids have most rapid foliar uptake

Actagro Plant Nutrients

What Are Your Top Benefits ?

1. Fertilizer Placement
   a) Starter Applications
   b) Subsurface Band (knife)
   c) Surface Band (dribble)
2. Homogeneous Blends/Droplets
3. Split Applications
4. Foliar Applications
5. Nutrient Use Efficiency
6. Uniform Applications (including micronutrients)
7. Handling Convenience
8. Combining With Weed Control
9. Fertigation
10. Environmental Benefits
11. Precision Ag/Variable Rate Prescription Application
12. Etc., Etc., Etc.

Why Fluids?

5. Logistics

- Handling Convenience
- Product Safety
- Equipment Requirements
- Storage, Transfer & Application

Temperature of Ammonia	Vapor Pressure
60°F	93 psi
100°F	197 psi

Fluid Fertilizer Foundation

Logistics

- **Handling Convenience & Cost**
  - Much easier and cost effective to equip for handling & applying fluid fertilizers (University researchers!)
- **Product Safety**
  - Desiccant properties & high pressure for ammonia
- **Numerous Fluid Equipment Options**
  - Many equipment options for fluid vs. dry
- **Transfer/Storage/Application Logistics**
  - Pumping vs. auger/belt transfer
  - Nurse tanks & plant storage requirements
  - Hose inspection/replacement
  - Caking, 'fines' development during handling

Why Fluids?

4. Precision - Right Rate

- Application Uniformity & Accuracy
- Homogeneous, No Segregation, Continuous Bands
- Calibration
- Variable Prescription Applications

Why Fluids?

4. Precision - Right Rate

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- Variable Prescription Applications

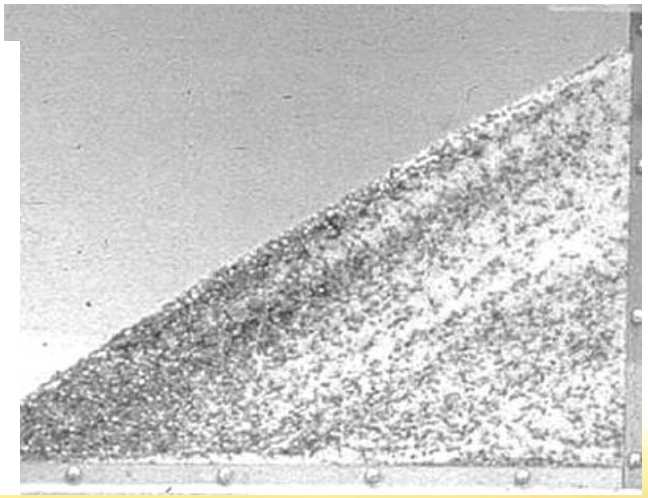
Uniform Distribution Of Nutrients With Fluid Fertilizers Is Unmatched

- *Uniform across the field*
- *Uniform across application swath*
- *Uniform within a continuous band*

Precision: No Segregation

Once blended, solid fertilizers immediately begin the process of unblending

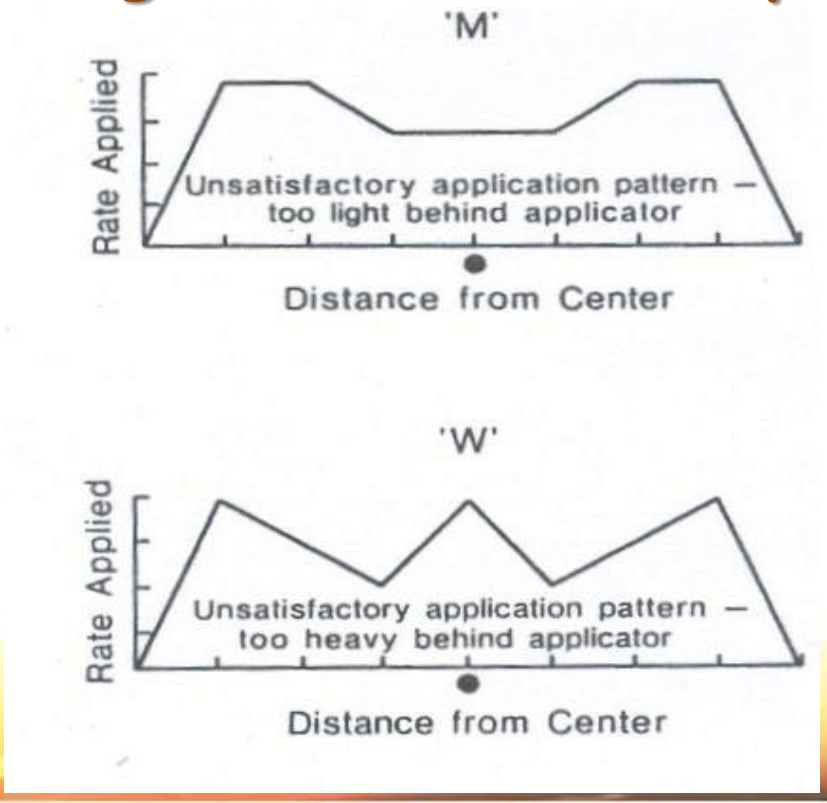
- **Coning** – Occurs as blended materials are dropped, forming a conical pile in storage and application equipment – Larger particles roll to the edge of the pile
- **Vibration** – Vibration segregation occurs as the tendering equipment and applicator travel to or across the field – Size, weight.
- **Ballistic** – Ballistic segregation occurs during application. Larger particles weigh more and travel farther than smaller particles – 2X difference in diameter = 8X difference in weight.



Precision: Uniform Application

Once blended, solid fertilizers immediately begin the process of unblending!

Particle size is also the dominant characteristic affecting swath uniformity as well



Right Rate: Distribution Uniformity

ALABAMA

Optimizing Nutrient Stewardship Using Broadcast Fertilizer Application Methods

By John Fulton, Timothy McDonald, C. Wesley Wood, Oladiran Fasina and Simerjeet Virk

Visual illustration of the resulting distribution from an individual pan test using Blend 1 (17-17-17). Note that the DAP particles (larger in diameter) were applied further out than the KCl (pink particles) and ammonium nitrate (white particles). While not clearly visible, the center three tubes contain the highest percentage of dust particles, which were mainly ammonium nitrate.

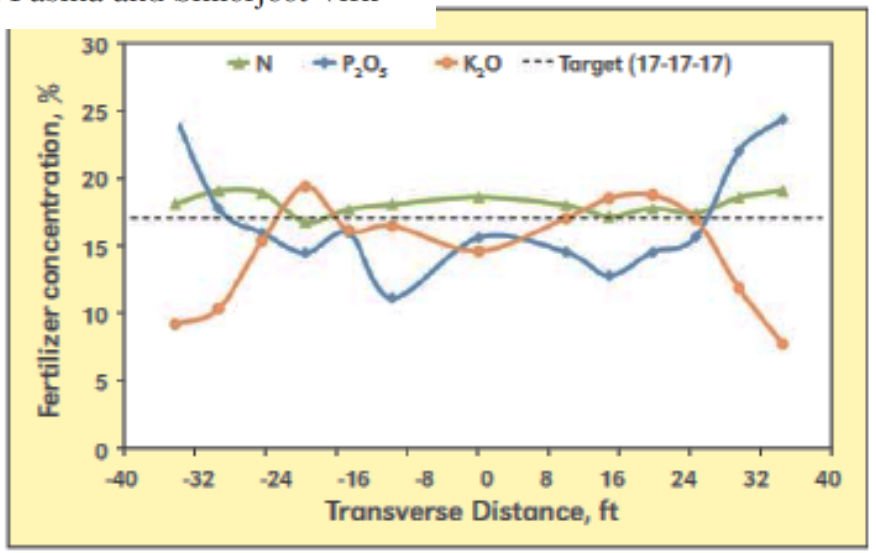


Figure 1. Example nutrient concentration across the spread width for Blend 1 (17-17-17) with a spreader setup at a 70 ft. spread width. Reported data are the mean of three pan tests.

Better Crops
2013, No. 3, pg. 15-17

Fluid Fertilizer Foundation

Precision: Band Uniformity

by Drs. B. Eghball and D.H. Sander

Does Variable Distribution Affect Liquid P-Use Efficiency?

Florida scientist offers tips on how to use starters, plus describes the many benefits that accrue from their use. He focuses on corn.

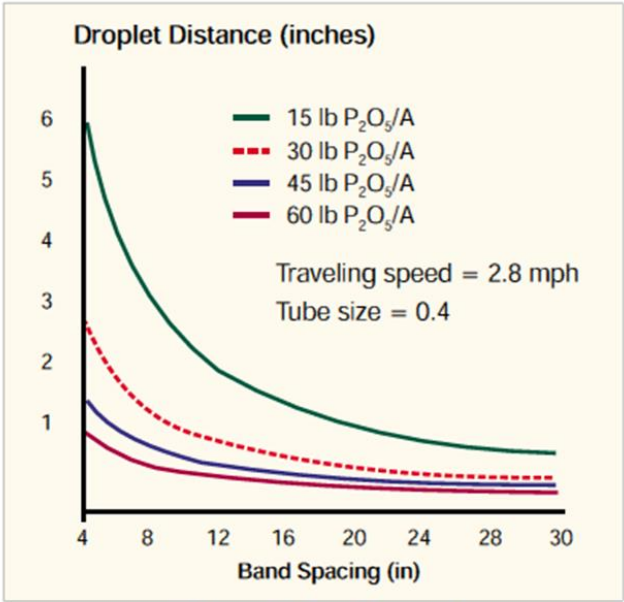


Figure 3. Effect of band spacing on distance between droplets at different rates of P application

Fluid Journal
Winter 2001

'*Root contact*. The probability of root-P contact is known to be very important to P efficiency. The growth rate of roots is much greater in P-treated than untreated soil. It has been shown that very sizable quantities of P can be absorbed by only a portion of the root system. ..... It appears that when roots contact a P droplet, root proliferation can be expected, as well as an increase in root growth in that part of the soil. *However, exhaustion of P in that soil area affected by the P droplet or dry particle could be a limiting factor*.'

Fluid Fertilizer Foundation

Precision: Band Uniformity

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Does Variable Distribution Affect Liquid P-Use Efficiency?

Florida scientist offers tips on how to use starters, plus describes the many benefits that accrue from their use. He focuses on corn.

Fluid Journal
Winter 2001

"..... we suggest that plant roots may follow a continuous band with only one root contact. However, with discontinuous bands, where fertilizer is placed in droplets or as dry particles too far apart to interact with each other, a new root contact may be needed for each droplet or particle."

"Mixing of 10-34-0 with UAN may improve P-use efficiency both through improved P distribution and through ammonium-N effects on P uptake and P fixation."

Drs. Eghball and Sander
University of California

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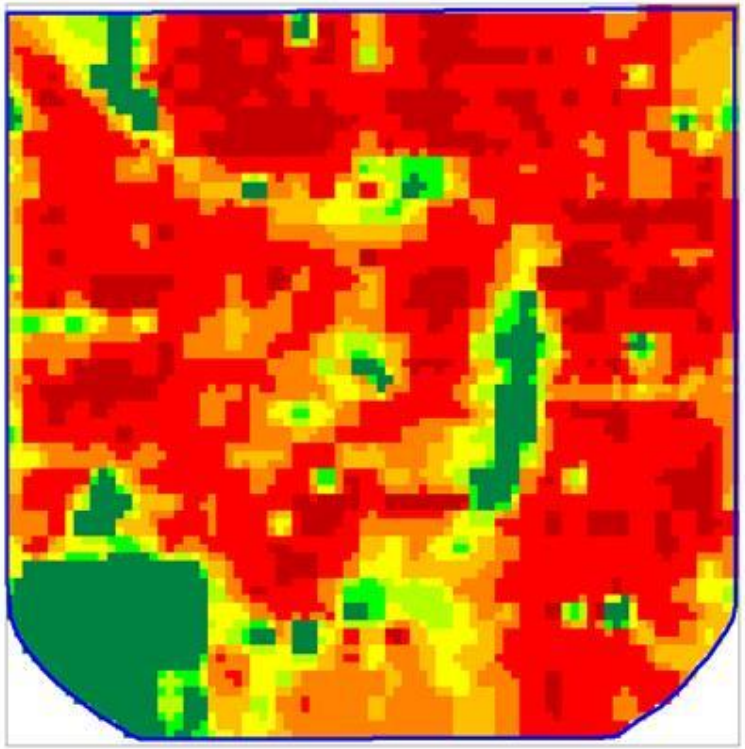
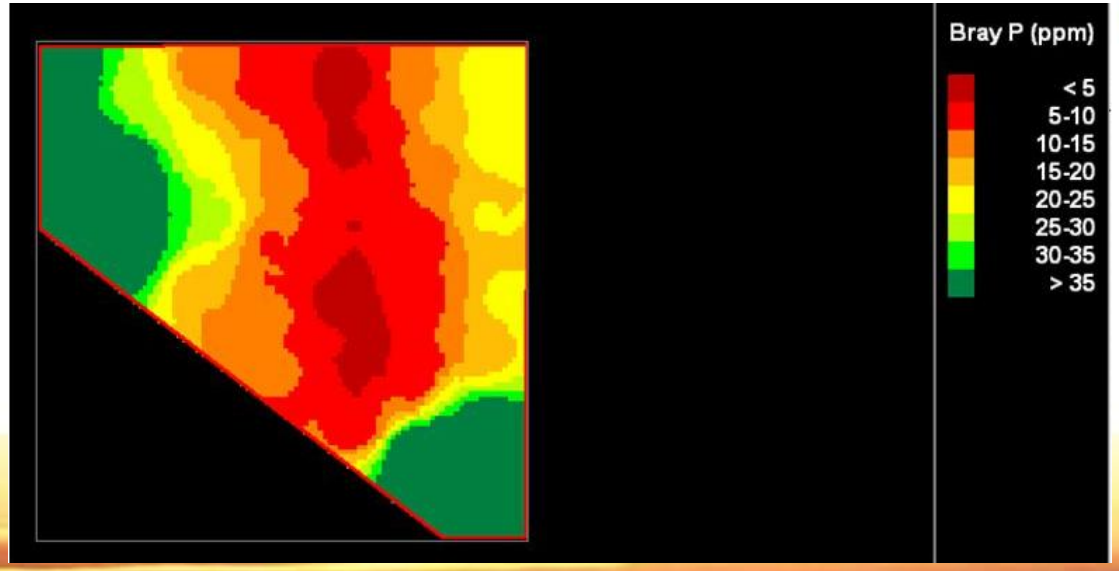
Right Rate:

Variable Prescription Applications

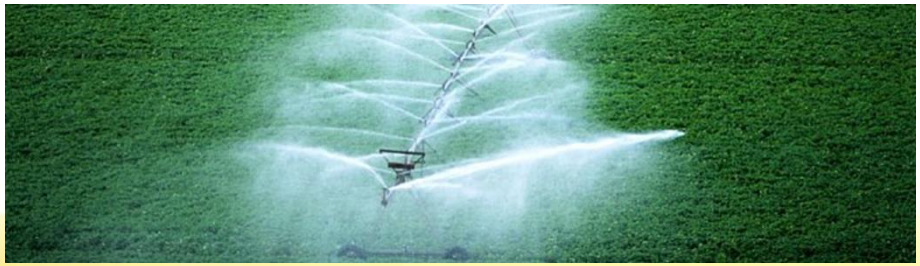




3. Flexibility

- **Adaptability**
  - Respond to changing environment (eg. weather)
  - Easily adjust to changing conditions (e.g. reduced-till)

- **Versatility**
  - A wide variety of best-fit functions/competencies
  - Ability to do many things very well
  - Ability to fit many and varied situations



Flexibility

Adaptable - Uniquely suited to changing soil/environmental conditions

Adaptable - Provides flexibility for simultaneous precision operations & applications

- **Tillage and planting equipment**
- **Irrigation/fertigation systems**
- **With other crop nutrients & micronutrients**
- **With many pesticides**
- **With many fertilizer additives**

Flexibility

Drs. Thomas A. Doerge and T. L. Thompson

Trickle Irrigation: One Answer To Site-Specific Nutrient Management

Practice is combined with tissue nitrate testing used to avoid N deficiencies as well as unneeded N inputs.

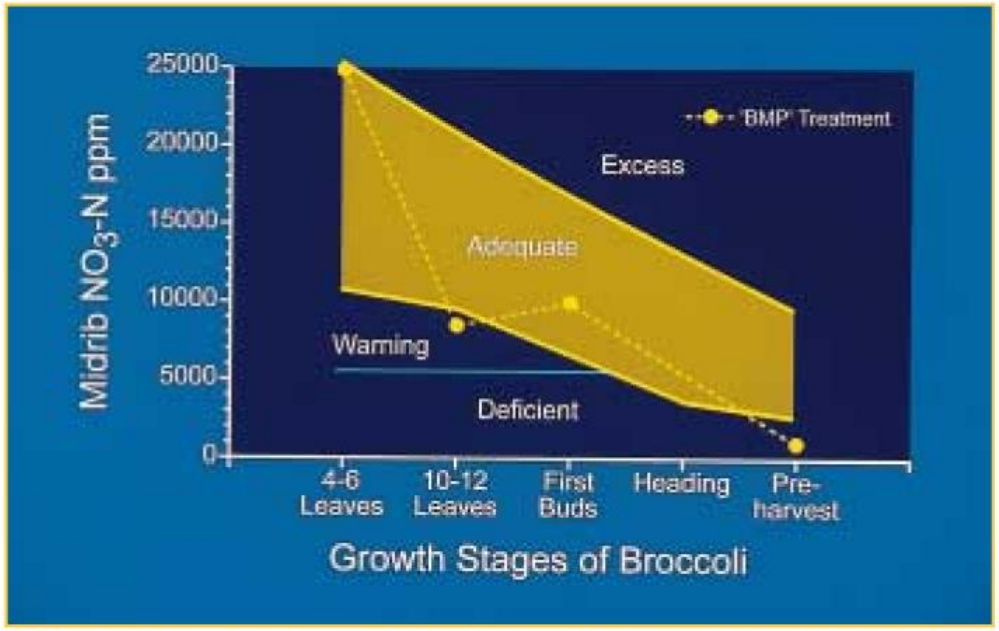


Figure 3. Interpretation of seasonal petiole nitrate levels in the BMP nitrogen treatment for broccoli, Doerge, et al., University of Arizona, 1994-95.

"Trickle irrigation in combination with feedback from in-season nitrogen (N) tissue tests offers almost unlimited flexibility in developing site-specific nutrient management plans."

Tom A. Doerge & T. L. Thompson
University of Arizona

Fluid Fertilizer Foundation

Flexibility

Versatile - Only nutrient sources adaptable to ALL methods & placements

- **Broadcast**
- **Subsurface, surface, dribble and starter banding**
- **Drip, sprinkler and flood irrigation**
- **Only option for in-season foliar application**

Versatile - Fits conventional, conservation, reduced, no-till systems and long-term permanent crops

Versatile - Ideally suited for pre-plant, planting time and in-season application

Flexibility

Dr. Gyles Randall

Managing Nitrogen With Five-dollar Gas

Escalating natural gas prices with little possibility of low-cost nitrogen returning, strongly encourages growers to fine-tune management practices or jeopardize profits.

What form of N fertilizer is favored for split applications?

Fluid Journal 2004

"Seven-year average corn grain yields were lowest with fall N without N-Serve, intermediate and equal for fall N + N-Serve and spring preplant N, and highest for split N treatment ..... Apparent N recovery and economic return in decreasing order: split N > Spring > Fall + N-Serve > Fall N.

These results clearly show yield, profitability and N efficiency advantages for the split N treatment."

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Versatility & Adaptability

Fluid JOURNAL
Official Journal of the Fluid Fertilizer Foundation
Late Spring 2009
Vol. 17, No. 3, Issue #65

Dr. Derrick Oosterhuis

Timely Foliar Applications Rectify Nutrient Deficiencies

Applications should be made either early morning or late afternoon for maximum efficiency.

"Foliar fertilization is a viable means of applying certain fertilizers that can supplement traditional soil methods. *It can be used to improve the efficiency of a nutrient urgently required by the plant to produce maximum growth, yield, and fiber quality*. In this way, foliar fertilization supplements soil applications for a more efficient supply of nutrients to the developing cotton plant for optimum yields and fiber quality. In general, foliar applications should be made early morning or late evening for maximum efficiency, and no foliar applications should be made to water-stressed plants."

Fluid Journal 2009

Flexibility:
Versatility & Adaptability

by Dr. Raun Lohry

Liquid Starter Makes Conservation-till Work

Research shows liquid starters continue to excel under intensive management

Dr. Gary Gascho

Late-Season Foliar Sprays Boost Soybean Yields

Yield increases as high as 9 bu/A achieved in Georgia experiments.

Paul S. Belzer

Point Injection: Viable Option for Growers

Studies show improved field responses, minimal soil disturbance, reduced energy costs and increased fertilizer efficiency.

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Why Fluids?

2. Agronomics

- Nutrient Use Efficiency
- Soil Chemistry
- Uniquely Suited To 4R Stewardship

Agronomics: Efficiency

Drs. J. L. Havlin, A. J. Schlegel and G. M. Pierzynski — Fluid Journal 1993

Improved yields improve environment

Tests made on grain sorghum and winter wheat to determine optimum recovery and minimize N leaching.

Fluid Journal 1993

Table 2. Fertilizer management effect on ANR and soil N content after harvest.

Rate (lbs/A) N	Rate (lbs/A) P_2O_5	Placement Method	Grain Sorgum ANR* %	Grain Sorgum Soil N* lbs/A	Winter Wheat ANR* %	Winter Wheat Soil N* lbs/A
0	0		-	41	-	25
40	0	Broadcast	22	70	31	44
40	20	"	36	59	44	40
40	40	"		52		36
80	0	"	**31.8%**	86	**36.7%**	57
80	20	"	30	66	32	50
80	40	"	34	64	33	48
40	0	Knife	37	61	46	41
40	20	"		50		39
40	40	"	**42.5%**	48	**54.0%**	33
80	0	"		76		49
80	20	"	36	58	50	43
80	40	"	38	57	49	40
40	0	Dribble	35	64	43	45
40	20	"		48		41
40	40	"	**41.2%**	50	**50.2%**	35
80	0	"	29	79	42	54
80	20	"	34	55	51	41
80	40	"	37	51	50	40

*ANR = apparent N recovery; Soil N = inorganic N content, 0 to 4-foot depth

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Agronomics: Efficiency

Fluid Journal
Spring 1993 & Fall 1994

by Dr. Raun Lohry

Liquid Starter Makes Conservation-till Work

Research shows liquid starters continue to excel under intensive management

"The most spectacular response from any plant food applied with starter is the tremendous increase in fertilizer efficiency gained by banding zinc in starter. In Nebraska tests, one-tenth of a pound of zinc increased yields by 37 bushels per acre! Researchers said, "With placement below and to the side of the seed only small amounts of zinc were needed to produce maximum yields."

Table 5. Effect of starter applied zinc on corn grain yield over two years.

lb Zinc/A	Yield bu/A	Increase
0	82	
0.1	119	37
0.3	127	45
1.0	135	53

Effective Zinc Management

An infinitesimal amount of this mighty nutrient goes a long way in helping to product yield gains

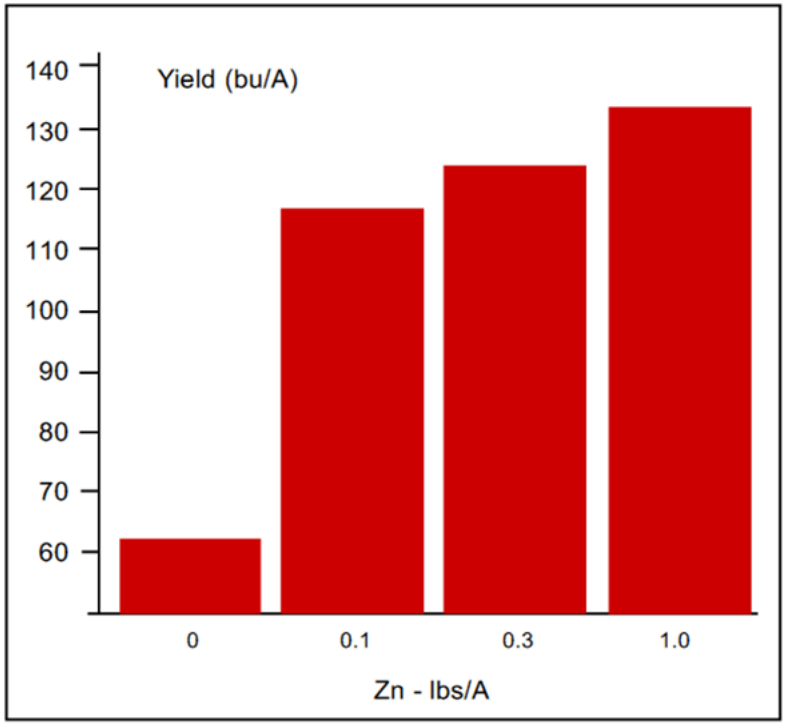

Figure 3. Effect on corn yield when banding zinc near seed, University of Nebraska.

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Agronomics: Efficiency

Dr. Richard H. Fox and William P. Piekielek

Fluids Shine in Ammonia Volatilization Comparisons

Tests in no-till corn fields in central Pennsylvania compare UAN with urea.

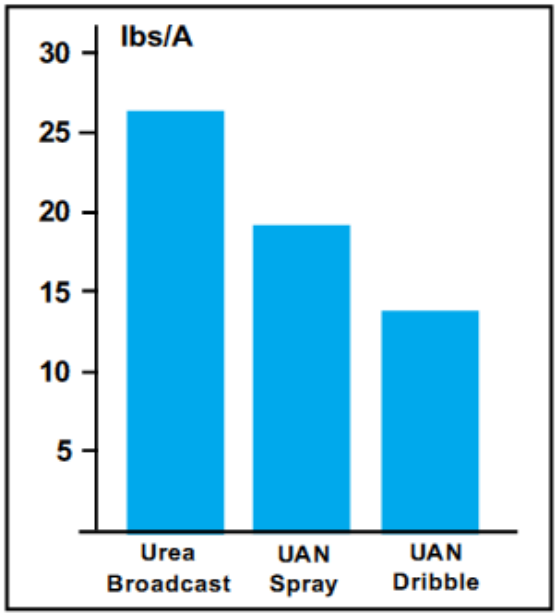

Figure 2. Total ammonia loss over 16-day period using different sources/methods, elinimating two outlier plots, Fox and Piekielek, Penn State, 1993.

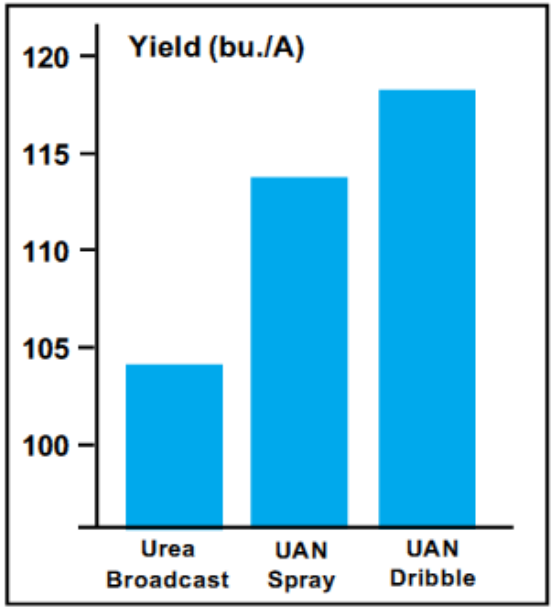

Figure 3. Corn Yields at early dent stage as function of N fertilizer source and method of application, Fox and Piekielek, Penn State, 1993.

"Fields had been in no-till for at least two years. ..... Nitrogen fertilizer was applied at the rate of 120 lbs/A on May 12 when corn plants were one to two inches tall. Soil surface covered with crop residue when treatments were applied ranged from 60 to 80 percent."

❑

Agronomics: Soil Chemistry

by Dr. R.E. Holloway, Dr. I. Bertrand, Mrs. A.J. Frischke, Mrs. D.M. Brace, and Dr. M.J. McLaughlin

Fluids Outdual Granular In Australian Wheat Trials

Fluid sources of P, N, and Zn performed markedly better than granular fertilizers in terms of promoting dry matter, P uptake, and grain yield.

Fluid Journal Winter 2002

" Shoot dry weight increased 27 percent by adding 9 lbs/A of fluid N, versus no response to granular application. Similarly, the application of 9 lbs/A of fluid N increased P uptake in shoots by 29 percent, Mn uptake by 31 percent, and N uptake by 30 percent. No differences were recorded with granular applications."

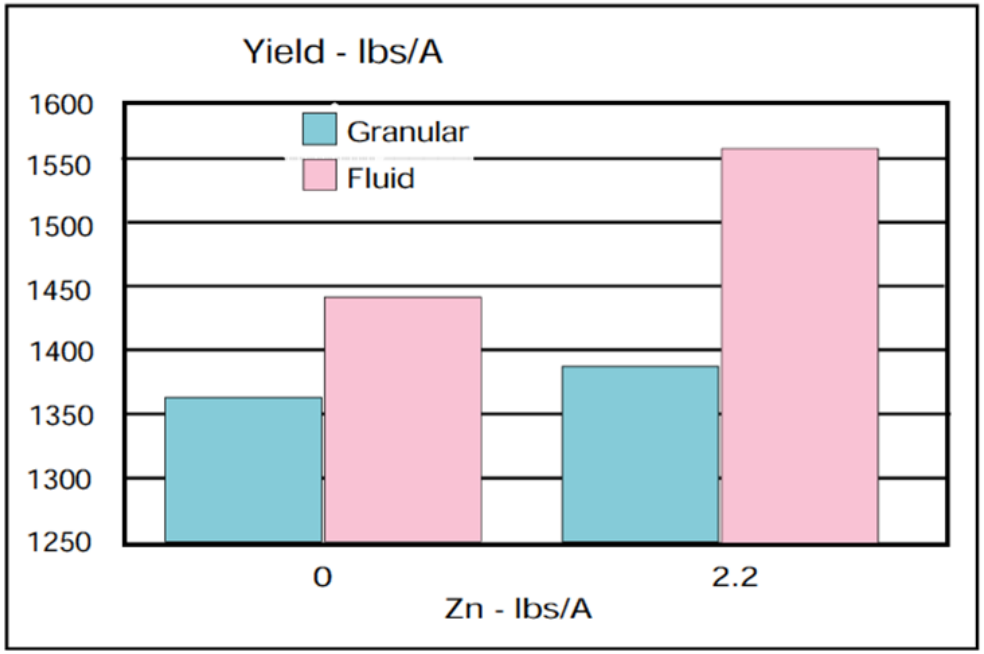

Figure 4. Effect of fertilizer source and application of Zn on grain yield of Frame wheat, Emerald Rise, 2000.

Agronomics: Soil Chemistry

DR. B. HOLLOWAY, D. BRACE, DR. I. RICHTER, DR. M. MCLAUGHLIN, G. HETTIARACHCHI, DR. R. ARMSTRONG

Micronutrient Availability Improved With Fluids

"The results support our conclusion in the 2005 issue of the Fluid Forum Proceedings, which shows that the best practice for cereal production on the highly calcareous soils of South Australia should involve the use of NP fluid fertilizers containing micronutrients-–principally Zn, Mn, and Cu, although Cu was not used in these experiments."

Fluid Journal 2006

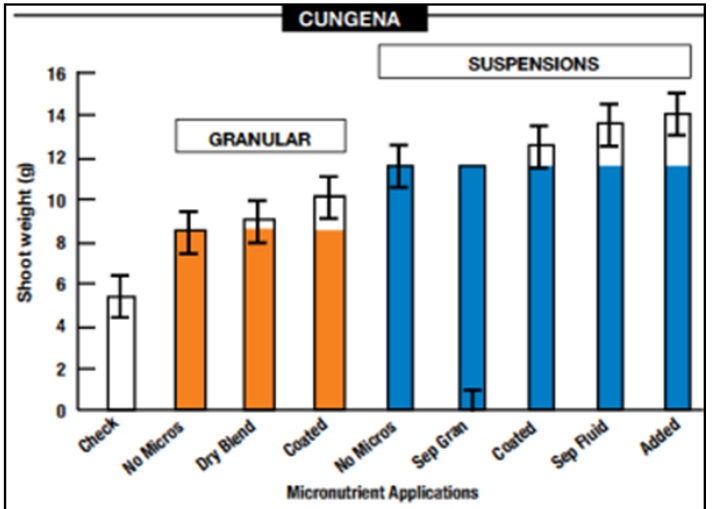

Figure 1. Response of Yitpi wheat shoot growth at early tillering. Color bars show response in shoot growth to granular and suspension fertilizer, with micronutrient response added as the clear top portion of the bar.Cungena, 2005.

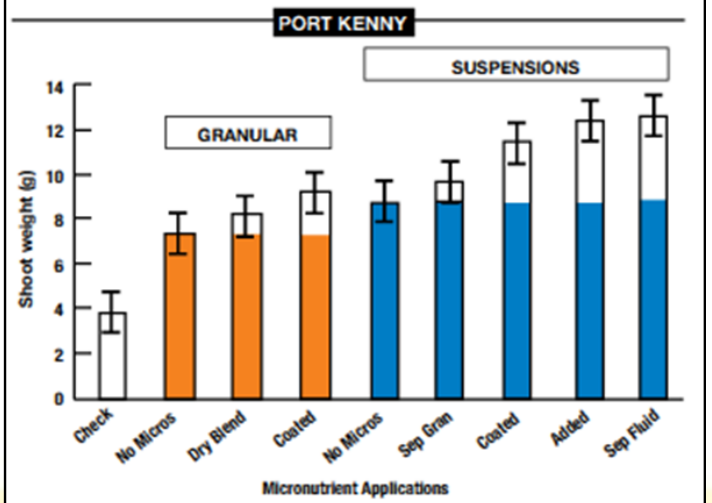

Figure 2. Response of Yitpi wheat shoot growth at early tillering. Color bars show response in shoot growth to granular and suspension fertilizer, with micronutrient response added as the clear top portion of the bar. Port Kenny, 2005.

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Agronomics: 4R Right Rate

The Right Rate: ***Uniform Distribution Of Nutrients With Fluid Fertilizers Is Unmatched***

- *Uniform across application swath*
- *Uniform across the field*
- *Uniform within a continuous band*

Agronomics: 4R Timing & Placement

by Dr. Stanley A. Barber

Timing And Placement One Key to High Yields

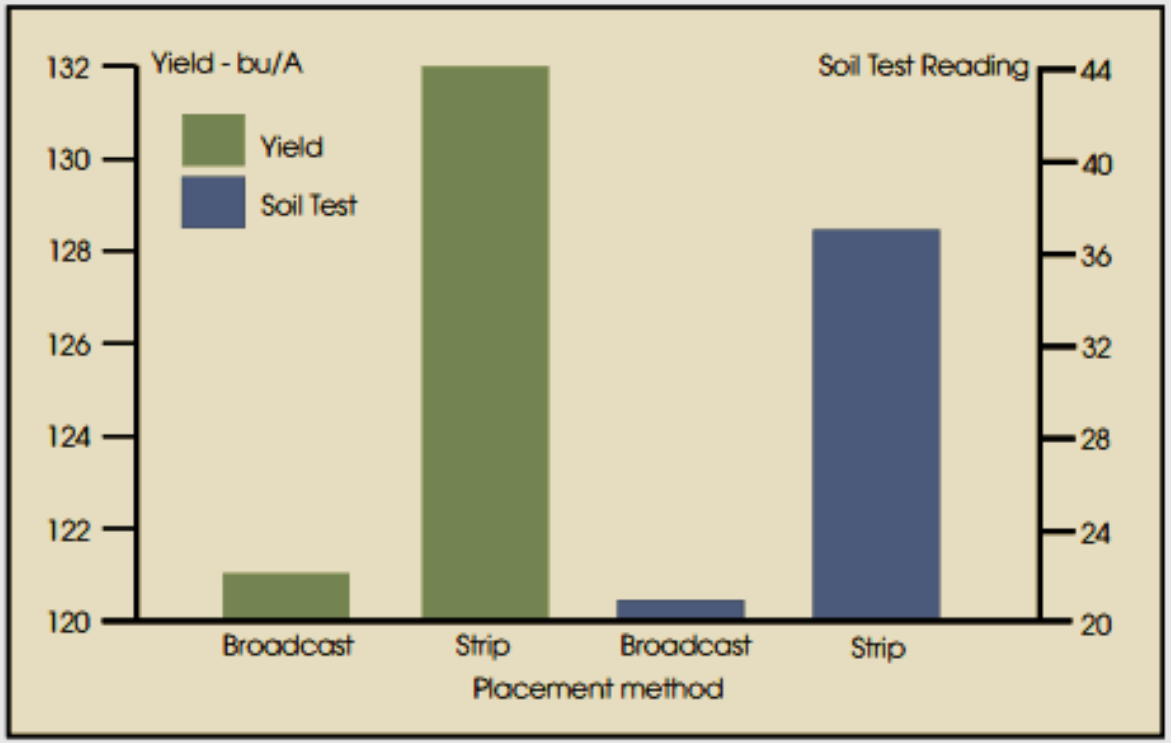

Figure 3. Average corn yields in a five-year comparison study of strip versus broadcast, Barber, Purdue University.

"Using an intermediate degree of mixing, accomplished via strip treatments, has proven the more efficient placement. Fertilizer reaches a greater proportion of the root system and is not tied up as much by the soil as occurs with broadcast applications. The use of strip treatments, versus the extremes of banding and broadcasting, is definitely worth considering in the pursuit of getting greater yield responses from applied fluids." .....

Dr. Stan Barber

Fluid Fertilizer Foundation

Agronomics: 4R Timing & Placement

Fluid Journal
2007

DR. M. ALLEY, M. MARTZ, AND DR. W. THOMASON

Timing of N and P Crucial In Achieving High Corn Yields

"Data from these trials clearly indicate that relatively **high rates of N are needed in starter band fertilizers, and that P applications can be determined by soil testing. Our recommendations for corn are to apply 50 lbs/A of N in a 2 x 2 starter band in conjunction with needed P up to a rate of 50 lbs/A of P2O5 in the starter band. This rate of P covers the vast majority of soils used for corn production in the mid-Atlantic region.** "

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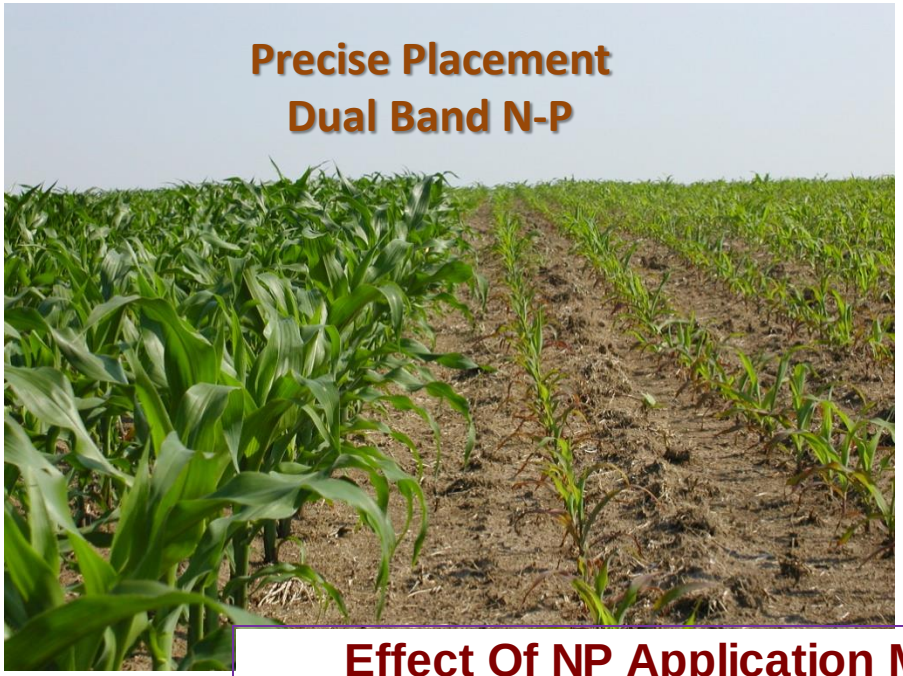
Agronomics: Precise Placement



Effect Of NP Application Method On Wheat Yield

Application Method		Wheat Grain Yield (1979)		
		Harper	Dickinson	Osage
N	P	(bu/a)	(bu/a)	(bu/a)
Knife	Knife	47.9	64.0	62.90
Knife	B'cast	44.8	52.9	56.40
B'cast	Knife	46.8	56.4	59.10
B'cast	B'cast	44.8	53.4	52.90
	LSD (0.05)	NS	6.8	NS
No P Check Yield		43.8	47.3	57.10

Kansas

Fluid Fertilizer Foundation

Agronomics: 4R Timing & Placement

Fluid Journal
Spring 1999

T.L. Wesley, Drs. R.E. Lamond, V.L. Martin, S.R. Duncan

Applied N At R3 Stage Bumps Soybean Yields

Nitrogen applications at R3 growth stage produce 11.8 percent average yield increase in two-year Kansas study.

"Results from a two-year study at four irrigated sites in Kansas show that late-season application of N to soybeans at the R3 growth stage will increase soybean yields."

DR. GEORGE REHM, DR. JOHN LAMB, AND MARK BREDEHOEFT

A Look At Seed-safe Applications Of Fluids

Fluid Journal
Winter 2007

Rehm, Lamb & Bredehoeft

Table 2. Corn yield as affected by fluid material, rate and placement in soils with two contrasting soil textures, 2005

	Texture, Placement, Rate											
	Silty clay loam						Loamy find sand					
	with seed		top of seed		below seed		with seed		top of seed		below seed	
Material	high	low	high	low	high	low	high	low	high	low	high	low
	Check 208.7 bu/a						Check 185.5 bu/a					
5 & 10 gpa 10-34-0	211.6	203.6	213.8	208.9	213.6	209.6	154.9	176.8	170.5	190.6	151.7	199.3
5 & 10 gpa 4-10-10	204.7	196.9	210.3	208.4	203.0	210.3	192.8	203.7	188.4	208.7	201.3	190.9
3.4 & 6.8 gpa 3-18-18	201.0	212.2	215.3	209.3	211.0	206.7	189.3	207.8	205.7	203.5	201.1	204.4

Control (no fluid fertilizer) = 208.7 and 185.5 bu/A for silty clay loam and loamy fine sand sites, respectively.

"Grower interest in use of banded fluid fertilizer at planting is increasing. This renewed interest is due, in part, to frequent observations that banded fertilizer increases crop growth and subsequent yield. ……. there are now several inexpensive attachments that can be added to planters to place fertilizer in a band near the seed at the time of planting."

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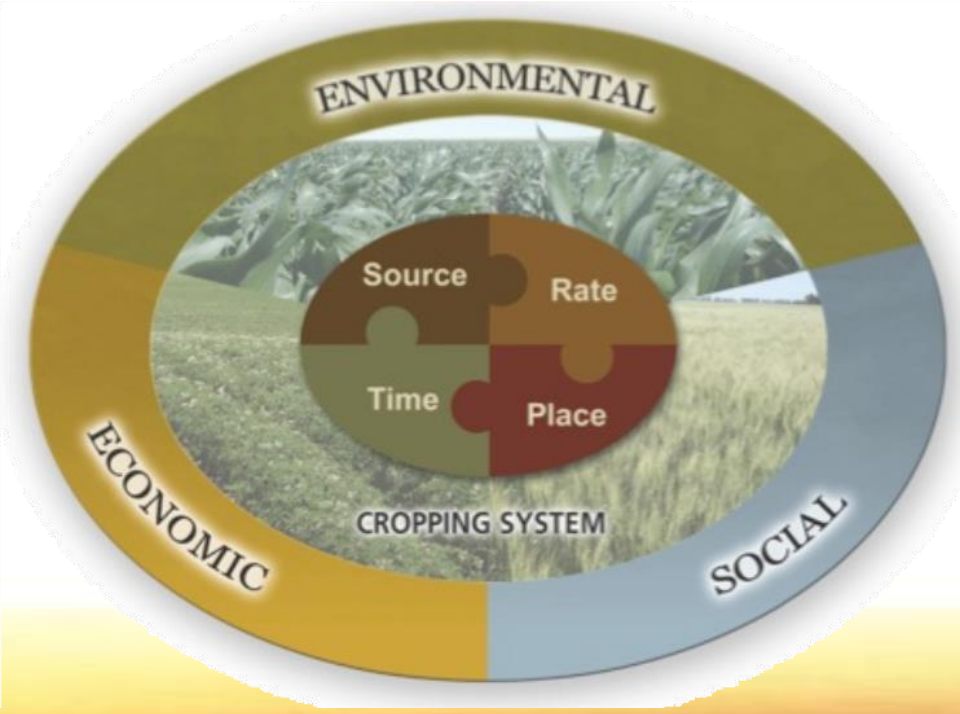
Agronomics: 4R Stewardship

3 R's ?

"~~Right source at~~ the right rate, right time, and right place"



Fluid Fertilizer Foundation

And the Number One Advantage Of Fluid Fertilizers Is ….

1. Value

- Logistics, Flexibility, Precision and Agronomics ……
- Profitability & Stewardship

Don’t Confuse Low Cost with Value

- Low Cost Is Not The Key To Profitability
- You Can’t Save Yourself Into Prosperity!

Why Fluids – Only 11 Top Reasons??

1. Fertilizer Placement
2. Homogeneous Blends/Droplets
3. Split Applications
4. Foliar Applications
5. Nutrient Use Efficiency
6. Uniform Applications (including micronutrients)
7. Handling Convenience
8. Combining With Weed Control
9. Fertigation
10. Environmental Benefits
11. Precision Ag/Variable Rate Prescription Application
12. Etc., Etc., Etc.

Why Fluids ?

1. Value

- Performance, Profitability & Stewardship

2. Agronomics

- Uniquely Suited To 4R Stewardship
- Nutrient Use Efficiency
- Soil Chemistry

3. Flexibility

- Adaptability
- Versatility

4. Precision - Right Rate

- Application Uniformity & Accuracy
- Homogeneous, No Segregation, Continuous Bands
- Calibration
- Variable Prescription Applications

5. Logistics

- Special equipment not required
- Product transfer/storage logistics
- Equipment complexity, versatility & cost

Why Fluids?

Dale Leikam

Dale.Leikam@cox.net

785-770-0009

Fluid Fertilizer Foundation

Fluid Facts

WHY FLUIDS ?

Top 10 lists are ever popular in our culture today – so what are the top 10 advantages of fluid fertilizers? Ask a handful of farmers and dealers and you likely will come up with a handful of different answers. There are so many, and the advantages so varied, that it is not possible to come up with a single top 10 list that everyone can agree to! Some advantages benefit everyone. For others their appeal depends on the specific situation involved. Typical benefits noted include things such as: a wide variety of fertilizer placements, homogeneous blends, best adapted for split applications, high nutrient use efficiency, handling conveniences, provides environmental benefits, required for fertigation, best suited for variable rate application, and many other benefits that give fluids a distinct economic appeal. While it is not possible to name the definitive top 10 benefits of fluids that apply in all situations, these top five advantages of fluid fertilizers should broadly fit most everyone. Let's start with number five!

Fluid Top 5 Advantages

#5 Logistics. *There is no doubt that fluid fertilizers excel in providing efficient logistics, which allows for the necessary timeliness of crop production practices required for efficient crop production.*

#4 ….. Right Rate. *Average application rates within a field are only one aspect of the 'right' rate. Application uniformity across the application swath and across the field (or portion of field) is equally important.*

Fluid fertilizers are homogeneous, with each drop having the same composition as the next drop. On the other hand, once blended, solid fertilizers immediately begin the process of unblending, segregating and becoming increasingly non-uniform during each step of the application process.

An often overlooked aspect in achieving the 'right' rate is the concept of achieving continuous crop nutrient bands in preplant and starter band applications. The probability of roots contacting a band and proliferating in the band will be higher if the fertilizer is deposited in a continuous, unbroken nutrient band as opposed to intermittent bands resulting from dry fertilizer granules.

#3 ….. Flexibility. *Because fluid fertilizers have unparalleled versatility and adaptability as compared to other fertilizer, flexibility is often the first thing that comes to mind when discussing the advantages of fluid fertilizers.*

Fluids are versatile and fit all crop nutrient placements, application methods, and nutrient timings – a characteristic not shared with any other class of fertilizer products.

#2 ….. Agronomics. *Fluid fertilizers, in conjunction with the previously discussed benefits associated them, have a long documented research history of providing high nutrient use efficiency (NUE), high yields, and improved environmental stewardship.*

#1 ….. Value. *The benefit of fluid fertilizers is high value – the overall benefit relative to costs. And the totality of the benefits associated with fluid fertilizers far outstrips any difference in the purchase price of specific crop nutrients.*

High Value Provides For Prosperity – Low Cost Does Not!

Author Credit

Dr. Dale Leikam is President of the Fluid Fertilizer Foundation in Manhattan, KS.

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FLUID FERTILIZER FOUNDATION
fluidfertilizer@fff.kscoxmail.com
fluidfertilizer.com

Fluid Facts

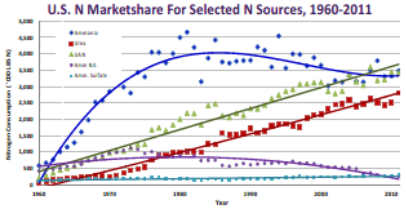
WHY UAN SOLUTION?

The popularity of urea-ammonium nitrate solution (UAN) in the U.S. has increased steadily and substantially over the past 50 years. While direct applied anhydrous ammonia dominated the overall U.S. nitrogen (N) marketplace through the 1980s, UAN and anhydrous ammonia have each had about the same market share (nutrient basis) in the U.S. over the past decade. While UAN consumption is not as high in other places across the globe as in North America, the global popularity of UAN continues to increase, especially in Europe and the former Soviet Union.

Summary Points

There are many reasons the popularity of UAN has continued its steady increase over the years:

- *Agronomics: Obvious crop nutrient source for 4R Nutrient Management.*
- *Fertilizer Placement & Timing: Keys to Nutrient Use Efficiency (NUE).*
- *Uniformity/Accuracy: Accurate rate, uniform distribution, no segregation, ease of calibration.*
- *Adaptability/Flexibility: Adaptable to wide range of production systems and flexible to fit limitless application needs.*
- *Combining Applications: With pesticides, field operations & micronutrients, via irrigation, etc.*
- *Logistics: Easier and logistically more efficient to pump, store, transfer and apply.*
- *Safety: Fewer safety concerns/regulations.*
- *Numerous additional situation specific benefits.*



Conclusions

Over the years there have been many discussions about what N source is the best. Of course, it does depend on the specific field situation being addressed, but in general, what N source would be favored?

Specialized equipment is required for ammonia application and that equipment is costly and not easily adapted to many desired fertility program options. Also, the fact that ammonia is limited to direct application below the soil surface is a huge limitation relative to other N sources. And while urea is the dominant global N fertilizer, that is a reflection of limited infrastructure and equipment for other N sources that are not yet readily available in many regions of the world. Urea is also subject to potential volatilization loss under certain conditions and equipment for subsurface application is not as affordable or common.

As a result, if we could have only one N source in the marketplace, it is an easy choice: UAN solution. Why? In addition to issues related to safety, storage, handling, and equipment requirements, the main reason UAN is much more a universal N source than other N sources in the marketplace can be summed up in one phrase: unsurpassed adaptability and flexibility!

Article Credits

Dr. Dale Leikam is President of the Fluid Fertilizer Foundation in Manhattan, Kansas.

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fluidfertilizer@fff.kscoxmail.com
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