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 ?

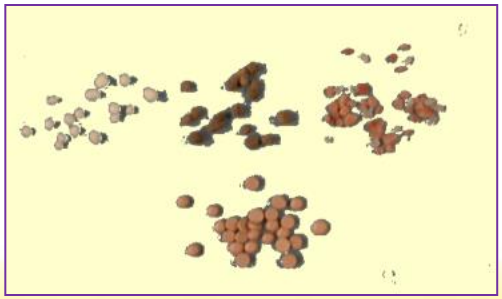
There Are So Many!

Some Benefit Everyone

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



vs.




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
- Logistics Of Storage & Application

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

Fluid Fertilizer Foundation

Logistics: Equipment and Safety

- **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

Precision: No Segregation

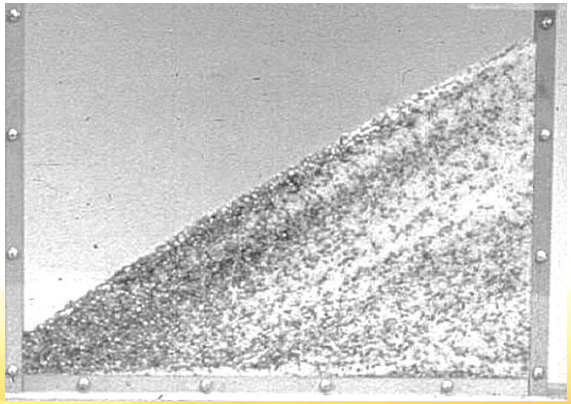
Once blended, solid fertilizers immediately begin the process of unblending

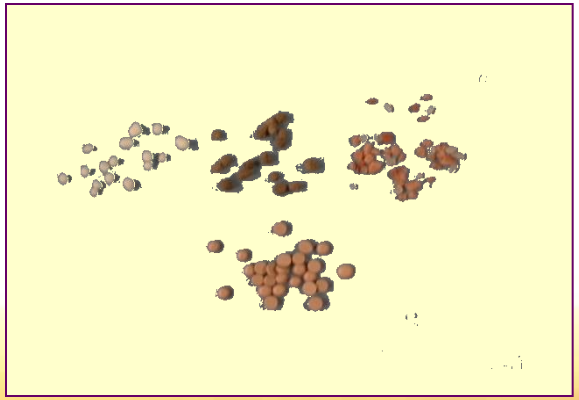
- **Coning** – Occurs as blended materials are dropped, forming a conical pile in storage and application equipment
  - Larger particles tend to roll to the edge of the pile
  - Smaller particles tend to accumulate in the center

Precision: No Segregation

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

- **Vibration** – Vibration segregation occurs as the tendering equipment and applicator travel to or across the field

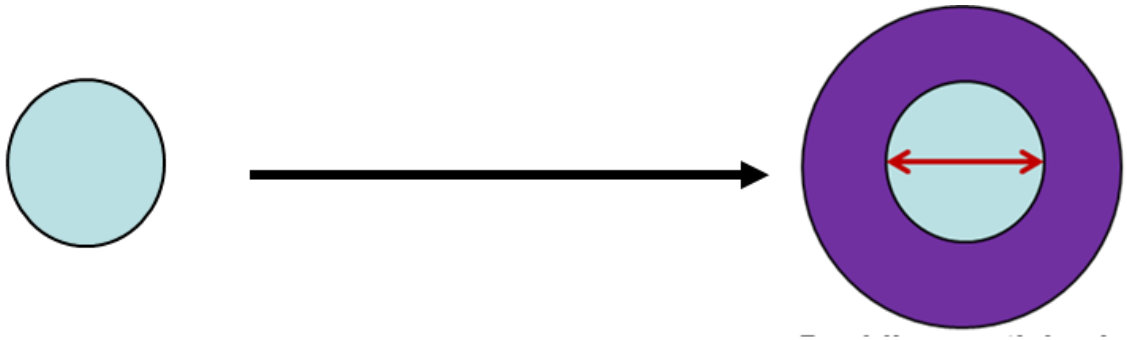




Precision: No Segregation

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

- **Ballistic** – Ballistic segregation occurs during application since larger particles weigh more and travel farther than smaller particles



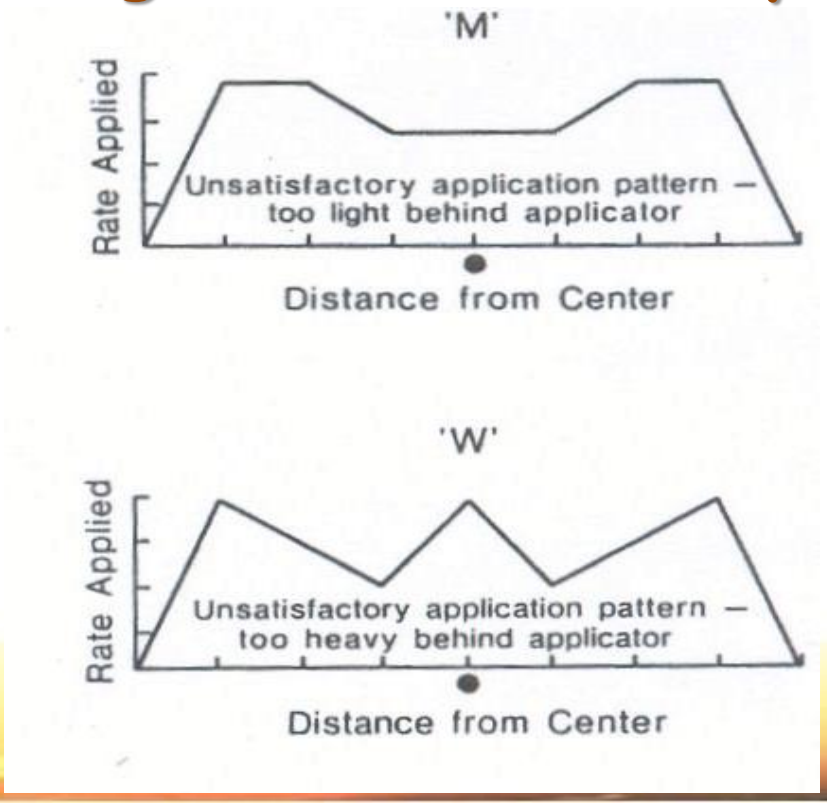
8x !

Doubling particle size increases weight by 8 times !!

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



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.

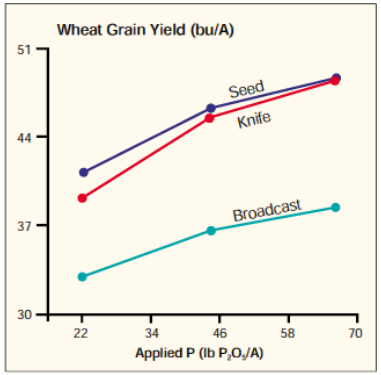


Figure 6. Effect of method of P application on wheat grain yield, Sander, et al.

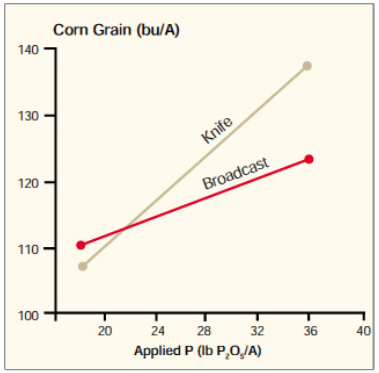


Figure 7. Effect of method of P application on corn grain yield, Raun, et al.

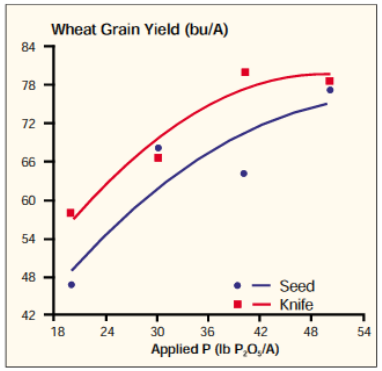


Figure 8. Effect of method of P application on wheat grain yield, Leikam, et al.

"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

"…… 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."

Fluid Journal
Winter 2001

Fluid Fertilizer Foundation

Right Rate: Distribution Uniformity

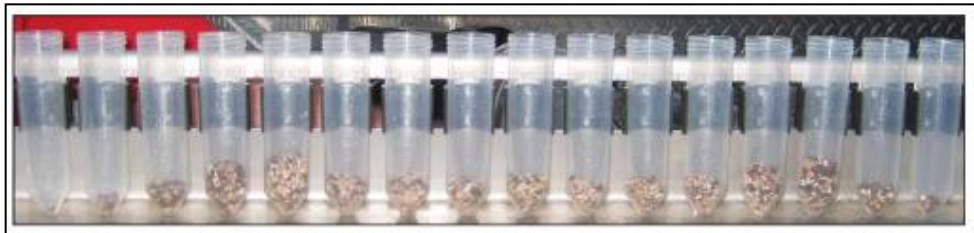
ALABAMA

Optimizing Nutrient Stewardship Using Broadcast Fertilizer Application Methods

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

Table 1. Mean physical characterization for the different fertilizer components and blended products.

	Product	Grade, %	Mean d_{50}[a], mm	GSI[b]
Blend 1	Ammonium Nitrate	34 - 0 - 0	2.16	25
	DAP	18 - 46 - 0	3.22	17
	Potash	0 - 0 - 60	3.05	29
	Blend 1	17 - 17 - 17	2.87	32



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.

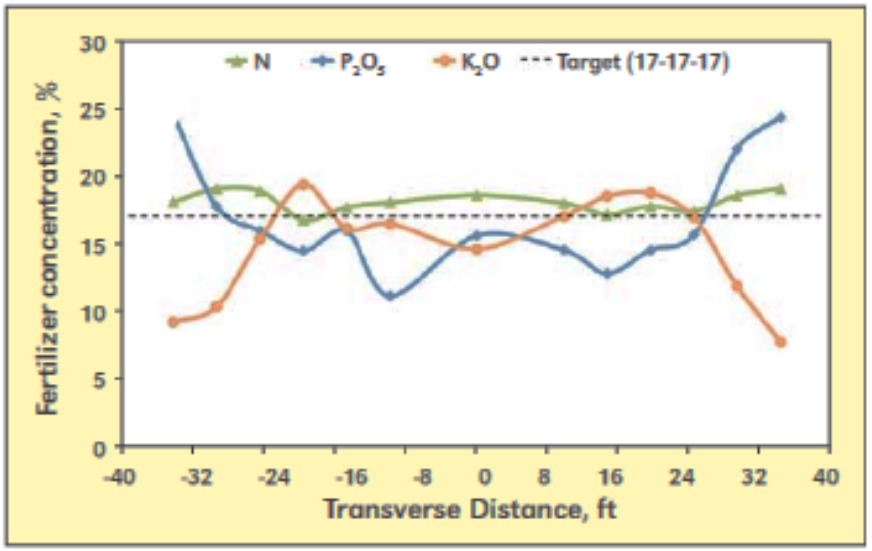


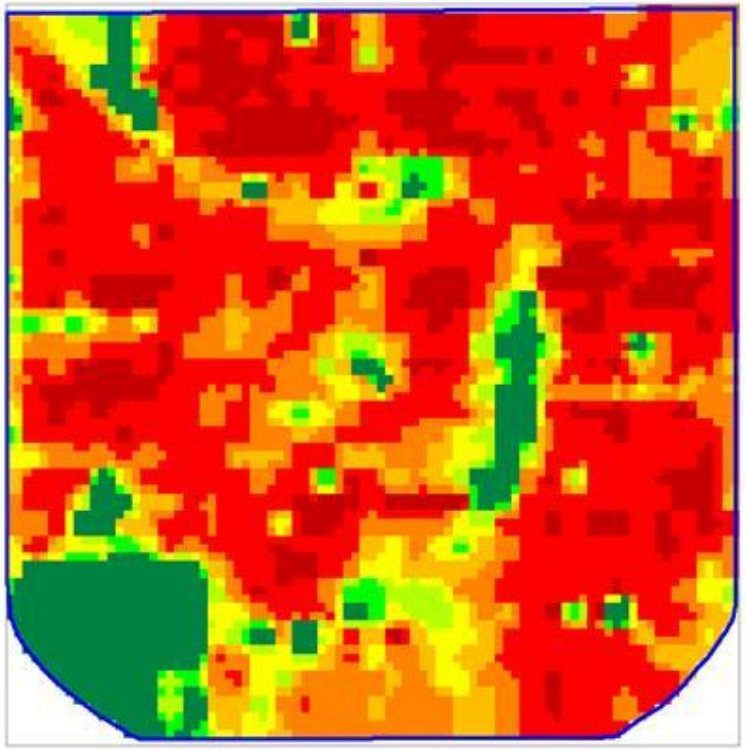
Figure 1. Example nutrient concentration across the spread width for Blend 1 (17-17-17) with a spreader setup at a 70 ft. spread width. Reported data are the mean of three pan tests.

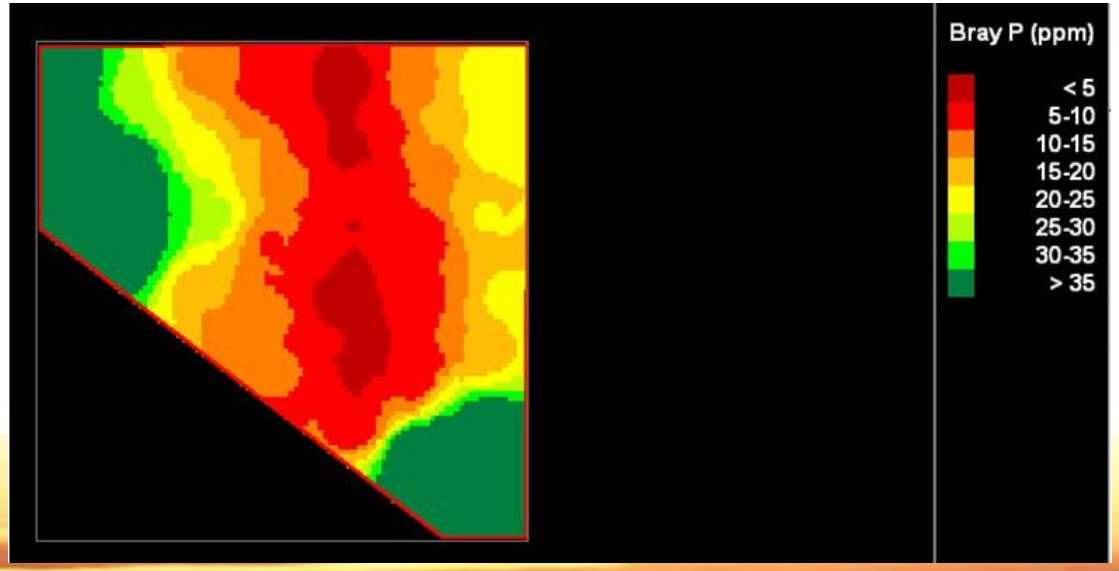
Better Crops
2013, No. 3, pg. 15-17

Fluid Fertilizer Foundation

Right Rate:

Variable Prescription Applications





Why Fluids?

3. Flexibility

- Versatility
- Adaptability

3. Flexibility

- **Adaptability**
  - Respond to changing environment (eg. weather)
  - Easily adjust to changing conditions (e.g. reduced-till)
  - Suitable for many and varied situations

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

Adaptability

Adaptable - Uniquely suited to changing soil/environmental conditions

Adaptable - Provides flexibility for simultaneous precision operations & applications

- **Tillage and planting equipment**
- **Irrigation/fertigation**
- **Other crop nutrients & micronutrients**
- **Many pesticides**
- **Fertilizer additives**

Versatility

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

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

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

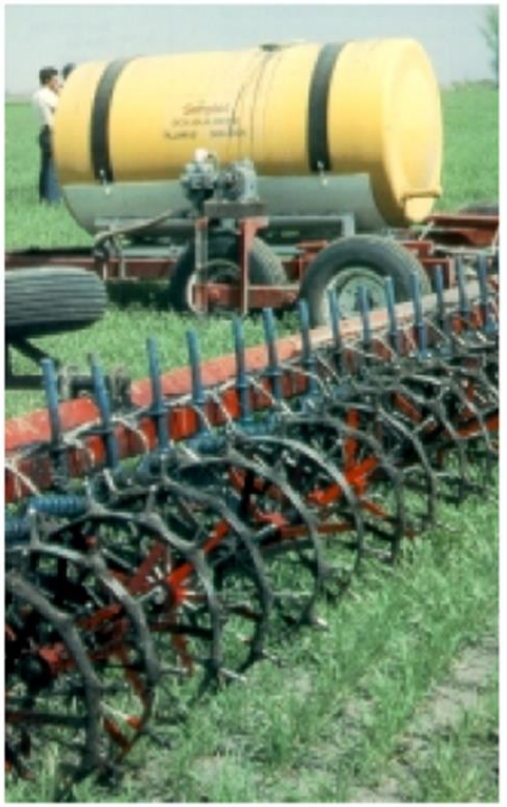
Late-Season Foliar Sprays Boost Soybean Yields

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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Versatility & Adaptability

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 fertilizers are favored with split applications?

"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."

Fluid Journal 2004

Fluid Fertilizer Foundation

Versatility and Adaptability

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.

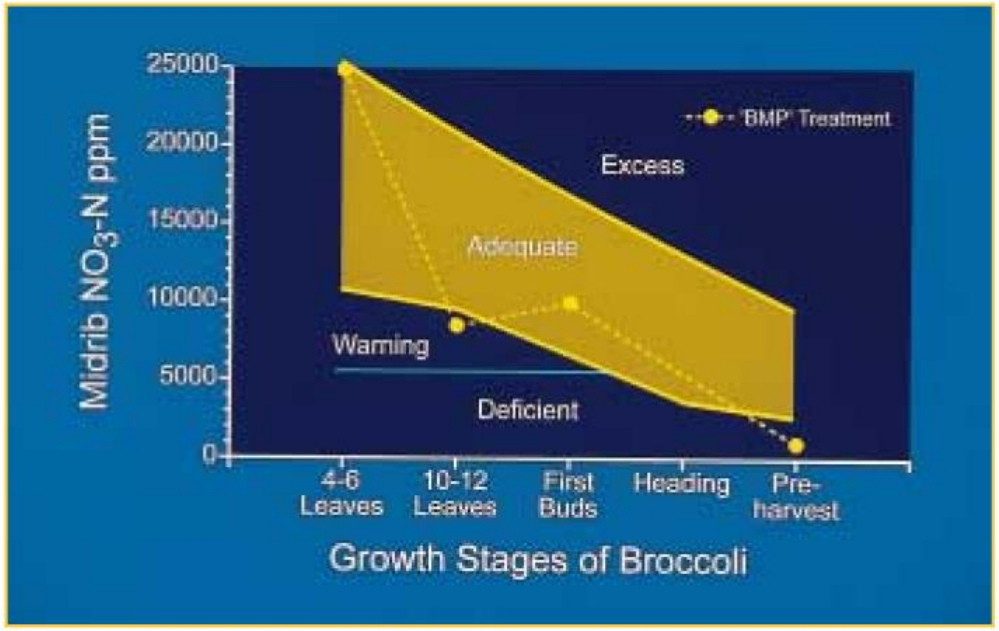

Figure 3. Interpretation of seasonal petiole nitrate levels in the BMP nitrogen treatment for broccoli, Doerge, et al., University of Arizona, 1994-95.

"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

Why Fluids?

2. Agronomics

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

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.

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

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."

FJ Spring 1993 & FJ 1994 Fall

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

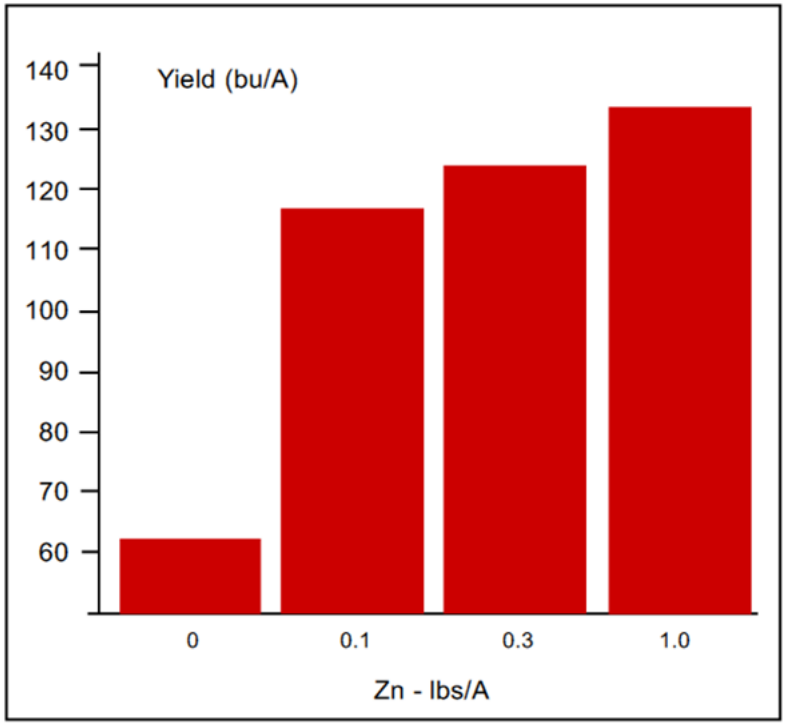


Figure 3. Effect on corn yield when banding zinc near seed, University of Nebraska.

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.

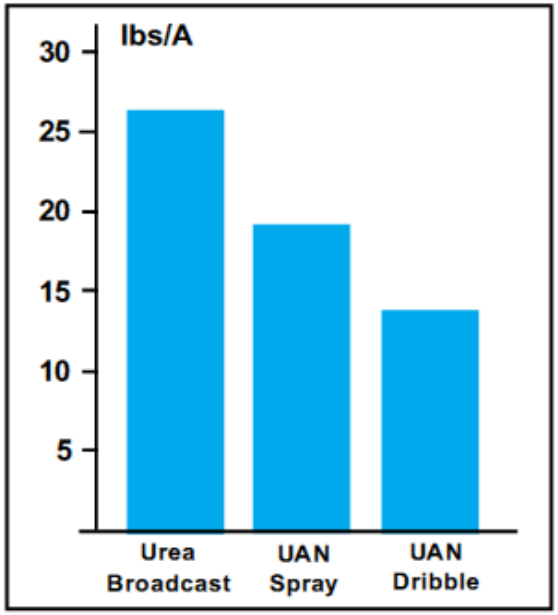


Figure 2. Total ammonia loss over 16-day period using different sources/methods, elinimating two outlier plots, Fox and Piekielek, Penn State, 1993.

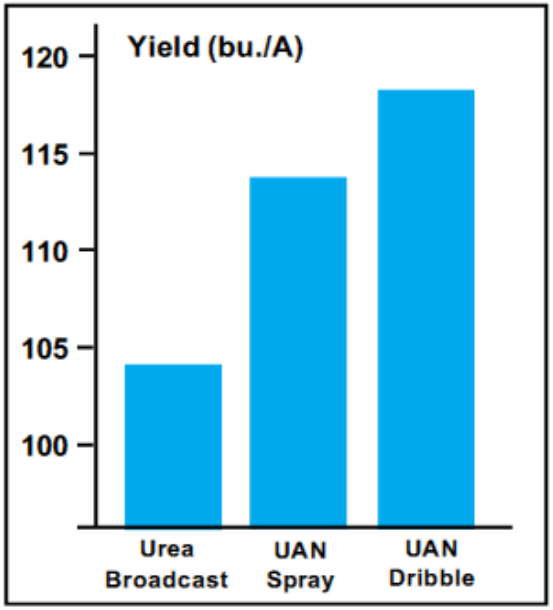


Figure 3. Corn Yields at early dent stage as function of N fertilizer source and method of application, Fox and Piekielek, Penn State, 1993.

"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."

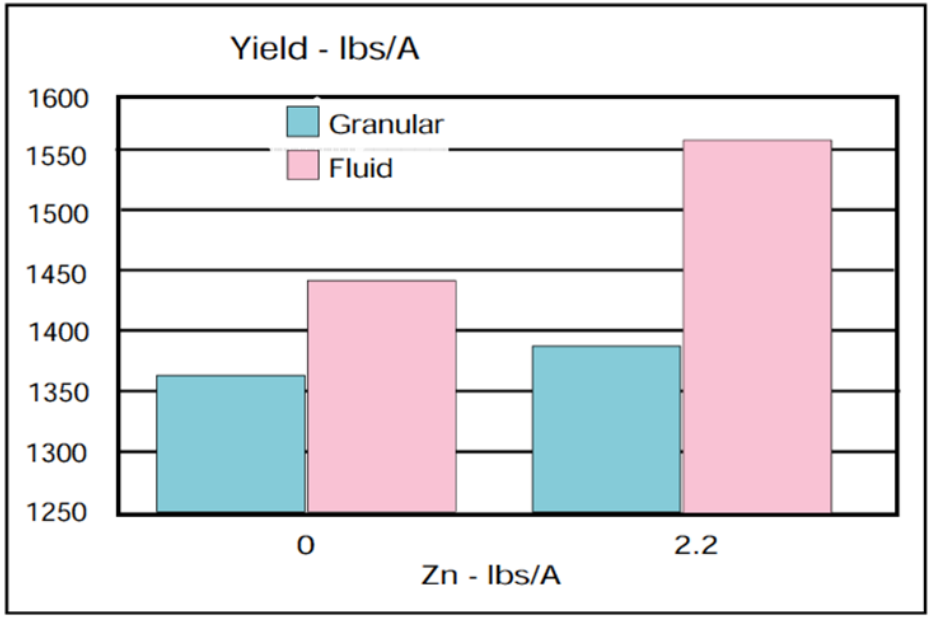


Figure 4. Effect of fertilizer source and application of Zn on grain yield of Frame wheat, Emerald Rise, 2000.

Fluid Fertilizer Foundation

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

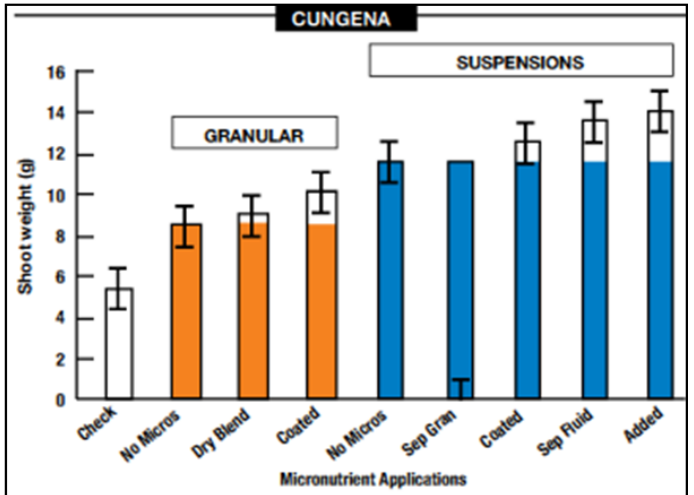


Figure 1. Response of Yitpi wheat shoot growth at early tillering. Color bars show response in shoot growth to granular and suspension fertilizer, with micronutrient response added as the clear top portion of the bar.Cungena, 2005.

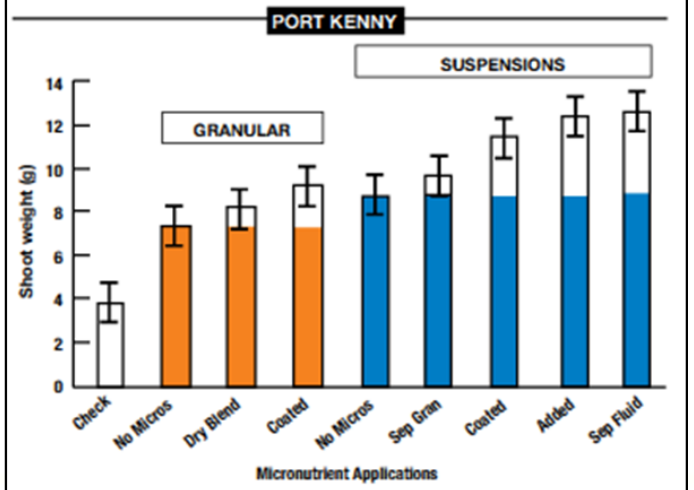
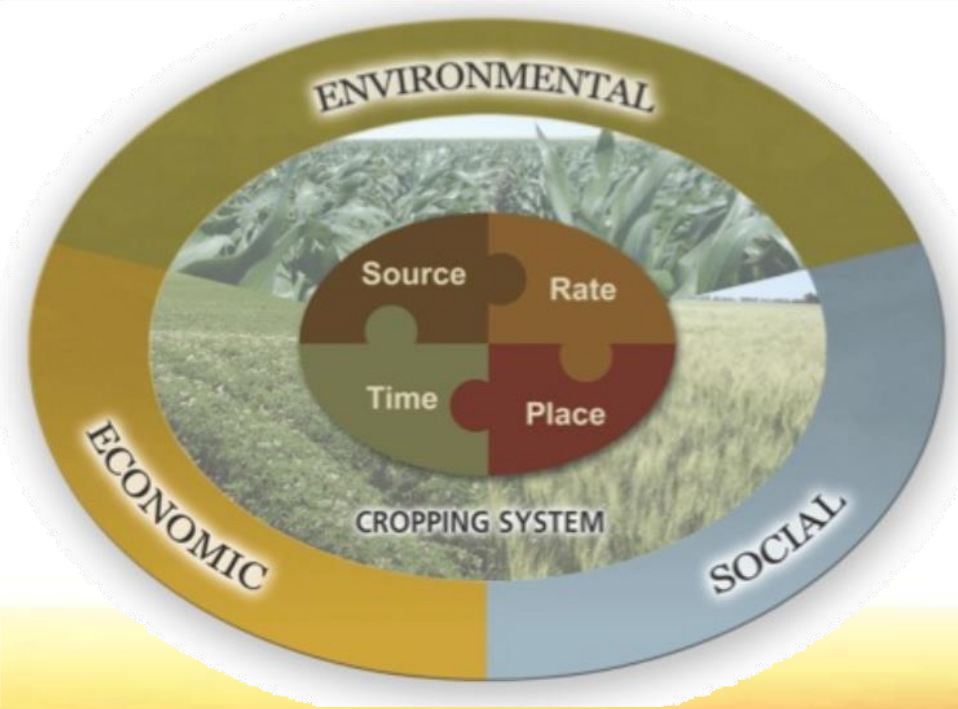


Figure 2. Response of Yitpi wheat shoot growth at early tillering. Color bars show response in shoot growth to granular and suspension fertilizer, with micronutrient response added as the clear top portion of the bar. Port Kenny, 2005.

Agronomics: 4R Stewardship

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



Agronomics: 4R Stewardship

When You Hear 'The Right Rate' . . .
Think Fluid Fertilizers

When You Hear 'The Right Placement' . . .
Think Fluid Fertilizers!

When You Hear 'The Right Time' . . .
Think Fluid Fertilizers!

'The Right Source' Is Obvious

….. *Fluid Fertilizers* …..

Agronomics: 4R Right Rate

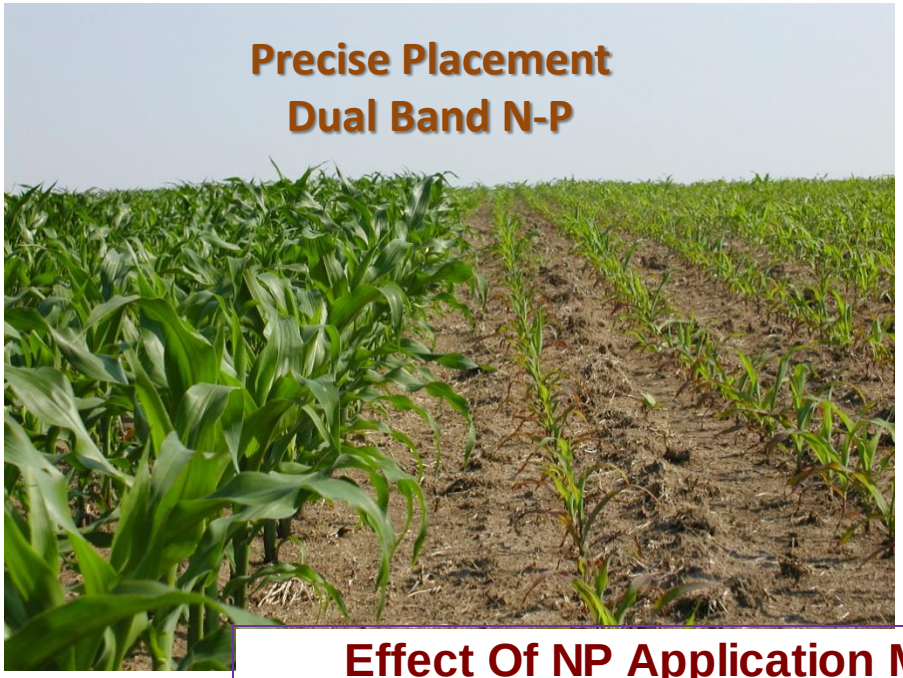
Precision - Right Rate

- Application Uniformity & Accuracy
- Homogeneous, No Segregation, Continuous Bands
- Calibration
- 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*

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

by Dr. Stanley A. Barber

Timing And Placement One Key to High Yields

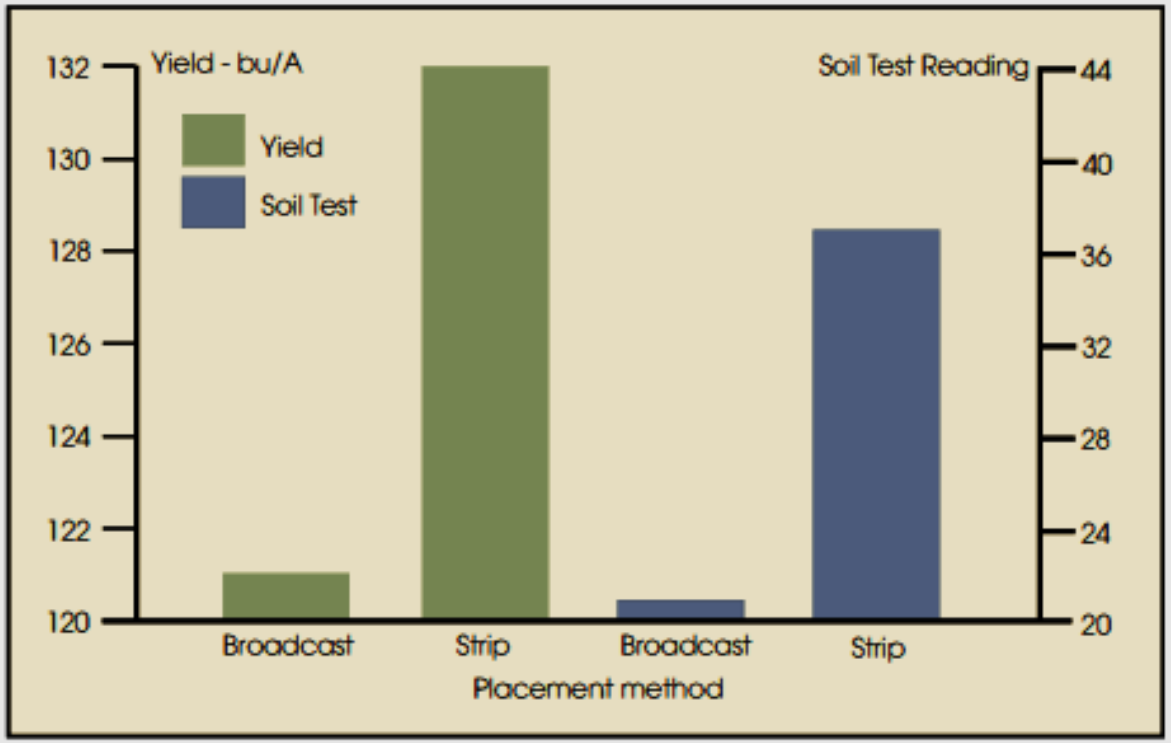


Figure 3. Average corn yields in a five-year comparison study of strip versus broadcast, Barber, Purdue University.

"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

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.** "

Fluid Journal
2007

Fluid Fertilizer Foundation

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."

Fluid Fertilizer Foundation

Agronomics: 4R Timing & Placement

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."

Fluid Journal
Spring 1999

Fluid Fertilizer Foundation

1. Value

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

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.

Top 5

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?

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