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.
Tom Gerecke
2011 Workshop

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

- 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
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.**
5. Logistics

• Handling Convenience
• Product Safety
• Equipment Requirements
• Storage, Transfer & Application
• **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
4. Precision - Right Rate

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

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Uniform Distribution Of Nutrients With Fluid Fertilizers Is Unmatched

- Uniform across the field
- Uniform across application swath
- Uniform within a continuous band
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.
Once blended, solid fertilizers immediately begin the process of unblending!

Particle size is also the dominant characteristic affecting swath uniformity as well.
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.
‘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.’
“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
Right Rate:
Variable Prescription Applications
3. Flexibility

- **Adaptability**
  - Respond to changing environment (e.g. 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
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
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.

“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
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
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.

“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.”

What form of N fertilizer is favored for split applications?

Fluid Journal
2004
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.
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.
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

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.**

<table>
<thead>
<tr>
<th>Rate (lbs/A) N</th>
<th>Placement Method</th>
<th>Grain Sorghum</th>
<th>Winter Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANR* %</td>
<td>Soil N* lbs/A</td>
<td>ANR* %</td>
</tr>
<tr>
<td>0 0</td>
<td>-</td>
<td>41</td>
<td>-</td>
</tr>
<tr>
<td>40 0</td>
<td>Broadcast</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>40 20</td>
<td>&quot;</td>
<td>36</td>
<td>44</td>
</tr>
<tr>
<td>40 40</td>
<td>&quot;</td>
<td>43</td>
<td>52</td>
</tr>
<tr>
<td>80 0</td>
<td>&quot;</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>80 20</td>
<td>&quot;</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>80 40</td>
<td>&quot;</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>40 0</td>
<td>Knife</td>
<td>37</td>
<td>46</td>
</tr>
<tr>
<td>40 20</td>
<td>&quot;</td>
<td>53</td>
<td>66</td>
</tr>
<tr>
<td>40 40</td>
<td>&quot;</td>
<td>51</td>
<td>50</td>
</tr>
<tr>
<td>80 0</td>
<td>&quot;</td>
<td>33</td>
<td>38</td>
</tr>
<tr>
<td>80 20</td>
<td>&quot;</td>
<td>36</td>
<td>50</td>
</tr>
<tr>
<td>80 40</td>
<td>&quot;</td>
<td>38</td>
<td>49</td>
</tr>
<tr>
<td>40 0</td>
<td>Dribble</td>
<td>35</td>
<td>43</td>
</tr>
<tr>
<td>40 20</td>
<td>&quot;</td>
<td>51</td>
<td>55</td>
</tr>
<tr>
<td>40 40</td>
<td>&quot;</td>
<td>48</td>
<td>50</td>
</tr>
<tr>
<td>80 0</td>
<td>&quot;</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>80 20</td>
<td>&quot;</td>
<td>34</td>
<td>51</td>
</tr>
<tr>
<td>80 40</td>
<td>&quot;</td>
<td>37</td>
<td>50</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>lb Zinc/A</th>
<th>Yield bu/A</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>119</td>
<td>37</td>
</tr>
<tr>
<td>0.3</td>
<td>127</td>
<td>45</td>
</tr>
<tr>
<td>1.0</td>
<td>135</td>
<td>53</td>
</tr>
</tbody>
</table>

**Effective Zinc Management**

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

![Figure 3. Effect on corn yield when banding zinc near seed, University of Nebraska.](image-url)
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."
“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.
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
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
“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
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.
### Effect Of NP Application Method On Wheat Yield

<table>
<thead>
<tr>
<th>Application Method</th>
<th>Harper (bu/a)</th>
<th>Dickinson (bu/a)</th>
<th>Osage (bu/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knife Knife</td>
<td>47.9</td>
<td>64.0</td>
<td>62.90</td>
</tr>
<tr>
<td>Knife B'cast</td>
<td>44.8</td>
<td>52.9</td>
<td>56.40</td>
</tr>
<tr>
<td>B'cast Knife</td>
<td>46.8</td>
<td>56.4</td>
<td>59.10</td>
</tr>
<tr>
<td>B'cast B'cast</td>
<td>44.8</td>
<td>53.4</td>
<td>52.90</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>NS</td>
<td>6.8</td>
<td>NS</td>
</tr>
<tr>
<td>No P Check Yield</td>
<td>43.8</td>
<td>47.3</td>
<td>57.10</td>
</tr>
</tbody>
</table>
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.
A Look At Seed-safe Applications Of Fluids

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

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<table>
<thead>
<tr>
<th></th>
<th>Silty clay loam</th>
<th>Loamy fine sand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>with seed</td>
<td>top of seed</td>
</tr>
<tr>
<td>Material</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>10-34-0</td>
<td>211.6</td>
<td>203.6</td>
</tr>
<tr>
<td>4-10-10</td>
<td>204.7</td>
<td>196.9</td>
</tr>
<tr>
<td>3-18-18</td>
<td>201.0</td>
<td>212.2</td>
</tr>
<tr>
<td>Check 208.7 bu/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 &amp; 10 gpa</td>
<td>5 &amp; 10 gpa</td>
<td>3.4 &amp; 6.8 gpa</td>
</tr>
</tbody>
</table>

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.“
Agronomics: 4R Stewardship

“Right source at the right rate, right time, and right place”

3 R’s?
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!
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
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

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Fluid Facts

**WHY FLUIDS?**

Top 10 lists are ever popular in our culture today — so what are the top 10 advantages of liquid 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 on. 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, flexibility adapted for split applications, high nutrient use efficiency, handling convenience, environmental benefits, required for irrigation, 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, the top five advantages of liquid fertilizers should broadly fit most everyone. Let's start with number five!

**Fluid Top 5 Advantages**

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

2. **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 profiting 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.

1. **Flexibility.** Because liquid 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 liquid 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.

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

1. **Value.** The value of liquid fertilizer is high value — the overall benefit relative to costs. And the total value of the benefits associated with liquid fertilizers far outweigh any differences in the purchase price of specific crop nutrients.

**High Value Provides For Prosperity — Low Cost Does Not!**

**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 application of 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 rates, 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/risks.
- 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 programs. Also, the fact that ammonia is limited to direct application below the soil surface is a huge limitation relative to other N sources. 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 Lenker is President of the Fluid Fertilizer Foundation in Manhattan, Kansas.

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http://www.FluidJournalOnline.com

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