Subsurface Banding at J. Herbert Stone Nursery - A New Method for Applying Fertilizers in Forest Nurseries

by David E. Steinfeld

Most bareroot nurseries apply fertilizers the way it's been done for decades – by broadcasting fertilizer directly to the surface of the seedbed and then incorporating it into the soil through tillage or irrigation. While this is a tried and true method and perhaps the only fertilizer method most of us have ever known, it might be time to step back and consider a totally different approach to fertilizing your crop – by placing *all* fertilizers in a concentrated band below the surface of the soil at the time of sowing. The method is called *subsurface banding.*

Wait! Before you say to yourself that a change of this sort would be too much of a hassle or too expensive, consider what the potential benefits to your nursery might be.

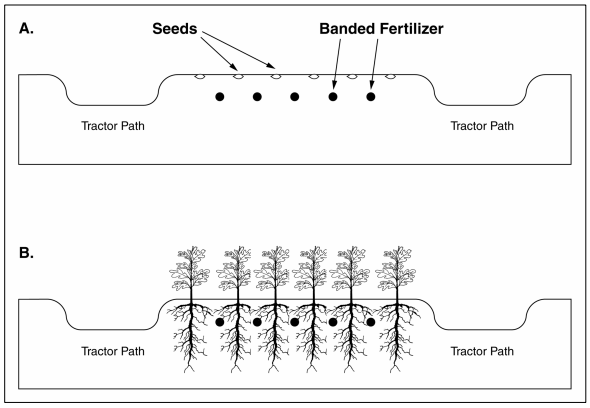
You could:

- ?? Eliminate all broadcast applications of fertilizer in the 1+0 year – which can be up to 9 times
- ?? Drastically reduce the amount of fertilizer applied
- ?? Free up tractors and people in late spring and early summer
- ?? Reduce the potential for nitrate leaching
- ?? Lower the risks for salt toxicity and seedling disease
- ?? Increase seedling quality
- ?? Lower costs

These are the benefits we are realizing at Stone Nursery. For over 15 years our nursery has banded phosphorus and potassium fertilizers with good results. We apply them at the same time we are sowing, whether the crop is being grown as a 1+0 or 2+0. Lately, we are working with control release nitrogen fertilizers as an alternative to broadcast applying ammonium nitrate and ammonium sulfate.

What is subsurface banding? Subsurface banding is the exact placement of fertilizers below and to the side of the seed at the time of sowing (Figure 1A). At Stone Nursery, the fertilizer bander is attached directly to the seed drill and fertilizer is delivered at the same time the seed is being sown. Having the bander attached to the drill assures that the placement of the fertilizer is always 3 inches (7.6cm) horizontally and 3 inches vertically away from the seed. This precise placement makes sure

Figure 1A and 1B: Fertilizer is banded precisely beneath the soil between seed rows.



that the fertilizer is available to the plants while eliminating the possibility of salt injury associated with the concentration of fertilizer near the roots of the developing seedling (Figure 1B).

The fertilizer bander is composed of a hopper that holds the fertilizer, a chain driven fertilizer distributor, coulters or knives that open the soil and drop tubes that deliver the fertilizer (Figure 2). In this way, any dry fertilizer or amendment that can flow through the drop tubes of the bander can be applied to the crop. This includes, but is not limited to, inorganic and organic granular fertilizers, control-release fertilizer, as well as non-fertilizer materials such as mycorrhyzae. In this article, two types of fertilizers will be discussed in respect to subsurface banding – phosphorus/potassium and control-release nitrogen fertilizers.

Figure 2: The fertilizer bander is attached directly to the seed drill but the application rate is controlled separately by hydraulics.

Banding phosphorus and potassium fertilizer. There were several very important reasons that Stone Nursery began to band P and K fertilizers. First, banding eliminated three tractor trips prior to sowing in the spring – two separate trips to apply each fertilizer and a pass to incorporate the fertilizers into the soil. Aside from saving employee salary and equipment costs, three trips over our soggy fields in the spring will definitely compact our soils and in the worst conditions, puddle them (another way of saying, sink a tractor!). If the spring is wet, like it was this year, our sowing window becomes so narrow that we can't afford to waste the few dry days applying fertilizers, when we could be sowing. Secondly, when P and K fertilizers are banded, they are readily and immediately accessible to the newly germinating seedlings. Thirdly, fertilizer rates can be reduced by a third to a half the broadcast incorporated rates. This is in part due to the fact that phosphorus does not move very far in the soil profile because it becomes chemically fixed on soil particles and unavailable to the seedling. The amount of fixation is directly related to the amount of fertilizer in contact with the soil. Since there is less soil contact with banded P and K, not only is less fertilizer needed but it is available for longer periods of time - up to two years.

Banding controlled release nitrogen fertilizer. Recently, we asked ourselves: if banding P and K fertilizers is this easy, why don't we band nitrogen fertilizers. If it worked, we might be able to eliminate some of the typical problems associated with broadcast N fertilization. Let's look at a typical broadcast nitrogen fertilizer program in a 1+0 year at Stone Nursery and see why an alternative might be beneficial.

When our seedlings begin to develop their first new leaves and the roots of the young seedlings are beginning to develop laterals, we hook up our three bed Barber spreader and apply ammonium nitrate over the seedbeds. This is usually done in late May and early June, generally 6 weeks to 2 months after we have sown the crop. Although we plug the fertilizer holes that drop fertilizer on the tractor paths, fertilizer prills end up in the paths anyway, becoming useless to the crop as well as potentially getting into the surface water with the first good rainstorm or irrigation. As the weather turns hot from late June on, our seedlings are at risk to the effects of high salts and diseases. Unfortunately, this is also the time we do most of our broadcast nitrogen fertilizer applications which can exacerbate these problems. Over the years, we have seen problems arise as a result of applying nitrogen fertilizers to our 1+0 crops when insufficient irrigation was applied to leach the fertilizer salts from the surface of the beds. As a result many seedlings either died or were severely stressed. Once, the tractor operator who applied the fertilizer forgot to inform the irrigator to water the fertilizer off the trees. The result the next day was a bright red field. Perhaps the risky aspect of broadcast fertilization in the late spring/early summer is the increased potential for damping-off or root rot diseases, resulting from the high concentration of nitrogen in the soil surface. After considering all these risks, we became interested in banding nitrogen fertilizers.

Since nitrogen is a very mobile ion in the soil, the benefits of subsurface banding ammonium nitrate and ammonium sulfate are different than for phosphorous or potassium fertilizers. This is where controlled release nitrogen fertilizers (CRNF) come in. By subsurface banding CFNF's at sowing, nitrogen slowly releases from the prills as the seedling develops. Since the release rates of most CRNF's increase with soil temperatures, more nitrogen is available during the optimum temperatures for seedling growth and less available during colder weather when the seedlings are not growing as much.

Several years ago, our nursery established two administration studies to evaluate the effectiveness and costs of banding subsurface CRNF's. The results of these studies demonstrated that seedlings grown with subsurface banded CRNF's equaled or exceeded the growth rates of seedlings grown under our standard broadcast fertilizer regimes even when the CRNF's were applied at a third of the standard rate. The evaluation of a 1+0 ponderosa pine crop, showed that after one growing season, seedlings were significantly taller on treatments using one third (50 pounds N/acre = 45 kg/ ha) and two-thirds (100 pounds N/acre = 126 kg/ha compared to the standard broadcast rates (141 pounds N per acre = 116 kg/ha).

Is subsurface banding more expensive? For P and K fertilizers, reducing the number of tractor trips is a definite cost savings. Upon request, fertilizer distributors will mix P and K fertilizers at specified rates, eliminating the need to mix the fertilizers at the nursery. While the seed drill operator is transporting seed from the pickup to the seed drill, the tractor operator can take this time to fill the fertilizer bins, thereby minimizing the time handling fertilizers. Since the tractor operator controls the fertilizer application as the seed drill is being pulled, this saves labor and equipment costs.

At first glance, subsurface banding of CRNF may not appear to be cost effective because these fertilizers can be 3 to 5 times more expensive than ammonium nitrate and ammonium sulfate. Yet depending on the type of

CRNF being used, the total annual costs on a per acre basis are comparable. Consider a standard broadcast N fertilizer regime at Stone Nursery where 114 pounds of N/acre (102 kg/ha) is applied in four applications. Compared to a CRNF, such as polymer-coated urea, ammonium nitrate is a third the cost. However, since only half the rate of polymer-coated urea is applied to achieve the same result, the actual cost per acre of ammonium nitrate is just over half the cost of polymer-coated urea (Figure 3). Of course, the overall savings comes from eliminating four tractor applications of ammonium nitrate and ammonium sulfate. The cost for broadcast application of N fertilizers can actually be 25 percent more expensive than banding CRNF and almost 100 percent more expensive when P and K are banded at the same time.

Nitrate leaching. Cost comparisons aside, perhaps the best reason to consider banding control release N fertilizers is the effect this practice will have on ground water quality. If fertilizer use can be cut by a third to a half, leaching of nitrates into the ground water can be significantly reduced. This could be critical for your nursery as ground water issues take on greater importance.

Equipment availability. Fertilizer banders are readily available through your local agriculture equipment outlets. We purchased a bander through Gabilan Manufacturing, Inc (TEL: 800-538-5864), however there are several companies that manufacture this equipment. Any product you purchase will probably have to be adapted to your nursery equipment or needs. The J.E. Love Company is in the process of developing a fertilizer bander for bareroot nurseries that can be attached to the seed drill (see Figure 2). They can be reached at TEL: 509-635-1321 for further information.

Conclusions and recommendations. In summary, banding P, K and control release N fertilizers can reduce the amount of fertilizer used and substantially decrease the number of tractor trips. This will save money in the long run. Using a control release fertilizer can reduce nitrate leaching, reduce surface salt buildup and potentially reduce the incidence of early season diseases. Changing fertilization systems, as with any major change in nursery practices, should be accomplished first on small scale, to see what the effects will be at your nursery.

Further Reading

Soil fertility and fertilizers – an introduction to nutrient management – sixth edition. Havlin, J.L., Beaton, J.D., Tisdal, S.L., Nelson, W.L. Prentice Hall, Inc.

Figure 3: Even though fertilizer costs are higher, the real savings of subsurface banding comes from the single application cost.