Fluid JOURNAL
Official Journal of the Fluid Fertilizer Foundation
Late Spring 2008
Vol. 16 No. 3, Issue #61

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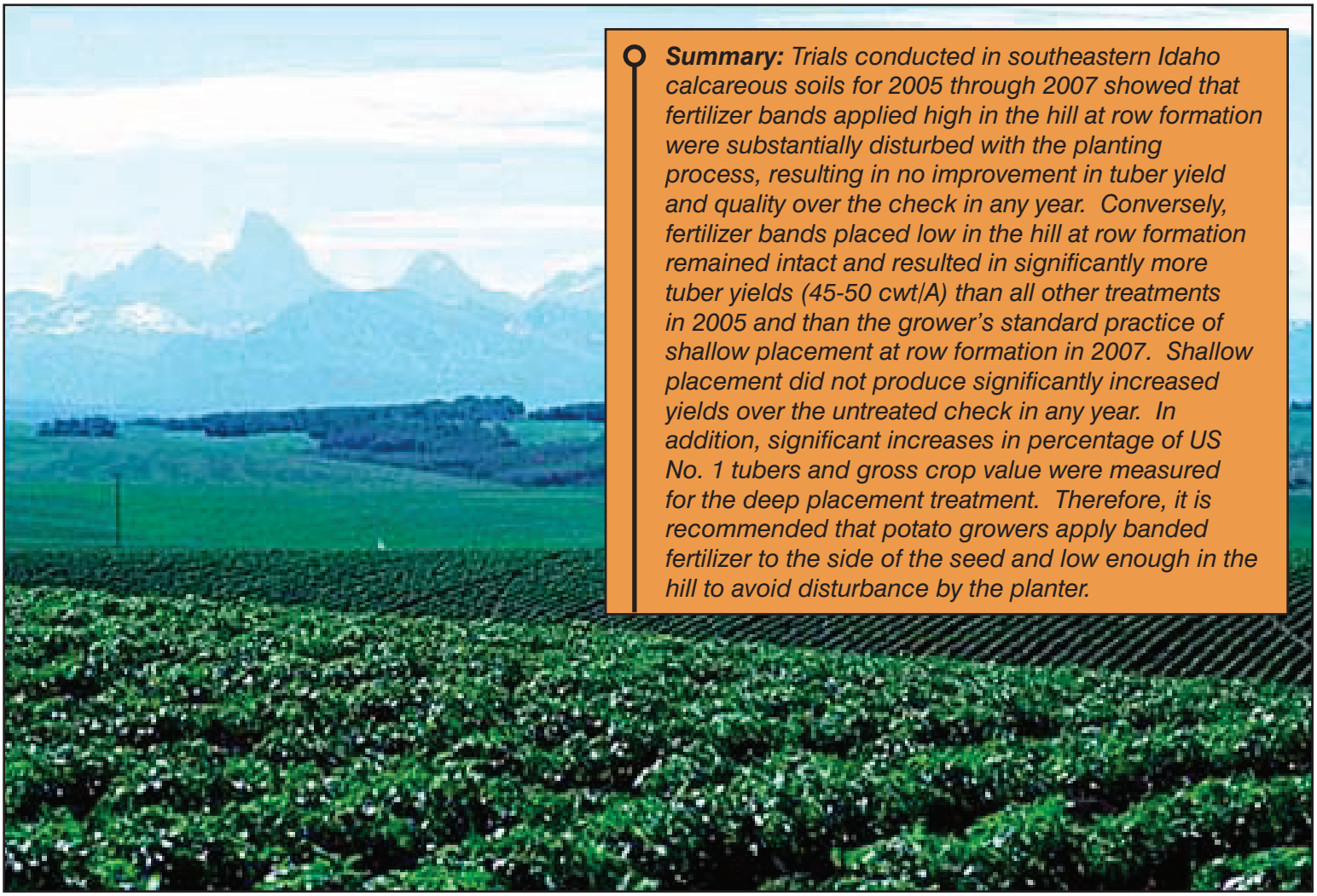
Band Placement Critical To Potato Yield

Field trials in southeastern Idaho calcareous soils show significant increases in tuber yield for deep-placed treatments.



Summary: *Trials conducted in southeastern Idaho calcareous soils for 2005 through 2007 showed that fertilizer bands applied high in the hill at row formation were substantially disturbed with the planting process, resulting in no improvement in tuber yield and quality over the check in any year. Conversely, fertilizer bands placed low in the hill at row formation remained intact and resulted in significantly more tuber yields (45-50 cwt/A) than all other treatments in 2005 and than the grower's standard practice of shallow placement at row formation in 2007. Shallow placement did not produce significantly increased yields over the untreated check in any year. In addition, significant increases in percentage of US No. 1 tubers and gross crop value were measured for the deep placement treatment. Therefore, it is recommended that potato growers apply banded fertilizer to the side of the seed and low enough in the hill to avoid disturbance by the planter.*

Potatoes are a crop of major economic importance, especially in the irrigated western U.S. A good percentage of the productive, intensively cultivated areas in this region is dominated by potato cropping systems. From a national perspective, only grain, bean, and cotton crops exceed potatoes in terms of row crop production value and acreage.

Potatoes have a relatively high nutrient requirement and small root system. As a result, producers commonly apply significantly more fertilizer materials to their potato crops as compared to grain and other rotational crops that tend to be more nutrient efficient. Growers are more willing to apply high rates of fertilizer to potatoes due to the high value of this crop, with cost of production typically ranging from $1,500 to $2,500 per acre. Therefore, it is common for growers to apply the vast majority of their fertilizer for the entire cropping system well in advance of crop needs. Much of the fertilizer is broadcast, but it is also common to band a liquid mix in the hill either at planting or, more routinely, when the rows are formed (known as "mark-out").

Research shows that, in most situations, a combination of broadcast and banding is beneficial. However, many potato growers and agronomists, owing

to on-farm observations, have begun to question whether or not they are benefiting from concentrated liquid bands. It is possible that these observations are due to problems with band placement. It is common practice for the liquid fertilizer band to be applied with the row formation process and at a depth at or above where the seed piece is planted. The advantage of shallow placement is it takes less fuel to pull an implement as compared to deep placement. Although this mark-out application is considered by many to be a "starter" fertilizer, the potato planting operation results in dramatic soil disturbance and a significant mixing of the banded fertilizer with the bulk soil. It is likely that much of the expected benefit of concentrated banding of mark-out fertilizer is minimized as a result of this practice.

Surprisingly, very little research has been published since the 1960s on the placement of starter fertilizers in potato production. Yield potential and production systems have changed dramatically since the initial work was reported.

The benefits of starter fertilizer have been shown repeatedly in most other major crops. Research establishing the effects of concentrated liquid fertilizer bands is badly needed for potato production. This work is needed particularly in the western U.S. where soils tend to be calcareous and have an alkaline pH. High pH calcareous soil results in reduced solubility of phosphorus (P) and micronutrient metals and, as a result, there is an increased potential benefit of concentrating these fertilizers in a band near the roots. Furthermore, it is common for potatoes to be grown in sandy, low-organic-matter soil in this region. Crops grown in sandy, low-organic-matter soils have been shown to be relatively more responsive to starter fertilizer applications. However, greenhouse research suggests that the nutrient rich, large potato seed piece (in comparison to true seeds) may contain adequate nutrition to allow it to get by without a starter fertilizer benefit for the first few weeks of growth. Although concentrated fertilizer bands may not be improving early-season nutrition and growth, final tuber quality does seem to be impacted favorably, suggesting that the mid-to-late season contribution may be important.

The objective of this study was to determine the effects on potato growth, nutrient uptake, grade, and yield of complete fertilizer bands at various placements in the hill, applied to calcareous soil either mark-out or as a starter application.

Band disruption

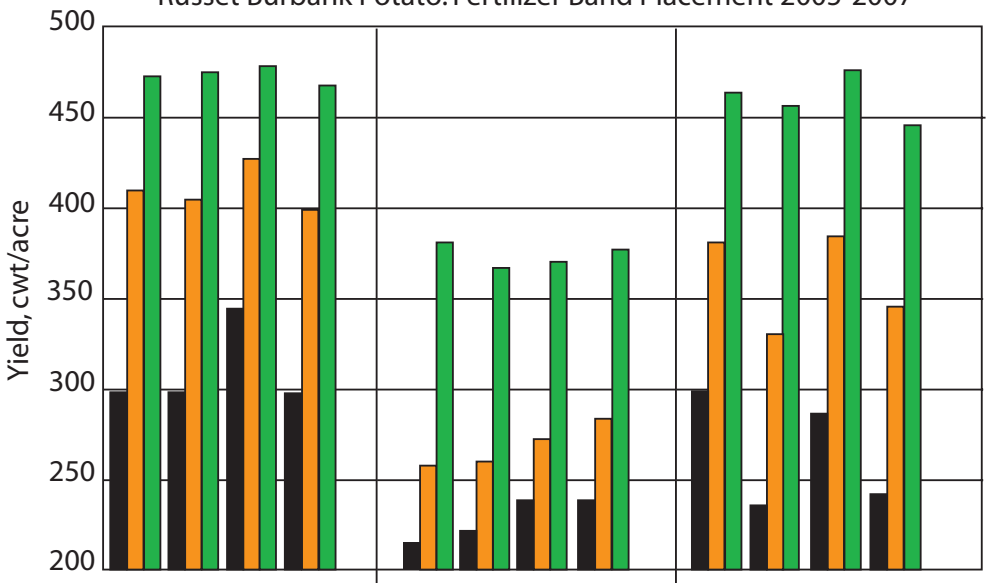
The results of soil sampling and analysis show that the nutrients from the 3 x 3 markout shallow (MS) fertilizer band were disturbed significantly, whereas the other fertilized treatments tended to stay concentrated in the band. The MS band was essentially spread evenly in the side of the hill in which it was applied. There were essentially no significant differences observed between sampling points in the side of the hill in which the fertilizer was applied, although the other side of the hill had significantly lower nutrient concentrations (data not shown). Not surprisingly, there were significant differences between the nutrient concentrations in the soil samples immediately surrounding the fertilizer band and those farther away for both the 3 x 3 mark-out deep (MD) and the 3 x 3 plant-starter-shallow (PS), with the greatest differences for MD. Results were essentially the same in all three years. Not surprisingly, these results show that growers who apply bands of fertilizer in the zone where soil is disturbed by the planting process lose the concentration effect and that they should instead apply the fertilizer more deeply or apply it immediately before the closing shoes at planting if their goal is to maintain fertilizer concentration in the band and thus improve availability of nutrients.

Yield

In 2005, the MD treatment for the 4- to 6-ounce US #1 category produced significantly greater yield than all other treatments, as well as significantly greater yield for the 6- to 10-ounce category than the check and MS treatments. There were no statistically significant differences for individual-size grades in 2006 and 2007.

The sum of all grade categories into total yield showed no significant differences for any treatment in any year (Figure 1). However, differences for US #1 yields (addition of all size categories) were significant in 2005 and 2007 and differences for marketable yield (US #1 plus US #2) were significant in 2006 and 2007 (Figure 1).

The MD treatment produced significantly more US #1 yield (45 to 50 cwt/A) than all other treatments in 2005. Although not significant in 2006, a similar trend was observed for the same treatment over the untreated check. In 2007, this same treatment produced significantly greater US #1 yield than the growers' standard practice treatment (MS). The MS and PS treatments did not significantly increase yield over the untreated check in any year. When including the US #2 tubers, the fertilizer bands did not increase marketable yield for any category in any year except for a slight increase in 2006 for the PS treatment. Combining the yield data across years for the orthogonal comparison



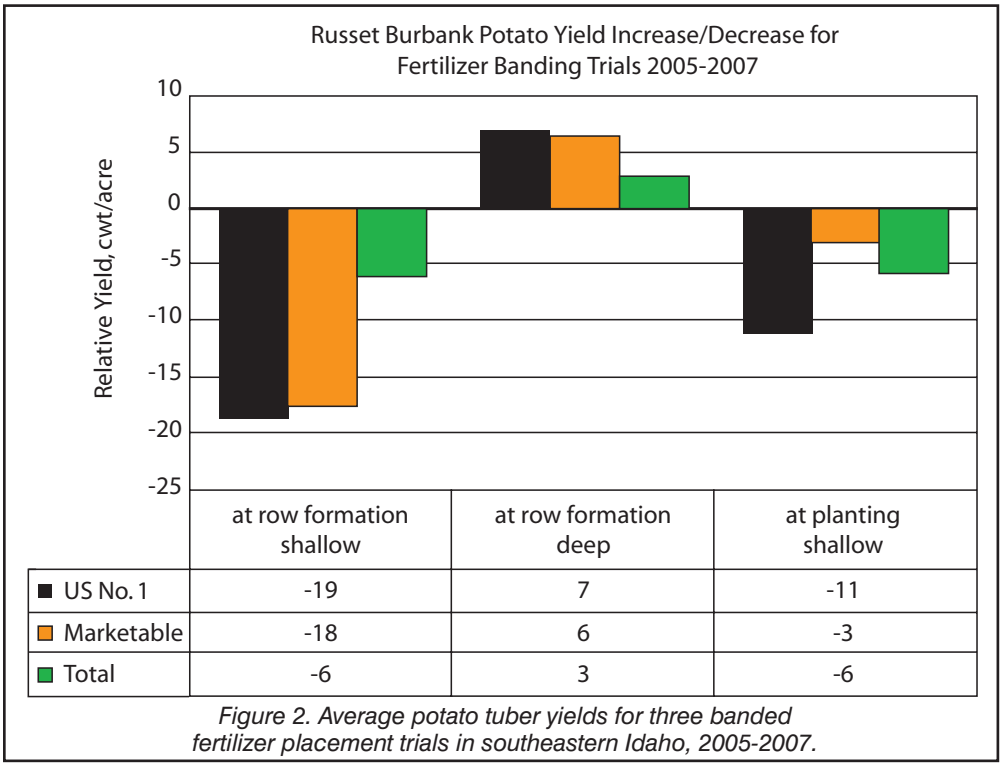
	UTC 05	MS 05	MD 05	PS 05	LSD 05 (0.10)	UTC 06	MS 06	MD 06	PS 06	LSD 06 (0.10)	UTC 07	MS 07	MD 07	PS 07	LSD 07 (0.10)
US No.1	298	296	343	297	39	214	222	236	238	NS	297	235	285	241	48
Marketable	409	403	427	399	NS	256	259	273	283	26	380	329	383	346	47
Total	472	475	479	468	NS	380	366	369	377	NS	463	457	476	446	NS

Figure 1. US #1, marketable (US #1 and #2), and total (marketable + cull) potato yields for three banded fertilizer placement trials in southeastern Idaho, 2005-2007. UTC = untreated check; MS = mark-out at shallow depth; MD = mark-out at deep depth; PS = planting at shallow depth.

resulted in significant increases in both US #1 and marketable yield for the MD treatment over the growers' standard practice (MS), as shown in Figure 2.

In addition, many fresh market contracts pay a premium based on the percent (as opposed to total weight) of US #1 tubers. In 2005, the percent of US #1 tubers for the MD treatment in this trial was 72 percent, which was substantially higher (9 to 10 %) than the other treatments. In 2006, both the treatments with undisturbed bands (MD and PS) resulted in significant increases in percentage (5 to 6%) of US #1 tubers over the untreated check. No increases in US #1 percentage over the check were measured in 2007 (data not shown). The treatment with the disturbed band (MS) did not have an increase in US #1 percentages over the check in any year.

Other tuber quality parameters measured did not seem to be impacted by treatment. Tuber specific gravity (solids) was high for all treatments (1.084 to 1.092) and not impacted by treatment. Internal and external defects were minimal (<7%) for all treatments in all years (data not shown). Petiole tissue analysis also showed no significant concentration differences for any nutrient measured in any years of the trial (data not shown). Increases in tuber numbers were significantly impacted in 2005, especially for the MD treatment.



	at row formation shallow	at row formation deep	at planting shallow
US No. 1	-19	7	-11
Marketable	-18	6	-3
Total	-6	3	-6

Figure 2. Average potato tuber yields for three banded fertilizer placement trials in southeastern Idaho, 2005-2007.

Gross crop value

Applying five-year average growers' fresh market contract pricing to these results showed a significant increase in gross crop value. In 2005, the MD treatment had a $136 to $160/A increase in gross crop value over the other treatments, which was due primarily to the increase in US #1 yield. In 2006, both treatments with undisturbed bands had a significant increase in gross crop value, with increases of $97/A (MD) and $127/A (PS) over the untreated check. Gross crop value for the fertilized band treatments was not significantly increased over the check in 2007. It should also be noted that applying pricing to yield results is highly speculative due to the variety of incentives paid to growers for tuber quality.

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