TIME AND METHOD OF FERTILIZER APPLICATION ON RUSSET BURBANK POTATOES

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It has been a common practice for potato producers to broadcast all or part of the fertilizer before plowing. Some growers broadcast part of the fertilizer before plowing, band part at the time of planting and add still more fertilizer, particularly nitrogen, as a side dressing about 30 days after planting.

The reasons for the various practices are that there is less fertilizer to handle at planting time when the push is on to get the potatoes planted; it doesn't make any difference how it is applied, just so it gets on; and if too much fertilizer is put near the seed it will burn the young roots. There may be other reasons but these are the main ones.

In much of our experimental work all of the fertilizer was banded about two inches to the side and two inches below the bottom of the seed piece. The procedure was criticized by some because in their opinion too much fertilizer was put too close to the seed piece. The maximum rate applied by this method was 240 pounds per acre of nitrogen, 160 pounds per acre of P_2O_5, and 400 pounds per acre of K_2O.

The first comparison between banding all of the fertilizer and split applications was conducted in 1961. One half of the fertilizer was broadcast before plowing and one half of it was banded at planting time in one set of treatments, and in the other set it was all banded as previously described. The highest rate used was 240 pounds per acre of N, 160 pounds per acre of P_2O_5 and 400 pounds per acre of K_2O. The fertilizer was compounded from ammonium nitrate, treble super-phosphate and muriate of potash. The rate was equal to 1,783 pounds per acre of a 12 - 8 - 20 fertilizer. The average yield for the split application was 394 CWT per acre. The average yield was 415 CWT per acre when all of the fertilizer was banded. Banding such a large quantity of fertilizer was certainly as good as the split application and may actually have been better. The percentage of No. 1 grade potatoes averaged 4 per cent higher when the fertilizer was all banded than when it was applied in a split application. The specific gravity of the potatoes was essentially the same for the two methods of applying fertilizer, as was also the blackspot index and the effect on chip color.

The amount of nitrogen in the tissue was higher when all of the fertilizer was banded than when only half of it was banded. This was true also for potash. The amount of phosphorus was the same for both methods of fertilizer application.

Soil samples taken from this experimental area showed phosphorus to range from medium to very high, whereas the level for potash ranged

from very low to medium. There is no reliable test for soil nitrogen. The level of phosphorus and potash in the soil may be a determining factor as to whether or not split applications are equal to or better than banding all of the fertilizer.

A second experiment to test the effect of method of fertilizer application on potatoes was conducted on the Othello station in 1962. The experimental area turned out to be extremely variable in phosphorus and potash content as determined by a soil test, but some of the differences were large enough and consistent enough to be worth mentioning.

The fertilizer treatments were applied (1) by broadcasting and plowing under all of the fertilizer, (2) by broadcasting and plowing under half of the fertilizer and banding half of the fertilizer at planting time, and (3) by banding all of the fertilizer at planting time.

Banding all of the fertilizer and banding half and plowing down half of the fertilizer were about equal, but broadcasting and plowing down all of the fertilizer was definitely inferior to the other two methods of putting on the fertilizer. In 1963 the same fertilizers were put on the same plots, and by the same methods of application as were used in 1962. Even the rows of potatoes were within two or three inches of where they had been planted in 1962. In 1963 banding all of the fertilizer produced an average yield of 470 CWT per acre; banding half and broadcasting half of the fertilizer produced an average yield of 455 CWT per acre, and broadcasting all of the fertilizer before plowing produced an average yield of 427 CWT per acre. As in 1962, the biggest difference was between banding all or half of the fertilizer and no banding of fertilizer.

An experiment to determine how much fertilizer can safely be applied in bands at planting time was started in 1962. The fertilizers were applied about two inches on each side and two inches below the bottom of the seed piece. The seed pieces were planted three to three and one-half inches below the level land surface and the irrigation furrows were made as shallow as possible but still deep enough for the water to flow through the field without breaking over the edges of the furrows. The seed was planted by press-wheel and no hilling was done other than that which occurred at the time of making the furrows.

The fertilizer rates began with the residual amounts in the soil as a check. Thereafter, the nitrogen, phosphorus and potash rates were increased stepwise by 80 pounds-per-acre increments until the maximum rates applied were 400 pounds per acre of nitrogen, P_2O_5 and K_2O. Each of the fertilizers was applied all in bands and as a split application wherein half the amount was applied in bands and half was broadcast and plowed down.

The average yield per acre was slightly higher when all of the fertilizer was banded than when a split application was used, even at the highest rate of 400 N, 400 P_2O_5 and 400 pounds per acre of K_2O, but the differences

were not statistically significant. The two methods of applying the fertilizer were also about equal insofar as yield of No. 1 grade potatoes, percentage of No. 1 grade potatoes, specific gravity and chip color were concerned.

The blackspot index was significantly lower when all of the fertilizer was banded than when it was only half banded, but the percentage of smooth skin on the tubers was significantly greater when the fertilizer was all banded than when it was only half banded.

The same fertilizer treatments and the same methods of application were applied to the same plots as in 1962. The seed was also planted within inches of where it was planted in 1962. The yields, even at the highest rates of fertilization, were as high when all of the fertilizer was banded as when a split application was used, even though there had now been 800 pounds per acre of N, 800 pounds per acre of P_2O_5 and 800 pounds per acre of K_2O applied in the immediate vicinity of the roots during the two year period. There is a strong indication that the second year, rates below 300 pounds per acre of N - P - K might best have been banded, whereas those above this level might best have been applied half banded and half broadcast. It would not be unreasonable to expect that with the prolonged use of phosphorus and potash, the levels in the soil would increase to the point where it wouldn't make much difference how they were applied, so long as the levels in the soil were high. How much would have to be added to make this true is not known. Phosphorus seems to build up rapidly, but an application of 400 pounds per acre of K_2O was insufficient to maintain the soil test level for potash, and a band application of 250 pounds per acre of K_2O was insufficient to eliminate potash deficiency symptoms in some soil spots.

Results With Side Dressing

An experiment to determine whether or not it was possible to lower the yield and grade of potatoes by applying nitrogen in the irrigation water was conducted in 1961. In this experiment the basic fertilizer rate was 140 pounds per acre of nitrogen, 140 pounds per acre of P_2O_5 and 140 pounds per acre of K_2O. The check treatment received all of the nitrogen, phosphorus and potash in bands at planting time. The phosphorus and potash were banded on at planting time in all of the other treatments, but in some plots half of the nitrogen was banded on at planting time and half was applied as anhydrous ammonia in the irrigation water. In others, all of the nitrogen was applied in the water.

When half the nitrogen was applied in the water and the first application was made forty days after planting, the grade-out of No. 1 potatoes was 34 per cent. When all of the nitrogen was applied in the water and the first application was made forty days after planting, the result was 18 per cent No. 1 grade potatoes.

When all of the nitrogen was applied in the water and the first application was not made until sixty days after planting, the percentage of No. 1 grade potatoes was only six per cent.

Many questions were left unanswered, and therefore another experiment was conducted in 1962 and again in 1963. In these experiments, all of the fertilizer was banded on at planting time for a check treatment. The phosphorus and potash also were banded on at planting time in the other treatments, but supplemental nitrogen was applied by injecting a nitrogen solution directly into the root zone. The use of a probe made it possible to apply nitrogen solutions into the root zone with a minimum of root injury, and thus eliminate the root injury associated with mechanical side-dressing. Ammonium nitrate, Aqua, and ammonium sulfate solutions were compared as sources of nitrogen and were found to be about equal in their effect on total yield and yield of No. 1 grade potatoes and percentage of No. 1 grade.

In 1962 Diphenyl-amine was used to test whether or not nitrates in the plant had been depleted at the time of side dressing. In 1963 side dressing was arbitrarily begun 35 days after planting.

In 1963 when half of the nitrogen (120 pounds per acre) was applied at planting time and supplemental applications of nitrogen were begun 35 days after planting, no detrimental effects of the side dressing were found. It would appear that the detrimental effects which have been found as a result of side dressing are due to the fact that the growth must have stopped because of a lack of nutrients and was started again when additional fertilizer was applied. In another fertilizer experiment in 1963, tuber types which previously had been attributed to moisture stress were obtained. Most of the tubers were affected to some degree. It would appear from studies to date that the number of off-type tubers are the result of changing the rate of growth of the tubers, and that the effect could be produced by a number of conditions, not just moisture and fertilizer. The total yields may be unaffected but the percentage grade-out most certainly is affected.

In summary, it would appear from the data that fairly large amounts of fertilizer can be applied in bands without deleterious effects on the crop. Factors other than yield and grade, such as the efficient use of labor and the lower cost of fertilizers in the fall need to be taken into consideration before the best economic practices can be established.

Side dressing per se does not appear to be detrimental except in those cases where tuber growth has stopped because of a nutrient deficiency. The source of nitrogen used for side dressing appears to be of minor importance. It should be remembered that soluble fertilizers move with the wetting front, and that if the water front is moving down, the fertilizers will move downward. If the water front is moving upward with respect to the location of the fertilizer, it will move upward.