I D A H O

Cooperative Fertilizer Evaluation Program Seeks Appropriate Recommendations

By Terry A. Tindall and Jeffrey C. Stark

The basis for university recommendations on rates, timing and types of fertilizer to be used in a given area is usually developed from research by university, USDA/ARS, and other government researchers with little direct input from growers or industry.

Because of constantly changing cropping systems, advances in plant genetics, improved irrigation management, and other factors, fertilizer guidelines must be updated periodically to remain current. In recent years, growers, fieldmen, and consultants in Idaho have expressed significant concern regarding the adequacy of university fertilizer recommendations for present management systems and yield levels. Many claim that they get higher yields and net economic returns by applying higher fertilizer rates than those predicted from small plot fertilizer research results. To a large extent, this perceived need to apply higher fertilizer rates results from growers' efforts to address problems associated with soil variability. Fertilizer response calibrations obtained from sites with low variability (such as small research plots) typically underpredict the optimum fertilizer rate for fields with high variability.

Cooperation of university, industry and growers is leading to more adequate guidelines for fertilizer recommendations in Idaho. This article reports the progress after four years of work to develop broad-based criteria for nutrient management in major crops of the state.

A primary concern of growers relates to the policy adopted by the Natural Resources Conservation Service in Idaho which, in conjunction with other agencies, developed the Nutrient Management Technical Guide. It imposes specific limitations regarding the rates of nitrogen (N) and phosphorus (P) that growers participating in government subsidy programs can apply to their crops. The limitation is equivalent to 1.2 times the University guidelines. If guidelines are inadequate, this program could cause serious production losses for participants.

Examining CFEP potato plots during the 1996 season are, from left: Bob Adams, private consultant; Dr. T.A. Tindall, University of Idaho; and Rocky Duncan, potato grower.

TABLE 1. Original University of Idaho P fertilizer guide for Russet Burbank potatoes based on soil test P, percent free lime and yield goal.

Soil test P[1] 0-12 inch depth	Preplant P fertilizer recommendation Percent free lime[2] Less than 5%	10%	15% or more
	pounds P_2O_5 per acre		
0	240	354	466
5	160	280	400
10	80	200	320
15	0	120	240
20	0	40	160
25	0	0	80
30	0	0	0

[1]Soil extractant for P is sodium bicarbonate ($NaHCO_3$); ppm.
[2]Free lime is measured as calcium carbonate equivalent (CCE).

Program Background

The Cooperative Fertilizer Evaluation Program (CFEP) was initiated in the spring of 1993 through joint university and industry efforts with the following objectives:

1) Increase the scientific database from which nutrient decisions are made.

2) Build cooperative relationships among the University of Idaho, growers and the fertilizer industry by providing joint ownership of newly developed fertilizer guides.

3) Provide growers with more broad-based, well-defined criteria that combine both on-farm and agricultural experiment station information.

4) Promote environmental responsibility based on research as opposed to opinion.

The 1996 season concluded four years of CFEP programs for all major Idaho crops. There has been tremendous support for the program from grower groups, the fertilizer industry, and state and federal agencies. The total number of CFEP plots initiated to date is over 150. These figures represent a tremendous amount of work by growers and those fieldmen responsible for coordinating and gathering much of the information. Costs to date total about $250,000.

All experimental plots were conducted on commercial fields utilizing growers' normal farming practices. The only variable was the type and rate of nutrient applied. Each location had an initial soil sample taken. Nitrogen, P, or potassium (K) was applied at rates that represented a range from zero up to 2 to 3 times the recommended rate, based on soil analysis.

Plot sizes were substantially greater than traditional research plots. Fertilizer treatments were typically applied in 50 to 100 ft. strips across the entire length of the field. Sites were selected from cooperators who were considered excellent growers. Each site coordinator was asked to keep track of all inputs and production data on a standardized CFEP worksheet. At the end of the season, plots were harvested with commercial harvesting equipment and subsamples were collected to determine grade and quality.

The authors were very pleased with the tremendous effort put forth by the individual site coordinators. Their cooperation cannot be over emphasized. The fact that this is truly a unified effort is a key factor in the success of the CFEP program.

Results

After completion of four years of experimentation on growers' fields and across many locations and soil types, the data indicated that there was adequate justification for revising the fertilizer guides for some of the major crops.

Phosphorus can be used as an example of the potential need for modifying current fertilizer guides. **Table 1** gives the earlier University of Idaho P recommendations

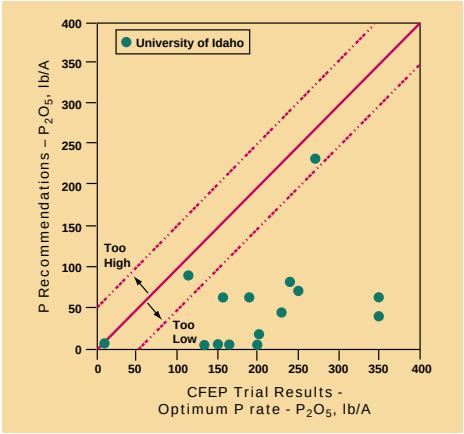

Figure 1. Original University of Idaho fertilizer P recommendations in relationship to the 1993-96 CFEP potato projects.

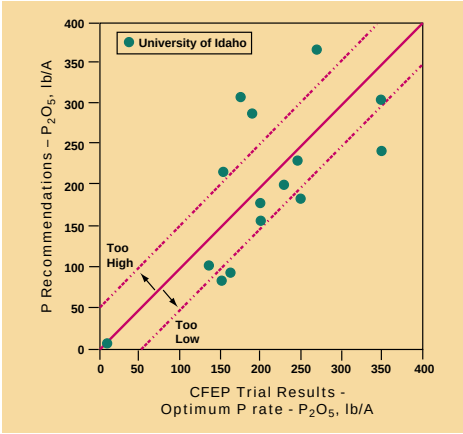

Figure 2. Revised University of Idaho fertilizer P recommendations in relationship to the 1993-96 CFEP potato projects.

for irrigated potatoes. This information takes into account soil test P levels and percent free lime.

Figure 1 shows the relationship between the present University of Idaho potato P recommendations for each of 15 CFEP field trials and the corresponding P fertilizer rates that produced the highest yield in each trial. The line intersecting zero represents a 1:1 relationship between fertilizer P recommendations (Y-axis) and corresponding optimum P rates. The dashed lines represent plus or minus 50 lb/A of P_2O_5 that should serve as a reasonable target for commercial operations.

Those fertilizer recommendations that fall below the lower dashed line are considered insufficient and those above the upper dashed line are considered excessive. The University recommendations were low at nearly all levels of recommended fertilizer P. In fact, all but two

TABLE 2. Revised University of Idaho P fertilizer guide for Russet Burbank potatoes based on soil test percent, free lime and yield goal.

Soil test P[2] 0-12 inch depth	Preplant P fertilizer recommendation[1] Percent free lime[3]							
	0	2	4	6	8	10	12	14
	pounds P_2O_5 per acre							
0	320	340	360	380	400	420	440	460
5	240	260	280	300	320	340	360	380
10	160	180	200	220	240	260	280	300
15	80	100	120	140	160	180	200	220
20	0	20	40	60	80	100	120	140
25	0	0	0	0	0	20	40	60
30	0	0	0	0	0	0	0	0

[1]Apply an additional 80 to 100 lb of P_2O_5/A as a starter at planting to any soil test P value below 31 ppm.
[2]Soil extractant for P is sodium bicarbonate ($NaHCO_3$); ppm.
[3]Free lime is measured as calcium carbonate equivalent (CCE).
Increase P_2O_5 application by 10 lb/A for each % lime increase.
[4]Recommendations are based on 400 cwt/A yield goal. Add 25 lb P_2O_5/A for each additional 100 cwt/A increase in the yield goal above 400 cwt/A and subtract 25 lb P_2O_5/A for each 100 cwt/A decrease below 400 cwt/A.

points fell below the target range. The differences between P recommendations and optimum P rates were substantial when P requirements were high.

The University of Idaho has developed a revised P fertility guide for potatoes (**Table 2**). The primary changes included in the revised recommendations are 1) raising the soil P sufficiency level from 15 to 20 ppm $NaHCO_3$-extractable P, 2) making the adjustment for percent free lime linear across all lime levels (10 lb P_2O_5 for each 1 percent increase in free lime), 3) recommending a starter application of 80 to 100 lb P_2O_5/A, and 4) providing an adjustment for yield goal based on differences in crop P removal.

Figure 2 compares the new P fertilizer recommendations to the results of the CFEP trials. The revised recommendations are in reasonably good agreement with the optimum P rates. Much of the variability may be due to the fact that the intervals between P rates for most of the trials were greater than 50 lb P_2O_5/A. Additional data from on-farm research and traditional small-plot fertilizer trials were also used to validate the revised recommendations.

The CFEP program provides good information that can be utilized to evaluate where we are in soil and tissue test correlation. It is also a means to interact with grower groups and the fertilizer industry in developing meaningful and usable guidelines. The program will continue into the foreseeable future, adjusting to current needs. BC

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Alabama: Phosphorus Availability from Phosphate Rock as Enhanced by Water-Soluble Phosphorus

The objective of the study was to distinguish phosphorus (P) availability from the soil, central Florida phosphate rock (PR) and triple superphosphate (TSP) so that P uptake by crops from the PR in the presence of TSP could be estimated. Radioactive 32P was used as a tracer.

Three sets of silt loam samples were mixed with (1) 32P solution and PR, (2) 32P-tagged TSP and (3) 32P-tagged TSP and PR at a 50:50 ratio. Phosphorus rates were 0, 12.5, 25, 50, 100 and 200 parts per million (ppm). An additional rate of 400 ppm was prepared for treatment (3). Corn and cowpea were planted, then harvested after 42 and 45 days, respectively.

The effectiveness of P source in terms of increasing dry matter yield and P uptake was TSP > (PR + TSP) > PR for corn and TSP = (PR + TSP) > PR for cowpea. Uptake of P from PR in the presence of TSP was higher than when PR was applied alone, indicating an enhancement effect on PR uptake by the TSP. BC

Source: S.H. Chien, R.G. Menon and K.S. Billingham. 1996. Soil Sci. Soc. Am. J. 60:1173-1177.