F.A.R.M. Phase One (Video)

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Abstract

F.A.R.M. Phase one is a computer program which controls the processing of soil samples at Plains Innovative Laboratory Services in Saskatoon. This video describes the four steps of the soil testing process and shows how this computer program maintains control of the sample flow through the laboratory and maintains the integrity of the data in the system. The video follows the soil samples through the various analytical procedures up to the printing of the final report which is faxed and mailed to the fertilizer dealer or farmer. The showing of this video will demonstrate the procedures involved in the analysis of a soil sample and outline the quality assurance procedures that are part of the system.

Script

"The Saskatchewan Soil Testing Laboratory prides itself on the quality of service that it provides and quality of service is not only limited to the quality of the analysis, in other words, the reproducibility and accuracy of the analysis which the laboratory performs, but on the whole process from the time a sample is taken in the field to the time that a report is printed and sent to the customer."

"As part of the quality of the soil testing process that the Saskatchewan Soil Testing Laboratory provides, the laboratory employs professionally trained staff; utilizes state of the art equipment, has employed very stringent quality control and quality assurance procedures, provides agronomic advice through its professional agrology staff, encourages people to send their samples for quick processing by providing free shipping by bus express for customers with four fields or more, provides free sample drying for samples that arrive at the lab in moist condition, provides rapid turn-around -- three to four days on most routine farm analysis and two weeks for most routine industrial analysis, has improved receiving procedures with user friendly information sheets, and offers improved custom reporting for the multitude of customers that we serve."

The FARM Phase 1 database developed by the Saskatchewan Soil Testing Laboratory is software designed to serve the agricultural community. It is a unique method of organizing soil analysis and making fertilizer recommendations based on target yields for the major agricultural crops.

Bagged samples arrive at the soil testing lab affixed with a color-coded sticker which indicates the sampling depth and contains a unique identification number. Samples go into the dryer in the order that they are received. The dryer maintains a temperature of 32 to 35 °C, and using forced air, is able to dry up to 3,000 samples in a period of only 8 hours.

While the samples are being dried, the information sheets are forwarded to the data entry clerks, where the unique number and all the information supplied for each field is entered into the computer.

In order to avoid mix-ups during processing, the computer groups the samples into trays of single depth, double depth, or triple depth categories. Each tray could hold samples from all over the prairies, because the computer links the results with the correct field information.

At this point, the computer assigns each sample to a specific position in each tray. It also randomly designates one field of every eleven as a duplicate... one of many built in quality control features of the system.

The system generates a receiving sheet, a lab sheet for each set of required analyses, and a set of labels for each tray of 24 samples. By the time the samples are removed from the dryer on the following morning, the data entry will be completed.

When the samples are removed from the dryer, they are returned to the sample bags, then placed according to the receiving sheet in the position on the tray assigned by the computer. Each tray represents 22 single depth fields, 11 double depth fields, or 7 triple depth fields. Before the case is ready to be processed, each bag must have the computer-generated label affixed which indicates the position number for each sample.

The quality-control assistant ensures that the identification number and position of each sample corresponds to the assigned number and position on the receiving sheet. Once this checkpoint has been passed, the receiving sheet is replaced by the lab sheets. The computer has recorded the position in each tray occupied by a particular field, and -- from this point on -- identification of each sample is strictly by the assigned tray position. The field information will not be matched to the samples again until all the tests have been completed.

Lab procedures require that the samples have a fine earth consistency, so they are run through a grinder. The idea of grinding is NOT to break the particles, but rather to break the aggregates -- or soil particles which are glued together -- so that particles over 2 millimeters can be sieved and discarded.

The soil texture of each sample is estimated by hand. . . this is important since the bulk density of the soil is affected by soil texture.

At this point, extraction of nutrients for analysis can begin. This is actually the second step of four in the complete soil testing process.

The first step is the soil sampling. This is the only one of the four steps which is not the responsibility of the soil test lab. Most soil sampling is done through or by fertilizer dealers, although many individual farmers and gardeners submit their own samples for fertilizer recommendations.

The second step is the extraction and analysis of the nutrients in the soil sample. Based on the test level of the analysis for each nutrient, the result is interpreted with a calibration curve which relates the test level to the quantity of nutrient that is required for the specified target yield. The interpretation is the basis for the quantity of nutrient recommended for fertilizer application.

Samples are "scooped" for analysis - once for pH and conductivity, once for nitrogen and sulphur content, and once for potassium and phosphorus content. Two additional scoopings are done if micronutrient analysis is requested. In the extraction process, different chemical extractants are used to estimate the available nutrients in the soil. The chemicals mimic the action of plant roots and remove a proportion of the available

nutrients from the soil. We are left with a solution - or extract - which represents the nutrients present in the soil indicating what is available to the plant at the beginning of the growing season. The analysis of this solution will determine the quantity of each nutrient that is present; nitrogen, phosphorus, potassium, and sulphur and when requested, micronutrients. The concentration of each nutrient in the extract is determined by an instrument designed and calibrated to determine the concentration of the nutrient. Nitrogen and phosphorus, for example, are determined by the strength of colour development of an indicator added to the extract. One of our qualified technicians monitors the instruments and directs the flow of extracts through the instruments according to the lab sheets prepared by the computer.

There are many controls built into the analytical process to provide assurance of the quality of the results printed on the final report. The technician checks the value of the standard sample analyzed with each tray of samples to monitor the performance of the analytical equipment. He also compares the results of the duplicate analysis. If either of these two checks are not acceptable, the technician will stop the instrument, correct the problem, and repeat the samples analyzed since the previous standard sample before continuing with the next tray.

Other checks are strategically placed in the process. The data is entered into the F.A.R.M. Phase 1 program twice by two different terminal operators. The two entries are compared by the computer for differences, and any errors are corrected. Quality control personnel are an integral part of the testing procedures at several points, adding "human" checks to the automated ones.

Each lab sheet is approved by both the lab supervisor and the quality control officer. Here is Lloyd Hodgins, Quality Assurance Manager, to explain the quality assurance process.

"Within various industries for a considerable period of time such as the automobile industry, the pharmaceutical industry, and the food industry, quality control has been an integral part of their sytem. Within the agricultural laboratory, it is a relatively new phenomenon. The reason that it has grown and evolved is to provide accurate, precise and cost effective analysis for our client. This allows us to guarantee to the client that the results they have are accurate and that we don't have to do a large number of repeats and are able to keep our costs down. It also allows us to maintain an accurate record on our instruments to see if they are in statistically control or analytical control and allows us to evaluate an analyst. If the system has been in statistical control and we put a new analyst on it and it loses statistical control, then it is time for training or retraining of that analyst. It might be reagent makeup or technique, but all of these things con be identified quickly and evaluated. That cuts down on the number of repeats that we have to do and increases our cost effectiveness and our competiveness. The chart that I will show you later on is for a run of potassium analysis of fertilizer which we run under the Canada Fertilizer Quality Assurance Program. It shows all of the points varying above and below the center line. When the lines are varying like that around the line with them neither above or below on a consistent basis, it indicates that it is within statistical control."

Once the data has cleared the checks of the quality control process, the F.A.R.M. Phase 1 program incorporates the nutrient level of the soil for determining the fertilizer required to achieve the requested target yield of the crop to be sown. The values used to make these interpretations form the FARM Phase 1 database - the heart of the soil testing lab's system. The database represents the agronomic fertility research conducted by government and other institutions on the prairies.

Information is kept confidential and impartial throughout all testing procedures through the use of numerical identification. Even so, the system allows for instant access to information on request by individual farmers or fertilizer dealers using the identification number on the sender's copy of the information sheet. The computer stores data based on each recorded quarter-section so that location, test depths, crop types, soil climatic zones, moisture levels . . . virtually all known variables can be correlated with the nutrient information to identify trends in soil nutrient status of an area's soil.

The end result of the FARM Phase 1 database, decades of research, and good customer service is the recommendation sent back to the customer. The Saskatchewan Soil Testing Laboratory operates with the understanding that farm profit margins are tight, and that farmers can neither afford to lose yield or waste fertilizer.

Soil testing is an important tool in farm management and fertilizer practices, and the Saskatchewan Soil Testing Laboratory has developed its database to maximize its service to this end.

"The motto of the Saskatchewan Soil Testing Laboratory is derived from the initials of its name: Service Science Technology and Leadership which we firmly believe is what differentiates this laboratory in the soil testing industry. We have improved our services to a great extent to be able to respond to needs of the user and implemented a number of science and technology projects to be able to serve our customers better. In that way, we consider that the Saskatchewan Soil Testing Laboratory is a leader in the soil testing industry."