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Quality Control

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The timely and proper application of sound management practices in the various phases of the seed business is essential for success. The time is now past when management could concern itself exclusively with buying, selling, bill collecting and shipping, while leaving the technical operations entirely in the hands of hourly-wage employees. Technical expertise, experience, facilities, are also essential to the successful operation of a seed business, but alone they are not sufficient. They must be integrated and "put-to-use" by management, and directed toward the basic concern of any supply business - consumer satisfaction.

One of the most powerful management techniques in the seed business is quality control. Unfortunately, it is often considered as something beyond the resources of all except the very largest seed companies. This attitude apparently derives from the association of quality control with the corporate giants in the manufacturing field. While quality control is a sophisticated management technique, it is equally available and applicable in the most modest seed business.

In the seed industry, quality control has three important aspects. These are:

1. Establishment of minimum acceptable seed standards.
2. Formulation and implementation of a system and procedures for exceeding the established quality standards, and maintenance of same.
3. A systematic approach to identification of causes of quality problems and their resolution.

The idea of high quality and the concept (and application) of quality control must permeate all phases of the seed business and not just be restricted to a momentary curiosity and a few routine tests after the seed are in storage or marketing channels. Concern about seed quality and actions to insure that standards are achieved and maintained begins with selection of seed for planting, extend through production, harvesting, drying, processing, storage and distribution, and end only with satisfactory performance of the seed in the farmer's field.

Quality control techniques are not unfamiliar to seed producers and seedsmen. Generally, however, they are randomly applied and uncoordinated. Some things are done routinely and well. Others are left

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[1/] This paper is based on a series of articles published in SEEDSMEN'S DIGEST in 1969.

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undone. Poor quality seed is most often the result of something that was not done or not done properly. Quality control integrates random and uncoordinated activities that are directed toward achievement of quality standards into a comprehensive, systematic and continuing effort. It does not permit vital operations or procedures to be accomplished or unaccomplished by chance or the whims of employees.

Quality control is concern about quality and attention to the various operations involved in the seed business. The procedures used in quality control range from simple, such as spot control of dodder in a clover seed field, to the complex, such as complete redesign of a handling and conveying system to minimize seed injury. Quality control seeks to prevent problems or when they are unpreventable, to minimize their effect. The most effective solution of a seed quality problem is always its prevention.

What is Seed Quality?

Most seedsmen have a rather definite concept of seed quality. However, their concept is often not sufficiently broad to encompass all the important attributes or aspects of quality. The concept of seed quality to far too many seedsmen simply means,"that which can be gotten by with."

Seed quality comprises many attributes or characteristics of seed. In terms of individual seed, these characteristics include trueness-to-variety, viability, vigor, mechanical damage, disease infection, treatment coverage, size and appearance. Extended to the population of seed that makes up a lot, quality characteristics include moisture content, storage potential, incidence of contaminants (weed and other crop seed, inert matter), uniformity of the lot, and performance potential. Highest quality seed are genetically pure, germinable, vigorous, undamaged, free from contaminants and diseases, properly sized (when necessary), adequately treated (for kinds that are treated) and of over-all good appearance. This ideal of quality is seldom achieved. Few seed lots meet all "ideal specifications." For this reason, minimum quality standards are established in most seed operations. These minimum standards are <u>not a goal</u> - the goal is <u>always highest quality</u> - but represents the lowest levels of the various quality characteristics that are acceptable.

Seed quality is important and it is becoming more important. The progressive seedsmen uses quality as a competitive technique just as he uses price and service. Quality fosters customer appeal, helps the seedsmen to develop a positive reputation (or good image), and results in satisfied customers and repeat business.

The Games Seedsmen Play

The attitude of management is the key factor in developing an effective quality control program. It is impossible to establish any sort of quality control program unless management is committed to certain quality standards. And, this commitment must be serious and consistent. All too often, management becomes gravely concerned about quality only when very serious problems arise and complaints are numerous, or when it is other-

wise convenient. As things smooth out or as the season ends, the concern vanishes, the problems are forgotten, and the next season gets underway in the same old manner.

A willingness to "just get by" is perhaps the real cause of most seed quality problems and attendent complaints. Getting by is one of the games that seedsmen play. Although, it takes many forms, the seedsman is always the protagonist and the seed analyst, seed control official, and certification inspectors are bit players.

One game is called "shopping". Samples are sent to various laboratories until the desired results (usually the highest) are obtained. These results are then used as a basis for labeling. Another, is a version of the old "now you see it, now you don't" game. A sample is sent to a laboratory for both germination and purity analysis. If germination is good and purity is not, then the laboratory gets another sample for germ. Resamples, however, are sent for purity only until by chance one turns out good. There are many variations of this game depending on which quality factor shows up low. Still another game might be called "divide and conquer". A seedsman has 500 bushels of wheat seed. A sample is sent to the laboratory and the results show good germ and purity but excessive noxious weed seed. The lot is divided into two 250 bag lots, and two samples are sent for tests. The results of the tests might show that in one of the samples the noxious weed seed is within permissible limits, while in the other it is still excessive. The half of the lot that has the good test is labeled, while the other half with the bad test is divided again, and so on, until as much of the lot "passes" as possible. Many other games could be described.

We have referred to the above procedures used by some seedsmen as "games", but they're not usually intended as such. Most of the seedsmen who use such procedures do so in good faith. They have the idea that if any test indicates that the seed are of reasonably good quality then they must be of good quality - regardless of test results from other labs that indicate variable or low quality. This is a natural reaction - most of us want to believe the best things - even seed. Yet, the variability inherent in sampling and testing must be recognized and appreciated. If 10 germination tests of a lot of seed average 75%, the odds are good that at least one of the 10 tests will show a germ above 80%. And, if enough tests are made, one will probably give a 90% germ. The average germ, however, will still be about 75%.

During many years I've been associated with the Mississippi State Seed Testing Laboratory, over 200,000 samples have been tested and we've been taken to task by seedsmen literally hundreds of times for reporting "low" test results. In only one case, however, have we received a complaint about our test results being too high. Seed testing laboratories do make mistakes and their interpretations do get out of joint with those of other laboratories. Seedsmen should keep them on their toes. However, if two laboratories test different samples from the same lot and one finds 500 dodder seed, while the

other finds only 200, the test giving the low count is not always correct. The dodder count is probably somewhere in between - about 350/lb. A similar situation might pertain when germination test results differ widely among laboratories.

We have spent some time discussing the philosophy of "getting by" because it is one of the first things that has to go before a quality control program can be installed. Since most seedsmen will have to depend on a seed testing laboratory for the information needed to make the quality control program go, an understanding of the nature of seed testing results is also important. Most laboratories simply report results, they do not comment or interpret test results. This must be done by the person in the company responsible for quality control.

The quality control program is based largely on inspections, timely and scheduled sampling, testing and interpretation of test results. Managerial decisions relative to disposition of seed lots, over-hauling of physical facilities to minimize quality problems, modification of procedures, etc., can then be taken from an enlightened perspective.

Standard Procedures

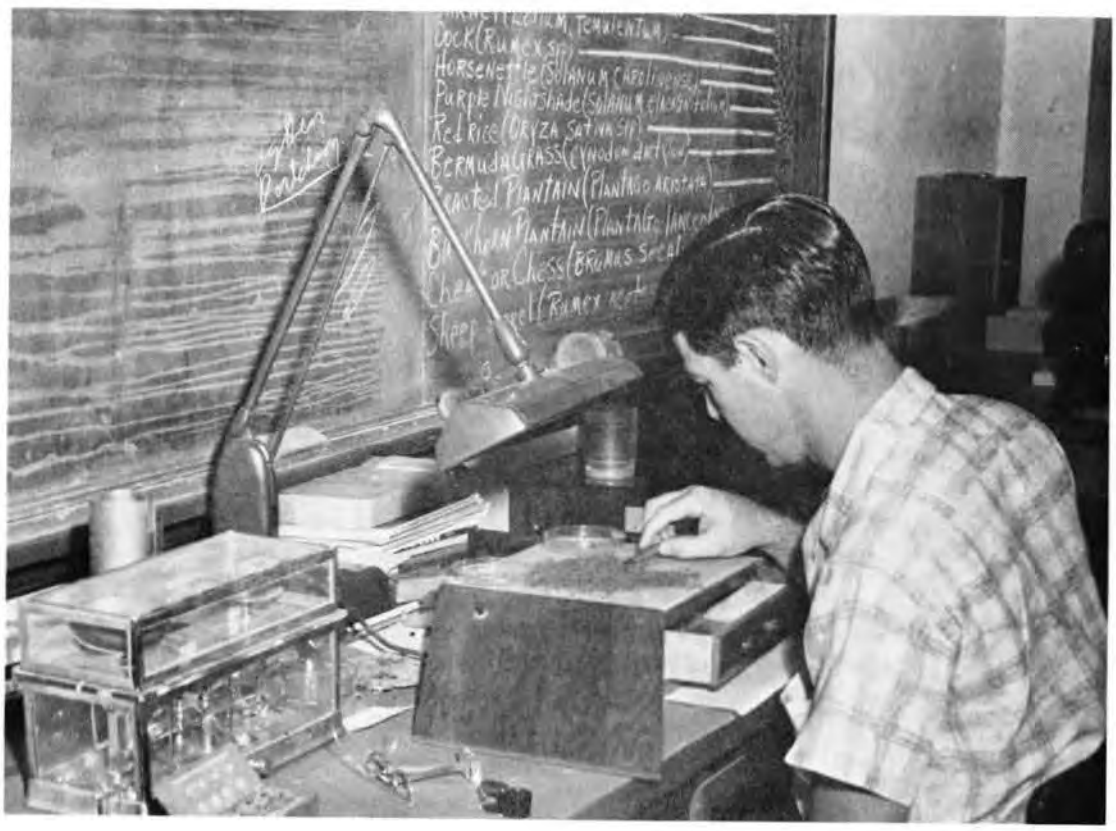
Retirement of the "getting by" philosophy and a new or renewed determination by management to produce, package, and market high quality is the basic requisite for a quality control program. But, determination and motivation - as important as they are - are simply not enough. They must be coupled with know-how, organization, and a willingness to sacrifice some short term gains for long term growth and development. A quality control program is not for the dabbler or even the pure trader in seed. Rather, it is for the seedsmen who actively participate in the production, processing and marketing of seed and who lays his reputation on the line each time he sells to a processor, wholesaler, retailer or directly to the farmer.

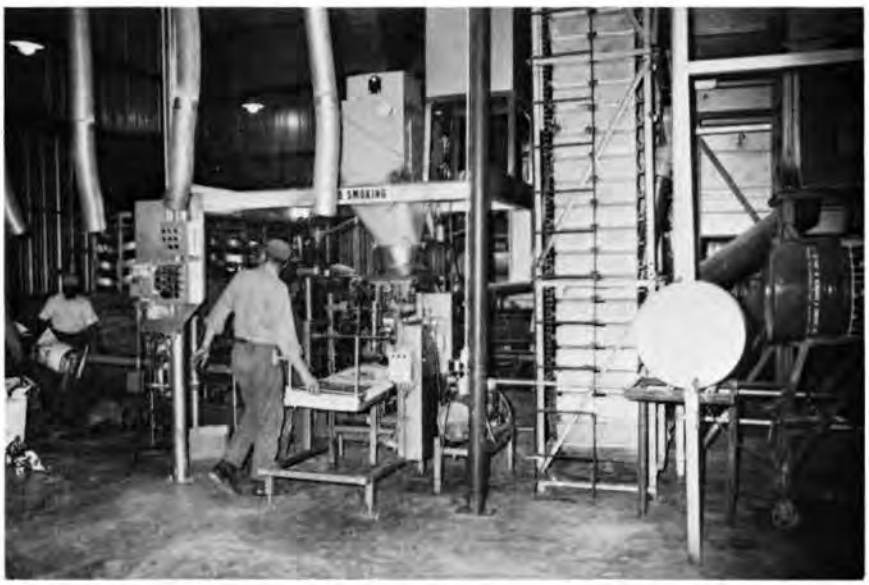
The first step in quality control is establishment of minimum standards for the seed handled by the company. These standards must encompass all the major quality attributes of seed: variety, trueness-to variety, other crop seed, weed seed, inert material, germination percentage, physical condition and appearance, treatment, vigor, etc. It really boils down to this question: what kind and quality of seed do you want to be associated with your company's name?

For illustration, assume that the company is moderate in size and specializes in the production, processing, and marketing of soybean seed. Minimum standards might be established as follows: (1) only recommended varieties produced; (2) varietal purity, not more than 2 off type or other variety seed per lb.; (3) pure seed, 98% (or not more than 1.5% inert); (4) weed seed, none; (5) germination, 85%; (6) splits and broken seed (fragments missing), 2%; (7) cracked or ruptured seed coats, 5%; (8) shriveled and very small seed, discarded; (9) soil particles, none; and (10) appearance, all seed

QUALITY CONTROL BEGINS IN THE FIELD....

.....INVOLVES DIFFERENT KINDS OF TESTS FOR QUALITY...





....REQUIRES QUALITY FACILITIES AND PEOPLE, AND CONTINUOUS LEARNING.....

processed over a spiral to remove misshapen seed (and soil particles, splits, badly broken seed, etc.).

How are these standards going to be met or, since they are minimum standards, even higher standards achieved? Obviously, an organized effort, educational program, and timely sampling and testing will be required. Someone in the company has to be responsible for the various activities that make up quality control. And, he has to know the things that must be done if the seeds are to meet the established standards.

Production is organized and contract growers are carefully selected on the basis of uniformity and cleanliness of land, type and condition of equipment, attitude (progressive or non-progressive), knowledge and appreciation of modern production practices, available labor, and so on. Seed production is important. Indeed, it is the first and most important consideration in a quality control program. There is much truth in the old adage, "you can't make a silk purse out of a sow's ear." If the contract grower delivers damaged, trashy, low quality seed to the plant, then more often than not, damaged, low quality seed will leave the plant. The cleaning plant is not the place to "create" quality, it can only enhance and refine what is already there. Yet, many seed plants are more often engaged in salvage operations than in dressing up an already high quality product. I am acquainted with a soybean seed producer who takes great pride that his seed usually meet minimum certification standards without cleaning, and he should be proud. I also remember another grower who had produced some cowpea seed, banged them up thoroughly during harvesting and ended up with 5% inert matter. Since this was too high, he started recleaning...and recleaning, and by the time he got through, germination was below 30% and inert matter was 22%.

Contract growers must be advised throughout the production cycle. Recommended cultural, weed and insect control practices should be followed. The fields should be checked several times during the growing season by the production supervisor for the company and/or quality control specialist. A thorough inspection just before harvest is critical. It is at this time that off-types, other varieties, weeds, and other crop plants can be best detected and most effectively rogued. Harvesting equipment, truck beds, wagons, and bins should also be inspected for cleanliness at this time.

The timing of harvest of a seed crop is very important. Considerable damage can result from harvesting when the seeds are too high or too low in moisture. The operation and adjustment of the combine are also important. The grower should be advised on cylinder speed and clearance settings and taught how to determine when changes in settings are needed by visual inspection of the harvest seed. Instruction and advice on the handling of the harvested seed (unloading into bins, etc.) to minimize injury and on aeration or drying procedures should also be given to the grower.

The grower will generally do a good job if he has suitable equipment, is properly advised and instructed, has the right attitude, and is provided with sufficient incentive (contract price) to justify the extra effort and greater care required to produce quality seed.

Sampling and Testing

Sampling and testing during the production phase are not neglected. Several pounds of pods can be gathered at the time of the pre-harvest inspection and hand threshed. Moisture content can be determined and the seed stored for reference in case problems arise later. The hand harvested seed should be highest in quality. Additional samples should be taken for moisture test as the seed are loaded into the bin so that aeration or drying needs can be determined, and for germination tests and visual examination for mechanical damage. Remnant seed should be filed for future reference as needed.

The seed should usually be sampled again before processing (assuming that some time elapses between harvesting and processing) and after processing (just before bagging or after bagging). The latter sample will usually be the sample tested to obtain information needed for labeling purposes.

Adequate records and timely sampling and testing procedures are the key elements in a quality control program for seed or any other commodity. The results of tests made at various stages provide information needed to identify both chronic and acute problem areas. Since identification of the problem is requisite for a satisfactory solution, progress in improvement of quality can only be achieved by knowledge of how quality is decreased.

Very often serious problems or deficiencies in seed quality become evident only during the marketing phase - causing direct financial loss, damage to reputation, and much valuable time spent on post-mortems. Post-mortems are necessary when a problem arises to determine its probable cause. Indeed, a business that does not post-mortem complaints or problems will not be a business for long. This procedure can be very effective in getting to the root of the problem, provided a corpse(s) and suitable tools for the autopsy are available. Usually, however, only a sample from the "complaint" lot and the file sample required by law are available. Examination of these samples will generally reveal - if everything was on the up and up - that there is a difference in one or more specific quality factors between the "complaint" sample and the file sample. Most often, however, the reason for or cause of the difference(s) cannot be determined or identified.

Let us look at two specific problems. First, consider the problem arising when a complaint is made by a farmer or filed by a seed control official that a lot of wheat offered for sale was a mixture of varieties, whereas it was represented to be essentially pure Variety X. On post-mortem, two situations can arise: (1) examination

or testing of the file sample shows that it too is not pure, or (2) the file sample can be pure as labeled. In the first situation, the seedsmen either did not (a) use pure seed for planting and failed to rogue, (b) carelessly mixed the seed in combining, binning or processing, or (c) accepted someone's word that the seed was of Variety X. He cannot determine the cause of the mixture more specifically unless he has ample records on land history, seed source, field inspection, roguing, and processing, and samples of the seed planted (original source), the seed just before harvest, after harvest and after each subsequent operation. If he does have these records and samples, then the cause of the problem can probably be determined and corrective actions taken.

When the other situation prevails (i.e., the file sample is pure but the complaint sample is not) the problem area is rather easily identified. The mixture most likely resulted from errors in tagging (a few bags of another variety got mixed in with the lot), assuming there was no chicanery on the complaint end.

Another problem: A seedsman or planter sends a large lot of cotton seed to a custom delinter for delinting and treating in February. After delivery of the delinted, treated seed, he submits a sample for testing and results come back indicating 57% germination. He has in his records results of a test made by the same laboratory in late October showing 84% germination and requests that the delinter make good on the seed that he (the delinter) has ruined. A casual consideration might suggest that the delinter did indeed ruin the seed. But, did he? This question cannot be answered unless a portion of the original lot was not delinted or a sample taken just before delinting is on file. When a file sample taken just before delinting and treating is available, then an analysis will indicate if the seed or the delinter is at fault. Furthermore, if delinting was detrimental to the seed, examination of the sample will often indicate why that particular lot was injured and others not - high incidence of mechanical damage, low vigor, etc.

Sampling after each operation in seed harvesting and processing does take time and space, but it is essential to any quality control program. As previously discussed, tests need not be made on each sample. Many of the samples are simply filed away so that they will be available when needed to post-mortem problems and identify problem areas. After the lot is marketed and the "complaint" season is past, the samples can be discarded with the exception of the file sample required as part of the lot record by the various seed laws.

Some tests, of course, should be made on the samples drawn after the various stages in harvesting and processing. Time of harvest should be determined by moisture test insofar as the weather permits. Knowledge of seed moisture content at harvest permits proper adjustment of the combine, and effective handling, drying and storage of harvested seed. Analysis of the seed after harvest will indicate whether the seed are of sufficiently high quality to keep as seed and

the most efficient processing and cleaning procedures for bringing the seed to their highest quality level. When the seed are stored for a relatively long period of time before processing (1 to 2 months or longer), another test just before processing is desirable to detect any change in quality of the seed that might cause it to drop below an acceptable level.

Quality control also encompasses inspections and examinations other than those made on systematically drawn samples. Periodic, visual inspection of the seed during combining will often indicate that adjustments have to be made to prevent excessive seed loss or to reduce mechanical damage. Similar examinations during processing can detect malfunction of equipment or reveal the need for modification of procedures used.

Quality control is constant concern about quality and attention to the various operations and procedures that affect quality favorably or adversely. When these traits are instilled in all employees, quality problems might not all be prevented, but they will surely be minimized. And, the seedsmen won't be faced with the same set of problems each season.

Application of Quality Control Procedures

We have considered what quality control is, what quality control is not, the importance of timely sampling and testing in the quality control program, and the benefits and uses of a quality control in a seed business. These have a been general discussions and not directly applied to the production, processing, and storage of a specific seed. The emphasis in this section is on application of the quality control philosophy and techniques to a specific kind of seed.

Soybean seed production and sales have increased dramatically in the past 15 years. The number of farmers saving their own seed decreases each year, so the market potential still looks very good. The modest quality control program outlined below for soybeans is generally applicable to other kinds of seed, particularly the non-hybrids.

1. Seed Source: The varietal purity of a seed crop cannot be better than that of the seed planted - but it can be worse. Use of varietally pure, weed free seed is the first step in quality control. If the seed are to be certified, then seed source is specified (as to class) and checked by the certification agency. When non-certified seed are produced, use of purple or blue tag seed for planting is one of the best ways of ensuring varietal purity.

2. Land: The land used for seed production should be fertile, well drained and reasonably free of weeds - at least those weeds whose seeds are difficult to separate from soybeans. The land ought not to have been planted to a different variety of soybeans the previous year, their is always the danger of volunteers. In situations where a planting has to be on land grown to another variety the previous year, the

land should be worked several times before planting so that volunteers will germinate and be destroyed.

3. Planting: Planters should be cleaned before filling, and planting scheduled so that only one variety is planted each day. When more than one variety is planted in different fields on the same day, one or two sacks can easily be unloaded at the wrong site. Seed should be inoculated. Save a 1 to 2 pound sample of the seed planted for the record.

4. Isolation: The distance between varieties should be at least the distance specified for certified seed, **even** if non-certified seed are to be produced.

5. Cultural Practices: Good cultural practices - including weed control - are necessary. Use practices recommended for good commercial soybean production.

6. Field Inspection: The person responsible for quality control or the production supervisor should inspect the field several times: after emergence to determine how good a stand was obtained, during the early growing season to check on weed control and progress of the beans, at flowering time to check on varietal purity, and then just before harvest to check on variety purity, presence of troublesome weeds, and do final roguing.

7. Harvesting: Combines should be thoroughly cleaned and inspected before harvest. Harvest date (as possible) should be determined by moisture content. Try to harvest when moisture content first drops to 13-14%. When the beans dry so fast that they drop all the way to 10-12% before they can be harvested, harvest during the morning and late afternoon, skipping the 1-4 p.m. period. Take a sample of hand harvested beans and save as a check on subsequent operations. Set cylinder speed so that field losses are minimized, the seed are well threshed, but damage is minimized. Check the combined seed periodically to determine if further adjustments need to be made as the day progresses. Draw samples of the threshed seed periodically, for moisture content determination, and the files. Avoid augers in loading or unloading into bulk storage bins. Be sure conveyors, trailers, etc., are clean.

8. Bulk Storage: After harvest place seed in clean bulk storage. Aerate if moisture content is above 13-14%. It is good practice to aerate for a time even when moisture content is 12% or less to remove "field heat". Draw samples from bulk storage after aeration, send half of the sample to a laboratory for purity analysis and germination test (or make the tests yourself). On basis of test results determine whether beans are up to your standards and suitable for seed, and plan processing procedures on basis of what needs to be removed.

9. Processing: Clean and inspect all conveyors and processing equipment for contaminants. Set-up and adjust equipment so that material that must be removed can be removed. Check during cleaning to determine that seed are being cleaned to standards. Use spiral

separators to improve appearance of seed and remove soil particles and the last few splits. Send a sample to laboratory for analysis for purity and germination. Use the results for labeling or to varify labeling. Retain a 2 lb. sample for record. Estimate lot size as accurately as possible and then check by estimating discard, number of bags, and number of tags used.

10. Storage: If bags are not tagged, identify them in some permanent way, then stack by lots. Stack by lots even if bags are tagged. Obtain an accurate count of bags, and enter into stock inventory card along with exact location of seed in warehouse. The warehouse should be clean and rodent proof.

11. Final Check: Draw a sample just before the shipping season and hold or submit for test. If the sample is tested and germination has dropped out of tolerance, recall seed. Don't wait for a stop sale notice or call from a dissatisfied customer. After the sales season is over, clean the warehouse, processing equipment, storage bins and harvesting equipment. Review records on all lots - all analysis reports - and re-examine all samples taken. Determine how quality might be further improved the next production season. Drive around the area and look at some of the fields planted with your seed. How do they look?

Quality control is not something mysterious. It's really just paying attention to the important operations and procedures in a seed business, and periodically checking to determine that standards are achieved and maintained.