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Strengthening Exercises for Seedsmen

H. C. Potts

STRENGTHENING EXERCISES FOR SEEDSMEN

Howard C. Potts [1/]

Individuals become involved in programs of strengthening exercises for a variety of reasons, but mainly to trim the fat, shape up to the competition, and increase the liklihood of a better and brighter future. Seedsmen need to organize and implement programs of strengthening exercises for about the same reasons:

(1) To trim the fat for survival during a very difficult economic period.

(2) To shape up to the competition in terms of efficiency, technology and quality control.

(3) To insure themselves a place in a business that will change drastically and dramatically during the remaining years of this century.

Strengthening exercises are needed because only the strongest will survive. All of us - students preparing for work in the seed industry, old seed conditioners and professors, middle-level managers in multinational organizations, certification inspectors and so on - will need all the mental and physical strength we now have plus that which we can develop in the next 5 to 10 years to meet the challenges that lie just ahead.

Diagnosis?

Recently, I made the statement: "I am sick of hearing about computers, genetic engineering, hard times and the need for change in the seed industry." I was told, "Howard, if you're sick see a doctor, if not go to work." Fearing work, I saw the doctor. After the examination, which required several consultations, my doctor gave me the prescription indicated below, and assured me that the prescription was not just for me but could be followed by anyone associated with the seed industry.

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Rx: Strengthening the Seed Industry

(1) Diet - continue the stringent economic diet to remove useless fat, or to add or shift weight to more desirable places.

(2) Exercise - immediately start jogging through a technical revolution to pushup efficiency.

(3) Wonder Drugs - when fiscally fit, start using "wonder drugs" to make the broadjump from the farmer's fields to laboratory situps.

As with any prescription, each of us has a choice concerning whether or not to follow all, part or none of that prescribed.

I understand that many of the "wonder drugs" won't be on the market for a few year, but, as you are aware, the economic diet and exercise programs have already started. We will have a chance to use the drugs, only if we are strong enought to survive the next 5 to 10 years. The remainder of this discussion is devoted to the details of how the prescription may be followed.

The Diet Program

Most of us think of losing weight when we hear the word diet. Keep in mind, however, that some diets result in a weight loss while other diets result in a weight gain or a shift in weight.

The implementation of Reganomics and PIK programs caused an immediate weight loss in the hybrid seed segment of the seed industry. These so called "fat cats" have suffered but with the proper diet and exercise they will come scratching back meaner than ever. On the other hand, the seedsmen who produce and sell vegetable seeds have finished their prescribed diet, started their strengthening exercises, and are ready to plant their seeds of success.

Let's go back to the prescription and look at the diet prescribed for the seed organizations who handle primarily public varieties of soybeans, rice, wheat and similar crops. Many of these companies were malnourished by the effects of the PVP act and Reganomics before they got PIK'ed? Many small, independent seed companies were tied-up by the effects of the recession before PIK. Unlike the fat cats or big boys, who have an occasional opportunity to relax, these traditionally independent, skinny cats, may even be cut off from their traditional sources of seed, i.e., public plant breeding programs. Just consider that of seventeen soybean varieties tested by our Experiment Station 5 years ago, only two were privately developed varieties. In 1982, on the other hand, eleven of 17 varieties were developed by private companies. It

should be apparent that, at least for soybeans, small seed companies which want to gain economic weight will have to associate with an organization which can supply the varieties from which a measurable profit can be earned.

Unlike most of the popular radio, T.V., and newspaper dieting ads which emphasize rapid weight loss, the diet for strengthening the seed industry will be primarily one of weight relocation. There is not a lot of time remaining before the sands of time will cover up any turkey who doesn't follow the proper diet.

The Exercise Program

Jogging will be a basic exercise for strengthening seed organizations over the next ten years. The definition I use for jogging is not the slow run most people think of, but rather to jog, in the sense to arouse to alertness. Jogging in the sense of alerting you to new possibilities and probabilities is a major purpose of this short course.

Now, recall the second part of the prescription for strengthening the seed industry. It states that we are going to jog through a technical revolution to push-up efficiency. Using this short course program as an outline, let us relate the revolution through which we must jog to some specific technical activities associated with the seed industry.

Consider seed conditioning. There have been no really basic changes in the design of seed conditioning equipment in over 25 years. Modifications yes, but not basic changes in the way that materials are separated. We all need to add a few drops of skill to more effectively operate and utilize the excellent array of equipment that is already available.

To be sure some of the so called "high technology" is being introduced into seed conditioning equipment but many of us don't even use the technology already available. An example: there is little difference in the appearance of gravity tables built in 1916 and 1980 and no real difference in their operation. Likewise, there has been little improvement in the methods we use to "teach" operation and use of the gravity table. The need for substantial improvements in the entire area of seed conditioning still exists!!

Discussions concerning the development and deterioration of seeds have traditionally been known as "weather talks." You know what a weather talk is: everyone talks about a subject, but no one does anything about it. But, technology does exist which permits us to circumvent undesirable environmental influences on seed quality. Technology concerning the use of foliar fungicide sprays, breeding for improved seed quality, and computerized crop modeling systems are just in their infancy in the seed industry.

Let us look at a few examples of ways technology might be used to eliminate some of our current seed quality problems. The examples concern the use of what we might consider "old hat" technology, plant breeding, to resolve an even older problem - stand establishment in sorghum (or any kind of seed, but retaining sorghum as an example).

Among the major reasons that farmers fail to obtain satisfactory stands of sorghum are that the soils into which the seed are planted are too hot, too cold, or too dry. Very little can be done about the weather, but can't something be done about the seed? The data presented in Table 1 indicate some of the variability that exists among different sorghum lines in their capacity to germinate at temperature extremes. Between 68F and nearly 100F, seed of all five lines and the commercial hybrid germinated near 100%. Differences among the lines, however, are very evident under cool temperatures (61-64F) and especially in the high temperature range of 104-108F. Wouldn't incorporation of high and low germination temperature tolerance in sorghum hybrids be helpful in reducing stand problems? The stand problem in sorghum could be further reduced by also incorporating capability for germination/emergence at low soil moisture levels. There is variablility in germinative responses of sorghum lines at low soil moisture levels (Figures 1 & 2). Five of the six lines established excellent stands only 3 days after planting when the soil moisture was good and the soil temperature was a warm 77F (Figure 1). On the other hand, the same lines when planted in a drier soil gave dramatically different results (Figure 2). Notice that only one of the lines produced a satisfactory stand. The sorghum seed studies discussed above were conducted here. Workers in Texas have demonstrated similar variability in sorghum in terms of development of root systems. Many workers have demonstrated tremendous variation in resistance to field weathering among soybean lines, etc. The pertinent question here is: when will these superior seed and seedling characteristics be available to farmers?

If there is any area related to seeds which is entering a more exciting period than that of seed treatment materials, I don't know what it is. At a time when seed health is finally receiving proper attention as an important factor in seed quality, chemists are developing an array of new seed treatment materials. These new compounds not only control some seed and seedling diseases, but include safeners which protect the seedlings from herbicides, systemic compounds which kill insects that feed on the seedlings, as well as suppress diseases that spread through the air. Somewhere over the horizon might be seed treatments that greatly extend the viability of seeds in storage or under seedbed stress, accelerate the rate of emergence and increase uniformity of emergence, and control the time of germination.

In 10 to 15 years we are likely to see corn, sorghum and soybean growers pregerminating their seeds and then treating them so that disease or insect control in the growing crop will not be necessary. Further, these pregerminated, treatment safened seeds may be planted in

Table 1. Germination response of selected sorghum genotypes to a range of temperatures. After Camargo (1982).

Germination Temperature (^{o}F)	Genotype				
	BTx 3197	Comm. Hyb.	P954063	MN 1811	SC599-11E
	----------%----------				
61	54	69	98	94	56
64	77	82	95	95	78
68	100	95	95	100	100
72	95	95	100	100	95
75	100	100	100	100	95
79	95	95	100	100	95
82	95	95	100	100	100
86	95	95	100	95	100
90	100	90	95	100	95
93	95	95	95	95	95
97	93	90	100	93	95
100	92	85	98	94	98
104	80	87	95	82	94
108	57	50	94	41	90

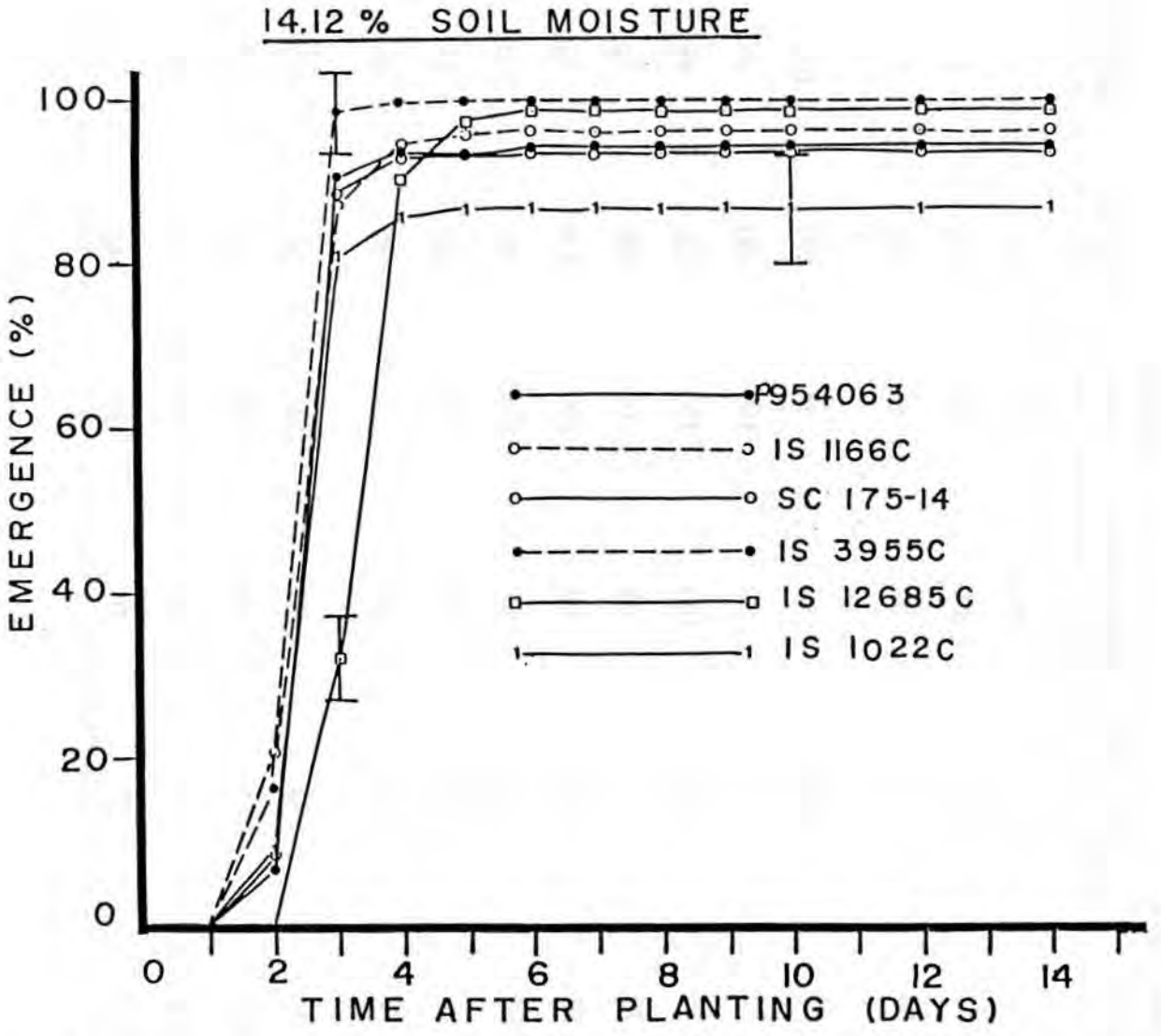

Figure 1. Rate and percentage of emergence of six sorghum genotypes at a soil water potential of -0.83 bars (14.12% moisture, d.b.). After Reusche (1982).

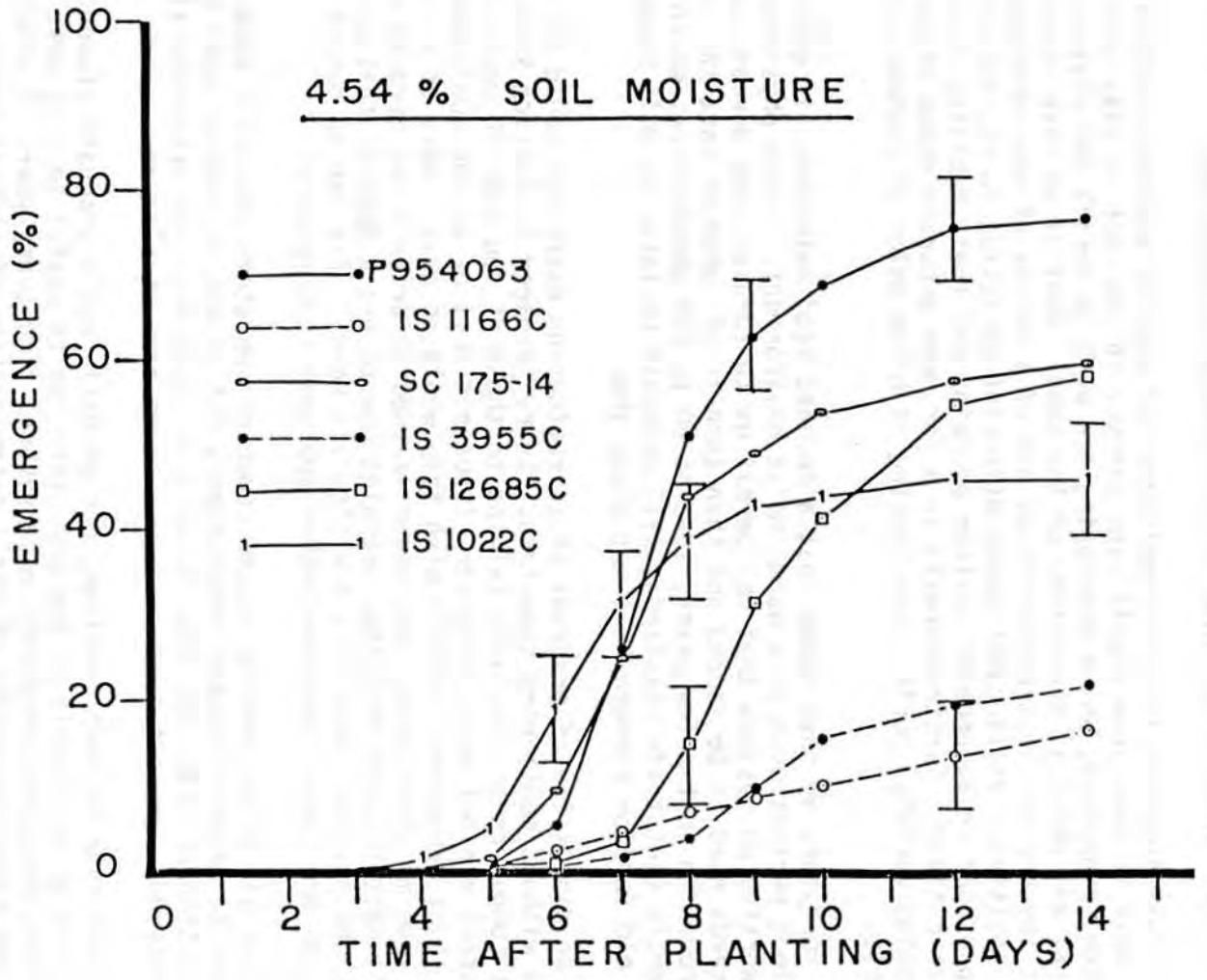

Figure 2. Rate and percentage of emergence of six sorghum genotypes at a soil water potential of -11.11 bars (4.54% moisture, d.b.). After Reusche (1982).

a gel which will permit the use of a single application of a broad spectrum herbicide, to kill every plant in the field except the desired crop. If you think that these ideas are just an old scientist's day-dreams, you should be aware that commercial vegetable producers are already beginning to use some of the techniques described.

Those involved in seed regulatory and quality assurance activities will have to make some significant changes in approach to stay up with the new technology, while developing new ways to verify the physiological and physical properties of the seed. Most of us have heard about the use of electrophoresis as one of a series of new techniques to more positively distinguish among different varieties on the basis of the presence or absence of various proteins and their mobility in an electric field. Electrophoresis is a far more accurate means of determining varietal purity than looking at hilum color of soybeans, for example.

For years we have known that a dormant seed maintains its quality for long periods even in a warm, moist environment. Today physiologists are working on systems that may permit us to turn-on seed dormancy when the seeds need to be stored and then turn-it-off when we want the seeds to grow. In just a few years, seed of 80 to 85% germination, which currently meet trade standards, will probably be taken to mill because even old fashion farmers will not plant them.

No discussion of programs of strengthening exercises would be complete without mentioning computers. Every teenager in America knows all about computers so I am only talking to those of you over 20 years old. Computers are not magic; however, I suspect most of us who don't know much about computers secretly wish they would go away. Many of us are much like my grandfather, who never learned to drive a car because he didn't want to waste his time learning how to use a machine that was, "just the passing fancy of a few city slickers." Are you so out-of-date that you are taking the grandfather approach to computers?

Not all of us need to become computer operators and still fewer of us need to become computer programmers, but unless we receive some basic instruction or read some good manuals on computers, our professional life may not turn out just exactly like we have it planned.

Work done by Juan Landivar, one of Bill Boyd's graduate students, can serve as an example of how computers can be useful to help make decisions most seed producers make several time every year. A simple computer simulation model of field deterioration of soybean seed was developed based on the date the seed attained physiological maturity, the average seed weight of the variety, and select climatic data: maximum and minimum daily temperatures, rainfall, and dew-point temperatures. These data are then used to predict the viability levels of soybean seeds before harvests. The levels of germination as predicted by the computer model are presented in Figure 3. Julian days are simply the number of days in the year: day 1 is January 1. Julian day 270 is

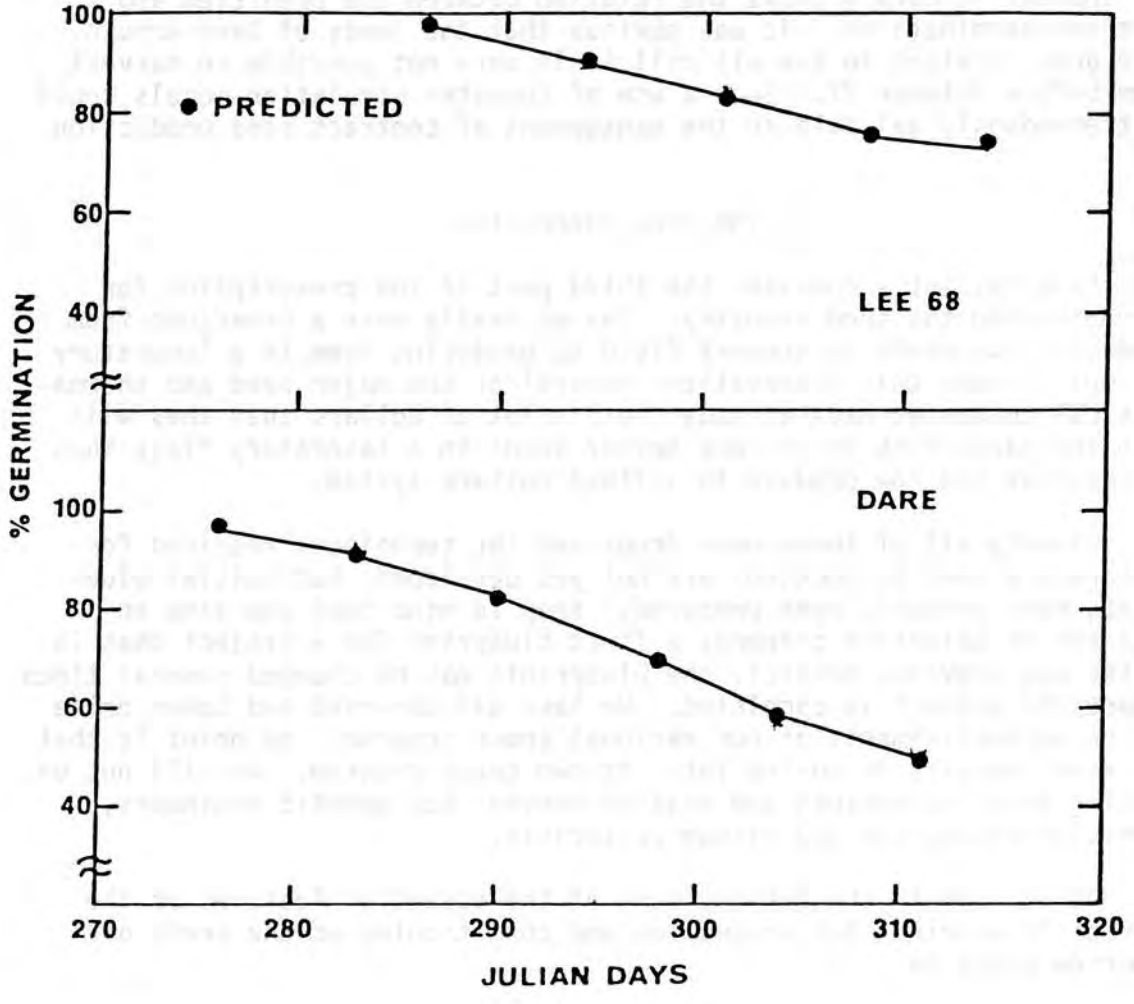

Figure 3. Predicted germination of two varieties of soybeans under conditions of delayed harvest. After Landivar and Boyd (1983).

September 27 or 28 depending on whether or not it is a leap year.

Seed samples were harvested from the plots on a weekly basis and germinated. Figure 4 shows the relation between the predicted and observed germinations. It was obvious that the seeds of Dare should have gone straight to the oil mill if it were not possible to harvest them before October 27. Such a use of computer simulation models could be tremendously valuable in the management of contract seed production.

The Drug Connection

Finally, let's consider the third part of the prescription for strengthening the seed industry. Can we really make a broadjump from producing our seeds in growers field to producing them in a laboratory set-up? I make this observation: several of the major seed and pharmaceutical companies have already "bet" a lot of dollars that they will gain the capability to produce better seeds in a laboratory flask than the best we can now produce in a field culture system.

Clearly all of the wonder drugs and the techniques required for "laboratory seed production" are not yet developed, but initial blueprints have probably been prepared. Keep in mind that any time an engineer or scientist prepares a first blueprint for a project that is unlike any previous project, the blueprints may be changed several times before the project is completed. We have all observed and taken pride in the accomplishments of our national space program. My point is that the seed industry is moving into its own space program. We will not be talking about astronauts and mission control but genetic engineers, molecular biologists and tissue culturists.

As we look to the future, some of the essential features of the current "blueprint" for production and conditioning of the seeds of tomorrow might be:

(a) Isolation of cell protoplasts and removal of the cell walls.

(b) Fusion of protoplasts from different genotypes or even species of plants.

(c) Regeneration of plants from the newly formed somatic hybrid through tissue culture.

(d) Transfer of desirable genes or gene sets among species by recombinant DNA technology. Single gene breeding rather than whole plant breeding.

(e) Selection of unique and desirable variants in cell culture - millions of cells - and regeneration of variant cells into plants.

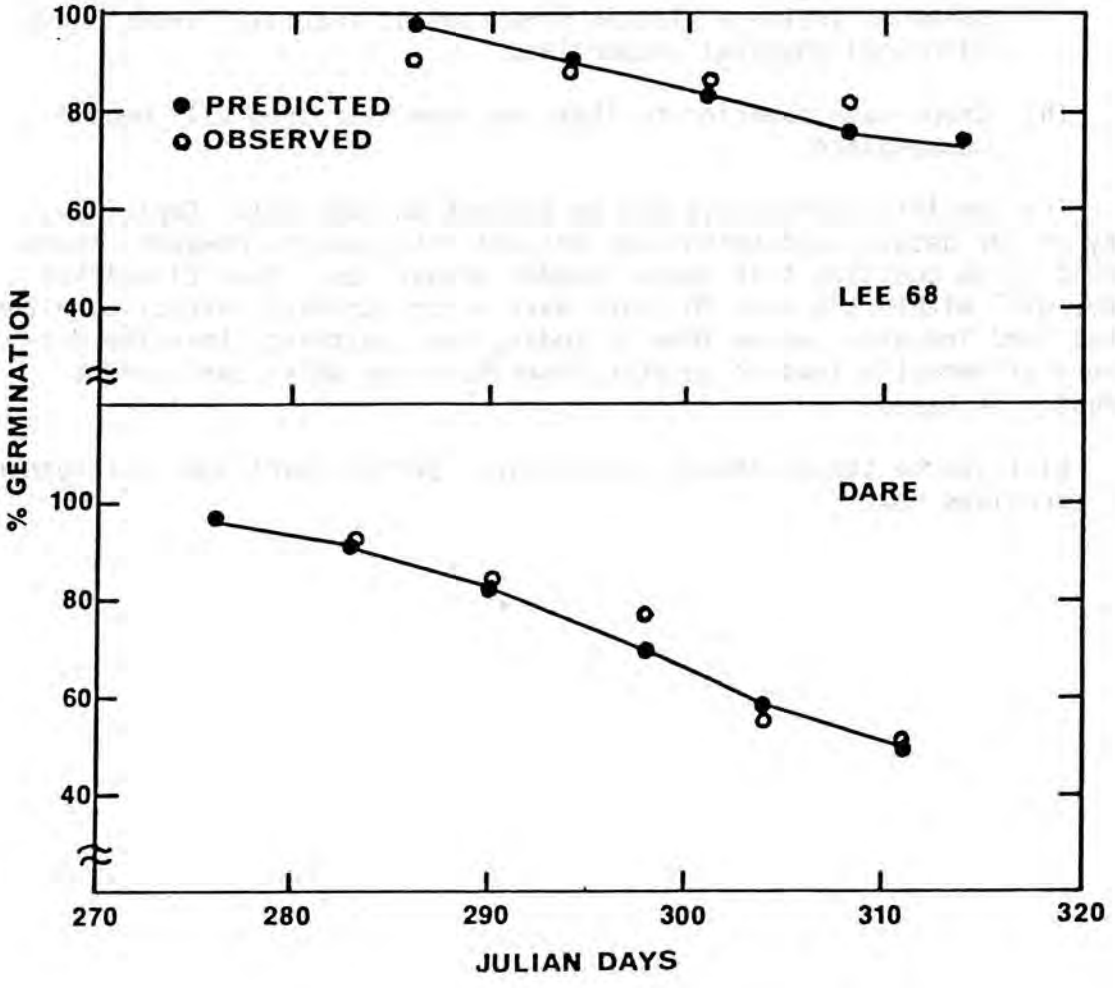

Figure 4. Comparison of observed and predicted germination of two varieties of soybeans under delayed harvest conditions. After Landivar and Boyd (1983).

(f) The production of somatic embryos for the "new" seeds.

(g) For planting, somatic embryos which will be encapsulated with stored food, insecticides, fungicides, safeners and growth hormones inside a plastic seed coat so that all "seeds" have identical physical properties.

(h) Crops much superior to those we have ever seen will become commonplace.

The specific items above may be subject to question. Certainly, many of the details and techniques are not yet evident; however, there should be no question that these "wonder drugs," as I have classified them, will within the next 20 years have a more dramatic effect upon the total seed industry, as we know it today, than anything since the discovery of Mendel's laws of genetic inheritance on which our current industry is based.

Will you be strong enough to survive? Better start some strengthening exercises now.