is a possible conservation of fertilizers by use of the plastic mulch. Soil analyses at the end of the 1958-59 season did not indicate a difference in nutrient levels at that time, but no measure of the rate of change of nutrient levels during the year was made.

SUMMARY

Strawberries have been grown at Gainesville for the past three years in plots where a comparison could be made between opaque plastic mulch and no mulch. Pine straw mulch was also included one year.

The opaque plastic eliminated essentially all of the weed competition. Soil moisture as measured by vacuum gauge irrometers was maintained at a more nearly optimum level under plastic mulch than no mulch. Soil temperatures tended to be warmer under plastic during periods of cool weather and cooler in warm weather periods.

During normal Florida strawberry seasons yields were higher from plastic mulched plots than non-mulched plots. Plants grown with plastic mulch tended to decline more rapidly than non-mulched plants with the advent of hot weather. Weekly applications of captan, combined with plastic mulch, appeared to act synergistically as measured by increased yields.

Additional work is in progress to determine the effects of other mulching materials, fertilizer rates and methods of application, time of application of mulches, and plant spacing on strawberry yields and quality.

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MAINTAINING THE GENETIC STABILITY OF VEGETABLE VARIETIES

GILBERT W. SCOTT

Associated Seed Growers, Inc.

New Haven, Connecticut

This discussion might more adequately be entitled, "Do our important vegetable varieties actually run out and, if not, why not?" inasmuch as the number of complaints on alleged "running out" indicate this to be a question of interest to most vegetable growers. Let us then consider in the next few minutes the important possibilities for variation in vegetable varieties and the means by which the seedsman prevents them from causing varieties to "run out".

SOURCES OF VARIATION

Vegetable varieties grown from seed — only sexually propagated varieties are under consideration here — vary greatly in their visible characteristics, these characteristics being regulated by a complex of genetic factors or genes. Any given characteristic may be regulated by a single gene or by the interaction of several genes, the latter being true for the principal characteristics of interest to the grower. The final expression of any characteristic, whether simple or complex, is, however, subject to wide modifications by the environment in which the plants are grown.

Heterozygous base. — A genetically homozygous basic seed stock is a primary requirement for absolute uniformity in any variety. Many, perhaps most, varieties are somewhat variable when they are introduced. If introduced by a seedsman, he will undoubtedly back up the original introduction with lines that are more uniform if the new variety is received favorably. If a variety introduced by a public agency is found to be variable to a significant degree, seedsmen will, if the variety is sufficiently promising, attempt to develop uniform stocks, usually by evaluating progenies of single-plant selections. This often results in numerous strains of the original varietal type, as is true for Homestead and Pearson tomatoes, Great Lakes lettuce, and many others. While these reselected strains represent changes from the original, they are improvements, and in no sense could they contribute to "running out". Without this reselection and purification, crops produced from the original, nonuniform stocks would continue to show variability.

Variable seed producing potential. —Perhaps the greatest potential source of variation in vegetable varieties is the difference in seed production potential between the individual plants making up the variety. Many of our present-day varieties are bred for characteristics which make seed production difficult, or limit the amount of seed produced per fruit or per plant. I refer to such characteristics as the slow bolting of some new lettuce, onion, collard, and spinach varieties, the limited seeding potential of the thick-fleshed cucumbers, peppers, tomatoes, and other items grown for their fruits, and the low seed yield of radishes, carrots, and other root crops which have small, refined tops. Since no variety is absolutely uniform, so that all individuals react exactly alike to a given set of environmental conditions under which a seed crop may be grown, there is a danger that one type in the population of a variety may be more prolific in its seed production than another, and thus be represented by a higher percentage of the population in the succeeding commercial crop. Unfortunately, the big, rough, wild types, which are less desirable horticulturally, usually produce the most seed. To prevent a build-up of these undesirable types, the seedsman does several things: (1) he develops the most uniform basic seed stock possible, as explained above; (2) he uses that stock for the production of successive seed crops, rather than repeatedly reproducing the stock; (3) he grows the seed crop under conditions favoring full potential seed production of the types which may bolt more slowly or yield less seed; (4) he eliminates from the population the undesirable "off" types, which are often so prolific, by carefully roguing the seed crop; and (5) he renews the basic seed stock by means of a carefully planned maintenance program designed to weed out any undesirable types.

Mutations.—Mutations, or the sudden change in the genetic make-up of one or more plants in a population, are known to occur in our present-day vegetable varieties, the rate of occurrence differing widely between species and varieties. Most mutations produce only minor effects and are hardly noticeable, but some produce distinctly different and highly undesirable plant types and must be promptly eliminated from the population to prevent deterioration of the variety. Examples of recurring mutants in vegetables are nonheading types in heading lettuce, certain aberrant types in peas, and crookneck fruits in Butternut squash. Fortunately, these undesirable mutations occur at low frequencies, and the resultant undesirable mutant forms are readily detected and can be eliminated from the basic seed stock or the seed crops grown from it. As long as they are not allowed to reproduce and increase to a significant percentage of the population, they have no serious effect on the variety and are of little economic importance. Not all mutations are deleterious, and some of the important characteristics of our present-day varieties may well be the result of recognition and preservation of beneficial mutations; in fact, considerable effort is now being expended to produce mutations by means of radiation in the hope that new, beneficial characteristics may be produced, although little of economic value has so far resulted from these attempts.

Outcrossing. — Many vegetable species are highly or entirely cross-pollinated, the pollen being transferred from one plant to another by the wind or carried by insects. With some, for example the cabbage group, intercrossing occurs between what the grower would consider to be different kinds, for instance, cabbage and broccoli. When two or more varieties of any of these cross-pollinated species are not sufficiently isolated from each other when being grown for seed, or when pollen-producing plants of these species are undetected in farm or home gardens or as volunteers along the fence rows, outcrossing may occur, giving rise to unintentional hybrids in the commercial vegetable crops grown from the seed so produced. These outcrosses, resulting from stray wind-borne or insect-carried pollen, would be expected to occur at an extremely low frequency, percentagewise, and in only rare instances would they be of economic importance. The point I wish to emphasize in this connection is that intervarietal hybrids resulting from outcrossing in the seed field are restricted to the particular seed lots in question, and would not recur, since they do not involve the basic seed stock. Although these outcrosses may look bad in the field, are annoying to the grower, and are frustrating to the seed producer, they do not indicate a "running out" of the variety.

Mechanical mixtures. — Human error is an ever-present hazard in the vegetable seed industry, as in any other industry; many opportunities exist for inadvertent mechanical mixtures of two or more varieties during the harvesting, processing, and merchandising of vegetable seed. The wonder is not that they do occasionally occur, but rather that they do not occur more frequently, and their infrequency of occurrence is testimony to the generally good seedsmanship on the part of the seed producers. Variability in a vegetable crop resulting from mechanical mixtures is related to the particular seed lot in question, and again in no way indicates a "running out" of the stock.

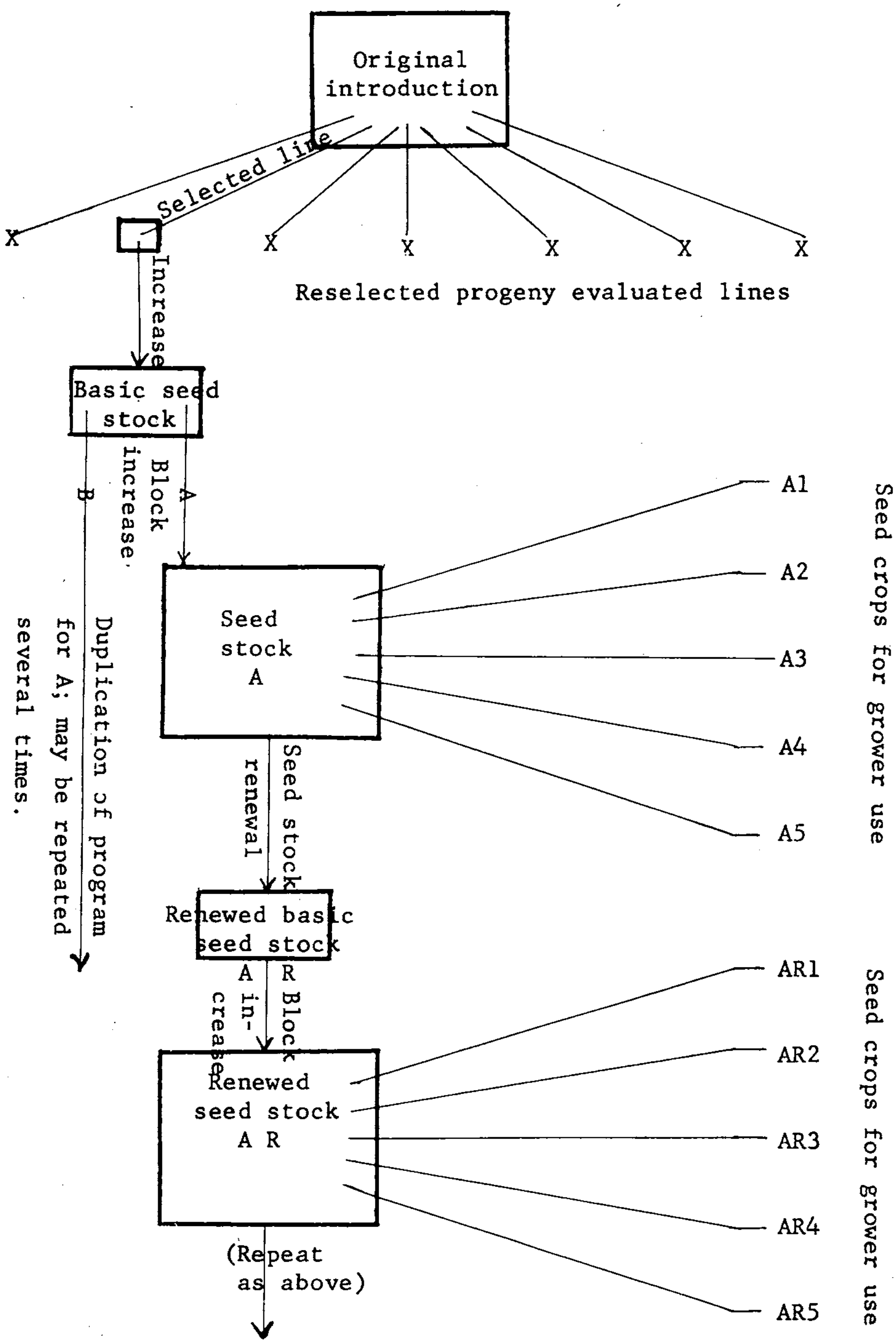
Environmental factors.—The most important cause of apparent variability within a crop, and between the performance of a given variety in different plantings, is the complex of environmental or nongenetic factors. Only brief mention can be made here of the more important environmental factors affecting the performance of a variety in a particular planting. These are soil fertility, soil moisture, toxicity or deficiency of minor elements, prevailing temperatures, day length, and disease and insect pests which may interfere with normal development of the crop. When any of these environmental factors, or a combination of them, produces a drastic effect on the crop, the responsibility is readily assigned; for example, a tender bean or pepper crop killed by a sudden freeze, a tomato crop damaged by standing water from unusually heavy rains, or a cucumber crop lost due to an epidemic of downy mildew is accepted by the grower as part of the hazard of farming. But most crops are subject to lesser modifications by these environmental factors, the causes often not being apparent to the grower, and sometimes not even to the experts. It is in such instances that the grower often concludes that the variety has "run out", or is not as good as it once was, when in fact its genetic make-up has not changed and the true explanation for the seeming variability is to be found in the environmental, or nongenetic, factors. A few such examples may be worth mentioning here.

Temperatures above a certain point are harmful to pollen, often causing a failure of the pollination and fertilization process, resulting in abnormal and unmarketable fruits. This is especially true of snap beans and corn. On the other hand, temperatures only a few degrees below normal, but well above freezing, may induce bolting in cabbage, collard, onions, carrots, and other crops. If sufficient exposure to low temperatures occurs when the plants are fairly young, they may go to seed without forming anything resembling a marketable product. When the exposure to low temperatures occurs at a more advanced stage, as in a half-mature cabbage head, the seed stalk may not be readily visible but the head will be elongated or pointed, and not typical of the variety. In such cases the grower often concludes that the variety has "run out", not fully understanding the effect of the cool temperatures which have not visibly damaged the plants. In contrast to the effect of cool weather, temperatures somewhat above normal, but below the point where any plant parts are visibly damaged, may cause bolting, or premature stalk formation, in lettuce, spinach, and other leafy crops. It is true that varieties differ in their tendencies to bolt, from the effects of either high or low temperatures as the case may be, but these differences are characteristic of the varieties and do not indicate any "running out".

Mild deficiencies of essential minor elements, such as manganese or magnesium, can modify the character of various plant parts, the result being easily attributed to genetic factors, whereas severe deficiency symptoms are readily identified as such.

Normal plant growth or fruit development is often interfered with by disease or insect pests. When these are soil-borne and affect the underground parts, such as root rots, wilts, and nematodes, the cause may not be readily understood and the poor crop said to be due to the variety "running out". Many virus diseases, about which we know relatively little, also markedly affect fruit development — for

Fig. I: Program for the selection and maintenance of vegetable seed stocks



example, bean pods and pepper fruits – often causing abnormal, malformed fruits which are unmarketable. In such cases growers often blame the variety and hold the seedsman who supplied it liable, when as a matter of fact the virus infection originated locally in other crops or weed hosts and was spread by insect feeding. Here again genetic variability or change is not the true cause of the difficulty encountered.

Another factor, which all too often is overlooked, is the human factor. By this I mean the change in our individual viewpoint, or sense of relative values, and our tendency to remember the pleasant and forget the unpleasant. A variety which some years ago was considered to perform satisfactorily would very likely be judged unsatisfactory when compared with modern varieties bred to meet present-day market requirements. Some of you may remember the fine crops of Colorado cucumbers you grew twenty years ago, but I am certain that if you grew those same crops today from the same seed lots, you would have difficulty in marketing them in competition with the Marketer and Ashley crops you are now growing. I'm afraid that many would be inclined to say that the seedsman had let the variety Colorado "run out", when in fact it has been the standard which has changed, not the variety. Similar situations with hybrid sweet corn or hybrid onions are frequently referred to by growers, claiming that this or that hybrid isn't as good as it used to be, when in fact it is simply being overshadowed by better hybrids which are constantly being developed. A 1940 Ford was a pretty good car, but would you rate it the same in comparison with the 1960 Ford just now coming from the assembly line? Of course not, for in the automobile we recognize engineering advances resulting from research and experience. In the same way the plant breeder deserves your recognition, for in vegetable varieties, too, the old hasn't "run out" – the new has been made better.

Varietal Maintenance

In closing this discussion I would like to illustrate the type of stock seed maintenance program employed by the progressive seedsman to maintain the genetic stability of the important vegetable varieties, in other words, to make certain that these varieties do not "run out".

A typical program for varietal maintenance is diagramed in Figure 1. The essential features of this program are: (1) development of basic seed stock from a selected line with desired characteristic(s); (2) successive increases of portions of this basic seed stock to amounts sufficient to serve as planting stock for seed crops produced over a period of several years; (3) renewal of the basic seed stock, when the supply of the stock in (2) above is exhausted, by appropriate methods depending on the species involved, the details of which need not be discussed here, the aim being to achieve greater uniformity and gradual improvement without significant modification of the variety; (4) increase of the renewed basic seed stock to give planting stock for successive seed crops, the number depending on the length of time the vitality of the seed stock can be maintained by storage under controlled moisture and temperature conditions; and (5) repetition of these steps as often as the stock seed supply situation requires.

By following a varietal maintenance program such as that outlined, coupled with good seed production practices, the progressive seedsman can assure the vegetable grower that the important varieties on which his program is based cannot and do not "run out".