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Description of Cultivars: Science or Advertising A Reply to Werner J. Lipton's Essay in the April 1988 *ASHS Newsletter*

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Any effort to improve cultivar descriptions in *HortScience* is laudable, but care should be taken to avoid making the rules for publication so strict that plant breeders stop publishing cultivar release statements in *HortScience*. Cultivar release information is very important to plant breeders. The cultivar name, pedigree, and general characteristics must be known before a breeder can intelligently use a new cultivar in his or her own breeding program.

I would like to make two points regarding data requirements for documenting cultivar release descriptions. First, there is a limit to what plant breeders can do. Most cultivars must exceed minimum standards for at least 30 different criteria, and very likely more if levels of resistance to all potential pests and pathogens are included. Based on long periods of observation, usually 10 years or more before cultivar release, the breeder gradually gains confidence that a particular genotype does not have a serious defect. Most breeders do not, when it comes time to release the cultivar, have the time or money necessary to formally test the new release for all the potential problems that could cause it to fail after its release. For many horticultural crops, there is only one group with enough resources to test conclusively the commercial possibilities of a new cultivar, and that is the growers. Cultivars are released for trial by growers. The amount of money that would be necessary to guarantee at the 5% probability level that a single new release will be successful would fund most university breeding programs for longer than the lifetime of the average breeder. Breeders are forced to accept the fact that some of their releases will be failures, some will be marginal successes, and only a few will be the clear successes that make them the industry standards.

The second point I would like to make regarding cultivar releases is that, in my opinion, Science Editor Lipton has far too

much confidence in "objective data which can be statistically tested" and far too little confidence in the breeder's opinion of his or her cultivars potential. Given a competent, experienced breeder, I would put much more confidence in the latter than in the former. Why? Because in the real world of quantitative characters and pervasive genotype $\times$ environment interactions, data collected for 2 or 3 years in randomized, replicated tests at one or two locations often give little information about how a cultivar will perform over an entire state or region over the potential life of the cultivar. Sample data gathered in randomized, replicated tests and subjected to statistical analysis are often exceedingly misleading, in that the sampling procedures violate the fundamental law that underlies statistical theory.

In statistical testing, there is a population about which inferences are to be made, and there is a sample, which is drawn randomly from that population. The sample size is made large enough so that mean values calculated from the sample estimate the population parameters within a certain confidence interval at a certain probability level. This process is valid if and only if the sample was drawn randomly from the population about which inferences are to be made, or, at the very least, if the population that actually was sampled can reasonably be expected to closely resemble [the population about which the inferences are to be made]. The greatest abuse of statistics in horticultural research today is the practice of drawing samples from one population, computing the sample statistics, and then assuming that the results apply to some other population, which may be quite different from the one actually sampled.

How well are the requirements for valid sampling normally met for cultivar release data published in *HortScience*? In most cases, very poorly, because valid samples would be far too expensive to obtain. Presumably, the population of interest for cultivar release data is the future performance of the cultivar in thousands of grower fields or greenhouses over a period of 10 to 50 years into the future. The sample data in cultivar release statements are not collected randomly from this population. Instead, they are collected from a few plants in a few replications in a few (sometimes one) locations over a few years, commonly at the university experiment station.

There are two main problems with such data: 1) The environments sampled often (usually) deviate in a systematic way from the environments in grower production fields; and 2) the environments tested, because so few years and so few locations are sampled, are far more homogeneous than the environments that constitute the population of interest. This gives a spuriously low error variance, which invalidates the statistical tests for mean separations.

My point here is not that the gathering of data for cultivar release is useless; my point simply is that means calculated from such data, be they significant to the thousandth of a percentile according to standard statistical tests, do not necessarily provide valid information on the future performance of the cultivar in grower fields, because the population from which the sample was drawn is not the population about which inferences are being made.

Let us turn now to the "breeder's opinion" of his or her cultivar, in which Lipton appears to have limited confidence. If the breeder is competent, an opinion is based on a much wider population of years and locations than can be tested in a formal test. At least in the case of fruit trees, advanced selections are usually tested informally with a number of growers for several years before they are proposed for release. Conditions in the grower test fields are much closer to those under which the cultivar will be expected to perform in the future than are conditions at the experiment farm. The range of environments tested is far greater than the range that can be tested at the experimental farm. The information gathered from such tests may be subjective; it may not be amenable to statistical analysis, and it may not lead to a neat, quantitative assessment of a characteristic, but at least the right population is being observed and a truer assessment of genotype $\times$ environment variation is being made.

Horticultural research is highly diverse. Some experiments are done in the laboratory, some in the greenhouse, some in growth chambers, and some in the field. Some experiments attempt to obtain generalized results over a wide range of environments. Others attempt to eliminate environmental variability and describe the behavior of plants in a single, specified environment. Clearly, not all research areas are amenable to the same techniques. In my opinion, it is a mis-

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take to specify one uniform set of rules as to how many years of data or what type of experimental procedures must be followed in order to qualify for publication of the results in *HortScience*. Fruit tree breeders seldom release a cultivar with fewer than 8 years of careful observations. Should laboratory experiments be considered unpublishable without 8 years of observations? Clearly not. Cultivar release notices are a unique and valuable type of publication in *HortScience*, and rules that may seem appropriate for certain other types of articles published in *HortScience* may be inappropriate for cultivar release notices.

Addendum

Science Editor's note: I have little problem with claims based on subjective evaluations made by one or more plant breeders, although broader-based, more objectively obtained evidence would be preferable. However, when claims are based only on the judgement of the authors, no matter how well qualified they are, they must make that *explicitly* clear. Only then can the reader make an informed judgement regarding the value of the claims. To the degree that such informed judgement is not possible, to that degree are the claims advertisement, rather than science.

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