Population Testing

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Population Testing is the exposure of representative samples of breeding populations to specific challenges in diverse environments. The purpose of population testing is to obtain genetic information on breeding materials concerning traits of interest (resistance to late blight, agronomic and quality traits, other economically important characteristics and their interaction with the environment) for decision-making in breeding, and to select *in situ* better-adapted varieties responding to local needs from selected segregating progenies

Past experiences in testing segregating families in both Colombia (Rionegro, 6^0 N lat., short day length) and Mexico (Toluca, 20^0 N lat., intermediate day length), have shown that family performances for resistance were highly correlated (Spearman's rank correlation r = 0.82 for AUDPC). Thus, either location could be used effectively for testing and selecting stable resistance to late blight. Late blight resistant parents with high combining abilities (general and specific) were selected from combined performances.

To date, progeny tests are routine practices at CIP in local sites in Peru (short days). Combining abilities for late blight resistance, yield performance and more simply inherited agronomic traits are usually obtained. Selected clones are exploited for further breeding and for use as parents or their combinations to select varieties in Peru and elsewhere (Population B).

We are currently experimenting with systematically testing segregating progenies under long days to determine combining abilities for late blight resistance and adaptation (yield performance, early bulking, selecting potential, etc.). Combined short and long day performances should provide clear information on GxE interaction for both traits, and affect decisions on breeding strategy.

Deployment of tuber families during the 1980s to a great number of less developed countries did not result in successful selection of varieties. Instead, parental clones with traits of interest were selected in some countries, particularly in long days. Presumably, a majority of these countries had long-established production systems with old *Solanum tuberosum* subsp. t*uberosum* varieties and little room for changing varieties, or did not have strong breeding programs. Selection was meant to improve seed supply and crop management.

In our experience, deployment of advanced clones to long days did not result in the selection of varieties, except for those bred in long days such as CIP-24 in China.

However, deployment of late blight resistant clones, particularly to those countries in short days, where blight disease was severe and local varieties did not do well, resulted in the release of new varieties. During the mid 1980s and early 1990s, more than 35 varieties in at least 15 countries were released from CIP's breeding population A.

Similarly, during the mid 1990s, deployment of segregating progenies to selected countries with similar blight disease problems (Uganda, Ethiopia, Kenya, Costa Rica, and Mexico) resulted in the selection of well-

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adapted late blight resistant clones with variety potential. (These progenies derived from CIP's population B).

To determine day length effect on adaptation and late blight resistance, segregating progenies from late blight resistant parents were sent to long day sites for testing (China, Argentina, 26-36^0 N and S lat.). These progenies suffered day length effect on tuber set and bulking, but not on resistance. Selected resistant clones were late maturing and unable to compete with local well-adapted varieties. It seems that short-day resistance is not affected by long days, but adaptation is. Interaction of resistance can be expected with environmental factors other than day length, such as temperature, relative humidity, disease severity, etc.

Similar progenies sent to short to intermediate day lengths did not show any effect on tuber set and bulking, or on late blight resistance. It seems that progenies as well as parents are well adapted to these latitudes (0-23^0 South and North).

Some technical and logistic problems in selecting resistant varieties *in situ* from segregating families include the following. Interference of R genes is a common problem in most breeding programs and makes recognition and selection of true horizontal resistance difficult. Complex local isolates to overcome R gene resistance are usually absent. Low frequency of resistant genotypes in segregating populations is common. Potential solutions are to use population B or similar, where known R genes have been removed, collect and inoculate during tests a single complex race and to use families from parents with high breeding value.

The lack of human and physical resources to carry out the work, the lack of experience and trained personnel, difficulties in data retrieval and follow up on subsequent stages of selection and lack of seed systems to sustain seed production of selected varieties are other problems. Potential solutions are to strengthen institutional capacity according to priorities and commitment, to enhance training of personnel, to improve interaction with providing sources and to define seed systems.

Logistical problems are the high costs of production and shipment of exported materials, increasing plant quarantine restrictions for introducing materials and increasing desire to apply IPR on selected varieties. Potential solutions are lower costs and share charges (?), simplification of custom procedures assuring high health standards and protection by CIP for public use.

Some suggested roles for population testing are: Enhancing utilization of new diversity, selecting resistant varieties in few locations with well established breeding and seed programs, representative of large regional agro-ecologies; testing and studying resistance, stability and durability in key sites within short and long days; determining breeding value of selected resistant parents and refining breeding strategy for long days (late blight resistance and adaptation).