STRAIN SELECTION IMPROVES THE BREED -- FACT OR FICTION

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Claims for improved strains within a variety are currently common in the potato industry. The concept of creating an improved strain involves identifying a mutant or sport and propagating it for sale and future production. This is a fairly common practice in clonally propagated crops (those planted with vegetative portions of the plant, rather than actual seed). But, we have to ask whether strain selection is an effective method to improve an existing potato variety. Can claims of improved strains be believed? The answer to this question is complex, but, in simple terms, can be "yes", "no", or "maybe".

The Case of "Yes"

For strain selection to be effective, several requirements must be met. The first is an actual change in the DNA of a single plant within an existing variety. This usually occurs in the form of a simple mutation that changes one or more important appearance or production characteristics. The second is for the mutant plant to be identified. The third is for tubers of the mutant plant to be segregated from the remainder of the tubers of that variety, a process we term the selection procedure. The fourth is for the mutant to be propagated and increased for production.

This process of selecting an improved strain within a variety has been successfully used in potatoes during the past century. In fact, approximately half of the acreage of potatoes produced in the United States is currently made up of sports or strains that supersede the production of the variety from which they originated (Table 1). The most important variety in Idaho and the United States, Russet Burbank, is a mutant of the smooth- skinned variety Burbank. Many red varieties are mutants of white or pink-skinned varieties.

In recent years, researchers and seed growers have found success selecting late maturing mutants of existing varieties in order to create strains with improved vigor and yield. This strategy has been especially effective with varieties that are early maturing to begin with. The most recent example is the Colorado and Texas strains of Russet Norkotah, which are documented to provide a yield advantage over the original variety (Table 2).

From these examples, it is apparent that improvements can be made in a potato variety through the selection of improved strains. However, there are also many instances where strain selection has not been successful or has been claimed but not substantiated.

The Case of "No"

In the late 1980's we investigated claims of improved strain selection in Russet Burbank. We identified nine sources of Russet Burbank seed that had been propagated in isolation from one another for up to 30 years and for which some selection for, and claim of, superiority had been made. Generally, the selection goals were to find a strain with better yield and improved tuber type. These isolated seed sources seemed to be the best situation from which an improved strain

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could emerge. The long isolation period the provided opportunity for mutations to arise and constant selection improved chances that a beneficial mutation might have been found. After we grew these strains in the same place for one year to establish a common seed source, we compared them in carefully controlled variety trials. What we found is that eight of the nine clones were statistically identical for yield (Table 3). The only one that was different was inferior. All nine were identical for tuber specific gravity and fry color. This study showed that selection for improved strains of a variety is not always successful and that claims of superiority are not always based on fact.

The strategy of selecting later maturing mutants, such as was used to find superior Russet Norkotah strains, is also not always effective. A Washington researcher used this strategy with Russet Burbank and found that these "bull hill" types seldom produced higher yields than the original and always had inferior tuber quality.

So, why is strain selection successful in some instances and not in others? I have identified three reasons. The major reason for failure is that selection is often based on what we call environmental variation. This is when the superior performance of a plant is due to its location, seed health, or some other reason that has nothing to do with genetics. If differences between plants are not due to genetic changes, they are not permanent. Mutations in plants have the potential that affect any trait. However, they occur much more often for some traits than others (Table 4). For potatoes, the most common mutations are for skin color, skin type, and maturity. These happen to be the traits for which virtually all improved potato strains have been selected.

The second reason for failure to select an improved strain is that selection goals involve traits that are very difficult to see or identify. It happens that one such trait is yield. Mutations for higher yield may occasionally occur, but probably in a frequency of less than one in a million plants. That means a yield mutant, whether positive or negative, will occur in only one plant in more than 70 acres. In a situation where the normal plant-to-plant variation in such a field is more than two-fold, identifying one plant with a slight tendency for higher yield is virtually impossible. I have never seen a documented case of successful selection for higher yield within a variety. That includes the case of the higher yielding Russet Norkotah strains. Remember, these were selected for later maturity. Higher yield was a secondary effect of the change in maturity.

The Case of "Maybe"

We are reasonably sure mutations occur that positively impact any economically important trait. It is also possible that with sufficient diligence, new strains of a variety can be selected which exhibit any one of these mutations. Just because we have not yet documented improvement for a specific trait in the past, does not mean it won't happen in the future. So, when claims of a superior strain are made, how do we tell if they have merit? I suggest two questions be asked of the claimant. First, ask how the mutant was identified. A sensible answer should include a description of selection and measurement techniques that are appropriate for finding a mutant with improvement in the designated characteristic. Then ask how the trait was verified. Trust only information generated using valid scientific procedures. It is essential that verification studies utilize seed with a common source and included multiple sites over multiple years. Testimonials claiming superiority just don't cut it.

Conclusions

Strain selection has historically been a valuable tool in improving potato varieties and will probably remain so in the future.

Strain selection has contributed to improvements in easily visible traits such as maturity, skin color, and skin type. It has not been successfully used to select for more subtle traits such as yield or tuber quality.

Many claims of superior strains are not valid. Unsubstantiated claims for high yielding strains of any variety may result from quality seed rather than genetic change.

Table 1 Examples of clonally selected varieties.

Old Variety	Selected Trait	New Variety
Burbank	Skin russetting	Russet Burbank
Pontiac	Skin color	Red Pontiac
Norland	Skin color	Red Norland
Norchip	Vine vigor (maturity)	New Norchip

Table 2. Norkotah strain performance.

Strain	Maturity[1]	Total Yield (cwt/A)
Russet Norkotah	2.0	461
Colorado 3	2.9	592
Colorado 8	2.3	527
Texas 112	2.4	550
Texas 223	2.6	554
Texas 278	2.7	504

[1]Maturity rated 1-5 with 5 = late.
Data from the 1997 Western Regional Trial.

Table 3. Comparison of 9 Russet Burbank clones.

Clone	Yield	Specific Gravity	Fry Color[1]
Idaho D	326 a	1.083 a	3.5 a
Idaho E	360 a	1.084 a	3.7 a
PEI	329 a	1.084 a	3.6 a
Colo	346 a	1.085 a	3.6 a
NB	238 b	1.084 a	3.7 a
BC ®	311 a	1.084 a	3.7 a
Man	320 a	1.083 a	3.6 a
RB-2	340 a	1.082 a	3.7 a
Mont. 2383-3	331 a	1.083 a	3.7 a

[1]Fry color rated 0-4 with 4 = very dark.

Table 4. Tendency for change in traits.

Often	**Rarely**
Skin color	Yield
Skin russetting	Quality traits
Maturity	Defect traits