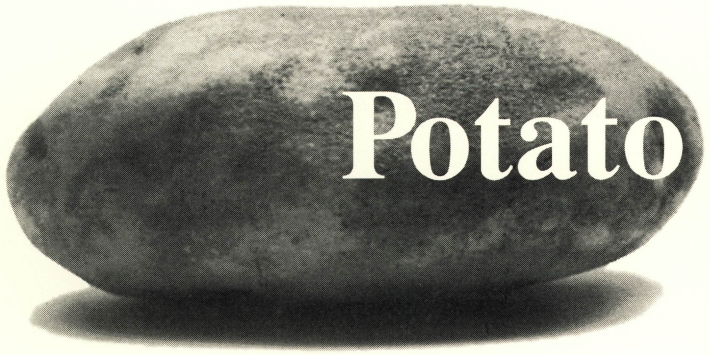

Potato Seed Myths

S. L. Love, P. Nolte, and M. K. Thornton

For a potato grower, selecting and purchasing high quality seed potatoes is a difficult process at best. Unlike potatoes sold in a grocery store, the appearance of potato seed has little to do with quality. Seed quality is affected by numerous factors that are hard to measure, much less understand. In order to make sense of available information and provide meaningful measures of seed quality, several concepts, or myths, have evolved which are not necessarily supported by scientific research. Often, these "opinions" are promoted and accepted by a potato seed industry seeking advantages in a very competitive market. This publication will address three of these "potato seed myths."

Myth 1 *Early generation seed will always outperform late generation seed.*

Since potato seed is classified according to generation, a seed buyer can determine how many field production cycles have occurred since the seed was originally propagated from disease-tested, laboratory-grown stock. In Idaho, the first field generation is designated "Nuclear" seed. Nuclear seed is planted to produce Generation 1 (G1) seed, and so on. The limited generation concept prescribes the maximum number of years a seed lot can be grown under field conditions before it must be removed from the certification program. For instance, in Idaho, when the seventh field season, Generation 6 (G6) is reached, the seed cannot be recertified.

One of the problems with buying seed strictly by generation becomes apparent when comparing seed from different states. Although all limited generation programs begin with disease-tested stocks, the designation of seed generation varies from state to state. Each state uses its own unique terminology to identify a seed generation. For example, G1 seed from Maine has already gone through four years of field production before being designated G1. In contrast, Colorado designates seed as G1 after only one field production year.

A perceived benefit of early generation seed is higher yield potential. Few trials have been conducted to determine the effect of generation on yield potential. However, a recent trial conducted at Kimberly, Idaho, did not show a consistent increase in yield with early generation seed (table 1).

Table 1. Effect of seed generation on performance of two seed lots at Kimberly, ID.

Seed Lot	Generation	Total Yield (cwt/acre)	Large U.S. #1 (cwt/acre)	Specific Gravity
A	3	471	118	1.082
	4	470	132	1.083
	5	466	92	1.082
B	3	464	97	1.081
	4	483	139	1.083
	5	487	112	1.083

Source: Kleinkopf, G.E., D.T. Westermann, and J.L. Barta. 1990. Report to the IPC, pp. 43-45.

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In seed lot A, yield and size tended to increase slightly with earlier generation, while in seed lot B the opposite occurred. Generation identification may reveal much about the likelihood that a seed lot has been exposed to disease during field production, but in reality some seed operations may be better at limiting disease contamination than others. While the limited generation program has greatly improved the process of producing disease-free seed stocks, it cannot make up for poor seed production practices.

Therefore, it is important to look at all factors that go into producing good quality seed when making a seed purchase. In addition to generation, growers should evaluate certification records, reputation and history of the seed grower, condition of seed handling equipment and storage facilities, and the physical condition of the seed. Even though the limited generation program has improved the quality of seed, it has not simplified the selection of seed lots.

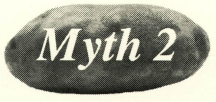
Table 2. Allowable disease tolerances at first inspection.

	Generation					
Factor[1]	Nuclear	G1	G2	G3	G4	G5/6
Varietal mixture	0.00	0.00	0.02	0.10	0.25	0.50
PVY-mosaic	0.00	0.00	0.01	0.50	0.80	2.00
Potato leafroll	0.00	0.00	0.01	0.05	0.10	0.20
Blackleg	0.00	0.10	0.50	1.00	2.00	---[2]
PVX	0.00	0.50	2.00	4.00	6.00	8.00
Total virus[3]						2.00

[1] Some diseases may be present in a potato seed lot and not exhibit symptoms in plants or tubers at the time of regular inspection.

[2] Visible blackleg will not be a disqualification factor in G5 or G6.

[3] Total is the combined percentage of potato leafroll, calico, PVY-mosaic , and all other viral, viroid, and mycoplasma-like disease (haywire, witches' broom, aster yellows, etc.). This does not include potato virus X (PVX).



Seed lots with disease readings of zero will perform better than seed lots that barely meet tolerance levels.

Certification provides high quality seed to commercial growers by ensuring that diseases are not present at levels above that which will affect yield or marketability of the subsequent crop. For some diseases, such as bacterial ring rot, complete exclusion is required to prevent problems stemming from such "zero tolerance diseases." But for most diseases, including the major viruses, a low level can be present without affecting crop yield or quality. These accepted tolerance levels have been established by research.

Growers can obtain information about seed lots from the Idaho Crop Improvement Association (ICIA) grower seed directory. The directory contains each grower's name, address, phone number, the number of acres entered, and readings for the two field inspections each seed lot received for two different viruses. The numbers appear under "PVY Mosaic" or "Leafroll" and might be .0001, .0005, or .0018.

Is a seed lot with a .0018 potato virus Y (PVY) reading likely to cause a problem? If a commercial grower uses this seed lot, will he have a lower yield than if he uses a seed lot with a reading of .0005 or .0001 or even .0000 PVY? In other words, what do these numbers mean?

These numbers are calculated when the fields are inspected for virus during the growing season. To do this, an inspector takes a series of "counts," or samples in the field, because it is impractical to examine every one of the approximately 16,000 plants per acre in a typical seed potato field. At this ratio, an average 120-acre field will yield about 2 million plants. As it is, an inspector must physically examine 200 plants per acre times 120 acres, which means that he visually inspects some 24,000 plants. The numbers in the seed directory are generated from these readings. Each field is inspected twice except for the Nuclear and G1 materials, which are inspected three times.

The numbers in the directory refer to infection per 10,000 plants in the field. Thus, a reading of .0001 means one plant in 10,000, or an average of 1.6 plants per acre, are infected. In otherwords, .01% of the plants contain the virus. This is insignificant because economic yield losses for PVY-infected seed lots of Russet Burbank cannot be detected until the incidence of disease exceeds 10%.

Tables 2 and 3 list the allowable disease tolerances for field readings on seed potatoes by generation. Notice that allowable virus in Nuclear and G1 is zero at the second inspection and the allowable amounts increase as the generation numbers advance to a maximum of 1% for total virus. A 1% virus level corresponds to a reading of .0100 in the seed directory. Seed lots also can be downgraded to a later generation if they fail to pass inspection at the disease or varietal purity tolerance established for each particular generation. For example, a G2 lot with a reading of .0050 (or 50 plants in 10,000) during the second inspection is

still certifiable at the G4 level, but not at G2 or G3 levels. In Idaho the seed class name (e.g., G3), reflects both the number of years planted and a prescribed maximum level of disease.

Table 3. Allowable disease tolerances at second inspection.

	Generation					
Factor[1]	Nuclear	G1	G2	G3	G4	G5/6
Varietal mixture	0.00	0.00	0.01	0.05	0.10	0.20
PVY-mosaic	0.00	0.00	trace	0.25	0.50	1.00
Potato leafroll	0.00	0.00	0.01	0.02	0.08	0.20
Blackleg	0.00	0.10	0.50	1.00	2.00	---[2]
Total virus[3]						1.00

[1] Some diseases may be present in a potato seed lot and not exhibit symptoms in plants or tubers at the time of regular inspection.

[2] Visible blackleg will not be a disqualification factor in G5 or G6.

[3] Total is the combined percentage of potato leafroll, calico, PVY-mosaic , and all other viral, viroid, and mycoplasma-like disease (haywire, witches' broom, aster yellows, etc.). This does not include potato virus X (PVX).

It is actually possible to start out with disease-free potato tubers. Our modern meristem procedures can produce completely disease-free potatoes in the test tube and in greenhouse pots. However, it is impossible to keep them that way during subsequent generations. Once the seed tubers are planted in the field, they likely will be exposed to disease and manifest some level of infected plants in subsequent years. This means that beyond the pre-nuclear class (the class preceding Nuclear), completely disease-free seed does not exist. A zero simply means that no disease was detected in the sampling process. So, the difference between 0.000 and .0002 is insignificant and will not affect seed performance.

Myth 3 *Some "lines" of potato seed are superior to others.*

The perception of "best lines" or "best strains" has existed in the potato industry for many years. This is probably a holdover from a time when seed certification was erratic and differences existed in the amount of virus carried by seed from various sources. The concept of a "line" (or strain) should not be confused with that of variety. Because of hybridization, all varieties differ genetically.

A line, on the other hand, usually results from a variant discovered as a single plant within a variety, diverging from the original in at least one trait. Variants arise from rare, natural mutations in the plant's genetic makeup. These mutations occasionally result in a beneficial change, and if the mutated plant is harvested separately and propagated, an improved line may result.

Though improvements in varieties have occurred through line selection, the discovery of most improvements has been accidental. For example, Red Norland is a darker red, more attractive selection of Norland. Russet Burbank is a russetted selection of the old white-skinned Burbank variety. In recent years, several coordinated selection efforts have resulted in more vigorous, higher-yielding lines of Norgold Russet, Russet Norkotah, and Sangre. This was accomplished by purposefully selecting for mild forms of giant (bull) hills, resulting in slightly later and more vigorous plants.

Use of this same strategy with Russet Burbank has failed because the giant hill lines have rougher, poorer quality tubers. Historically, most efforts to use line selection on numerous varieties have failed to produce improved lines for two reasons: (1) most of the important yield and quality traits are genetically complex and not much influenced by simple mutations, and (2) most selection efforts have not used appropriate methods for discerning lines with small, subtle improvements.

Table 4. Comparison of eleven lines of Russet Burbank grown in a three-year period in Aberdeen, ID.

Characteristic	Number of Nonconforming Lines
Time to emerge	1 (slower to emerge)[1]
Vine maturity	0
Tuber shape	0
Tuber set	0
Average tuber weight	0
Yield	1 (lower yield)[1]
U.S. No. 1 yield	1 (lower yield)[1]
Specific gravity	0
Blackspot bruise response	0
French fry color	0

[1] Line differences noted appear in just one line or strain of Russet Burbank.

A recent study compared 11 Russet Burbank lines. For the most part, the lines were indistinguishable (table 4). However, one line showed consistent differences, in lower yield, larger tuber size, more misshapen tubers, and slower emergence (table 4). To date, most

claims of improved lines of Russet Burbank are unfounded. Unless claims of line superiority are supported by visible improvements or independent tests, they should be considered suspect.

One last point needs clarification. Differences in seed performance from different growers is not necessarily evidence of a superior line. Seed grown, stored, and handled by individual growers can perform very differently, even though the seed is genetically identical. However, seed that performs well is usually evidence of a good seed grower. In rare cases, when documented improvements are apparent, it can pay to buy seed from a specific line of a variety. With Russet Burbank, no distinctly superior lines have as yet been identified. Consequently, claims of line superiority are currently uncorroborated.

Conclusions

The general concepts behind disease tolerance, limited generation seed, and superior seed lines are valid and important. However, the way these factors are used in seed commerce may or may not be correct. The following points should be considered when purchasing seed:

1. Early generation seed (e.g., G2 or G3) potentially carries lower levels of certain diseases than later generation (e.g., G5 or G6) seed.
2. Early generation seed is not necessarily more productive than later generation seed because many factors can contribute to vigor and quality.
3. Commercially produced seed is never completely free of disease-causing organisms, even though readings reported by a certification agency indicate that no disease was detected.
4. Certified seed lots listed in the seed directory as having low levels of disease will not necessarily produce a poorer crop than those in which disease is undetected.
5. Mutations can change a variety and allow for the selection of superior lines, but these occurrences are rare and are usually detected only for obvious traits such as skin color or time to maturity.
6. Claims of line superiority in Russet Burbank are currently unproven.
7. The most important factors in the consistent production of good quality seed are the experience, expertise, and integrity of the seed grower.

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