IMPORTANCE OF TUBER SET AND BULKING RATE

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Tuber size is an increasingly important aspect of potato quality. Buyers all along the potato market chain from those purchasing seed to end users (fresh market and processing) are requiring a uniform and consistent tuber size profile. Some businesses have implemented clauses in contracts with sizable economic incentives rewarding growers who meet specific tuber size specifications. These same contracts usually penalize growers who produce a potato crop with too many small or large tubers. Harvested tuber size profile is a function of the number of tubers set per plant, as well as the length of time tubers bulk during the season. Environmental and management factors can influence both of these characteristics.

OBTAINING TUBER SET UNIFORMITY

One reason obtaining a consistent tuber size profile can be so difficult is that the number of tubers produced by potato plants varies widely among years, fields and even among plants within a field. Throw in the fact that potato cultivars also have a wide range of tuber set characteristics, and it becomes clear that getting uniform size cannot be easily accomplished. While much of the year to year variation in tuber set can be traced to environmental conditions, it is likely that most to the field to field and plant to plant variation can be attributed to management practices. To increase the uniformity of tuber set requires growers to focus on the following management practices: 1) seed size and physiological age, 2) early-season plant growth, 3) disease management, 4) nitrogen management, and 5) plant spacing.

Seed Size and Age

The number of stems produced by a potato plant is directly related to the number of tubers that plant will set. Because each stem tends to produce a certain number of tubers, the higher the number of stems, the more tubers that will be produced by each plant. Having more tubers per plant can be advantageous for cultivars like Shepody that set few tubers with many of them oversized. However, the opposite is more often the case for cultivars such as Russet Burbank, which tends to produce a high number of undersized tubers. Both seed piece size and physiological age influence the number of stems produced by each plant. Every eye on a seed piece has the potential to produce at least one stem. Consequently, the more eyes per seed piece, the more potential stems. Additionally, as seed ages, the number of stems produced by each eye increases. The key to producing a more uniform tuber set is getting a consistent number of stems among plants by reducing variability due to wide ranges in seed piece size or physiological age.

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Early season plant growth

Recent research has shown that stolon production and subsequent tuber set occurs over a relatively short period of time after plants emerge. Anything that slows plant growth during the first 21 days after emergence was shown to reduce the number of tubers set plant. Plant growth during this time frame may be negatively impacted by soil compaction, deep planting, and low soil moisture.

Disease management

Rhizoctonia stem and stolon canker often infects plants during the early part of the growing season delaying emergence by girdling sprouts and pinching off stolons while setting tubers. Rhizoctonia does not infect all plants uniformly, thus causing an increase the variability in tuber set among plants. Seed piece treatments and in-furrow fungicides that control Rhizoctonia may likely improve the uniformity of tuber size profile under conditions where this disease is widespread.

Nitrogen management

Indeterminate potato cultivars, such as Russet Burbank, tend to set fewer tubers per plant when high levels of nitrogen are applied at planting. The exact mechanism for this reduction in tuber set in not known, but may be partly accounted for by the delay in the timing of tuber initiation caused by high levels of soil available N.

Plant spacing

Another management practice that has a large influence on the number of tubers per acre is in-row plant spacing. As seed pieces are spaced closer together, tuber numbers per plant typically decreases. However, because the seed pieces are spaced closer together, the resulting total plant population per acre increases, and the overall tuber number per acre will also likely increase.

From previous studies we know that potato planter performance is typically less than desirable. A combination of factors such as wide variability of seed piece sizes and shapes, incorrect planting speed, planter design, and poor equipment maintenance result in highly variable seed piece spacing, which can affect tuber set.

On-going research is focused on finding methods to manipulate tuber set/number in an effort to maximize grower profits. Manipulating the physiological age of seed seems to hold the most promise as it consistently influences stem and tuber numbers under controlled conditions. While the research is admirable, it won’t mean much to a grower with inconsistent plant spacing. Without proper spatial arrangement, plant population by itself is of marginal importance in optimizing economic return. For growers to maximize profits, improved planter design and the use of good planting management may go a lot further in the near term than any attempt to adjust the physiological age of seed potatoes.

TUBER BULKING RATE AND STEM DEATH

A two-year tuber-bulking rate study was conducted at the Aberdeen R & E Center, which included Russet Burbank, Russet Norkotah, Colorado Russet Norkotah #3, Ranger Russet, Alturas, and Shepody. Details of that study can be found in the 2006 University of Idaho Winter Commodity School Proceedings, Understanding Tuber Bulking Rates of Six Potato Varieties, pgs. 143-148 or online at http://www.ag.uidaho.edu/potato. Only the results of Russet Burbank will be used for this discussion.

In Figure 1, the yield curves are indicated by a green line. The orange line shows the percent dead stems (vines) visually observed at the last three sampling dates in 2003 and last five dates in 2004. The two vertical red lines represent the linear bulking period. The cwt./acre values shown just above the x-axis for the last five sampling intervals indicate the amount of production attained between those pairs of sampling dates.

The end of the linear bulking phase appears to be closely associated with the onset of stem death. Bulking rate began to decline fairly rapidly as stems declined. Note that the plots were rated to have 8 percent dead stems on August 26, 2004, yet the crop was within 20 cwt. per acre of its maximum yield shortly before August 26.

This data strongly suggests that the presence of dead stems is a good indication that bulking rate is declining. However, stem death is probably not the only factor responsible for tuber bulking. Temperature and/or other environmental factors are likely at least partially responsible for bulking rates declining. In that the onset of vine death coincides with a slowing tuber bulking rate can also be seen by the amount of yield gain during each two-week period for the last 8 weeks of the growing season ending approximately September 23. From yield curves generated from 2003-04 combined data, Russet Burbank produced 104 cwt. per acre the first 2 weeks of August, but decreased to only 28 cwt. per acre during the next two-week period (data not shown).

To gain more information about the apparent connection between visual stem death and diminishing bulking rates, three east Idaho grower fields were sampled in 2006 (Figure 2). Be cautioned that this is not replicated data, but only field observations. Note, however, we observed that 90 percent of the final harvested yield was reached when stem death was less than approximately 20 percent confirming what we noted in the small-plot research in 2003-04.

The small-plot research data and field observations presented here should not be interpreted to mean that end-of-season bulking is not important, but that most of the bulking occurs earlier in the season and producers need to pay particular attention to the linear bulking period making sure the potato crop is not stressed for water or nutrients.

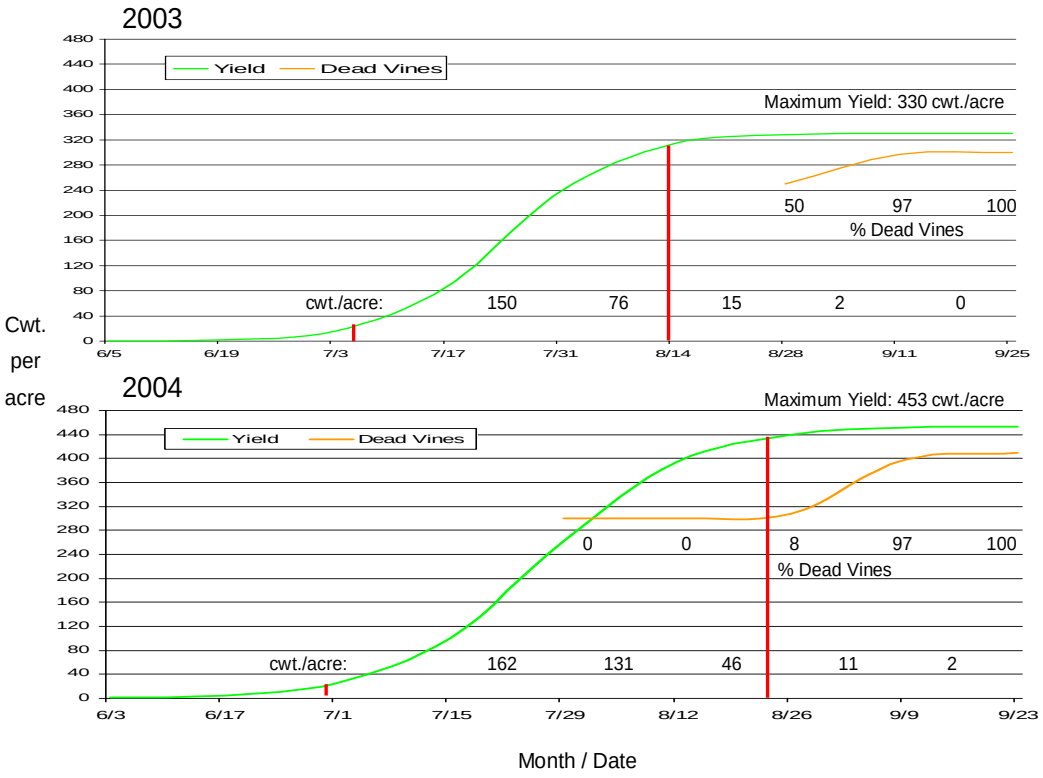
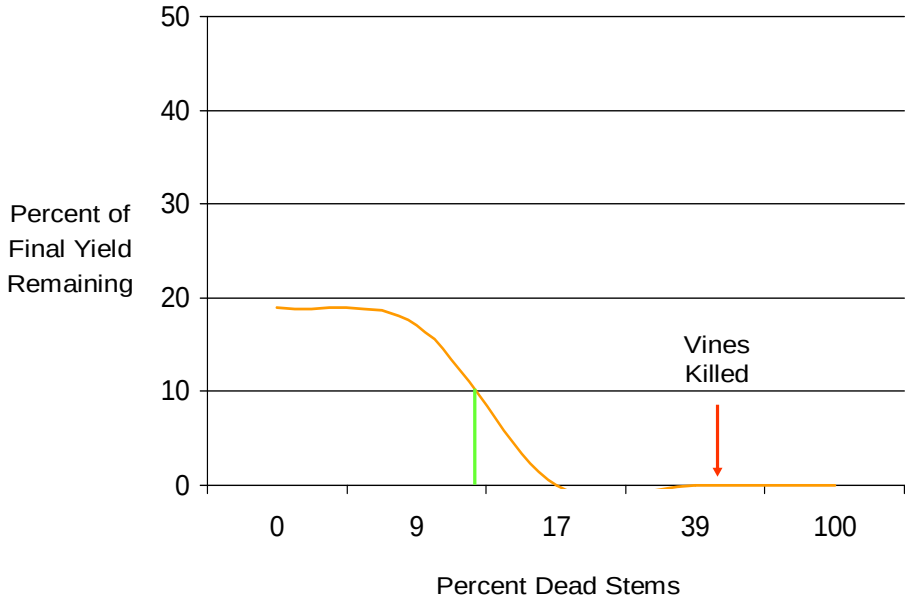


Figure 1. Bulking pattern of Russet Burbank potatoes grown in small plots at the Aberdeen R & E Center in 2003 (top) and 2004 (bottom).



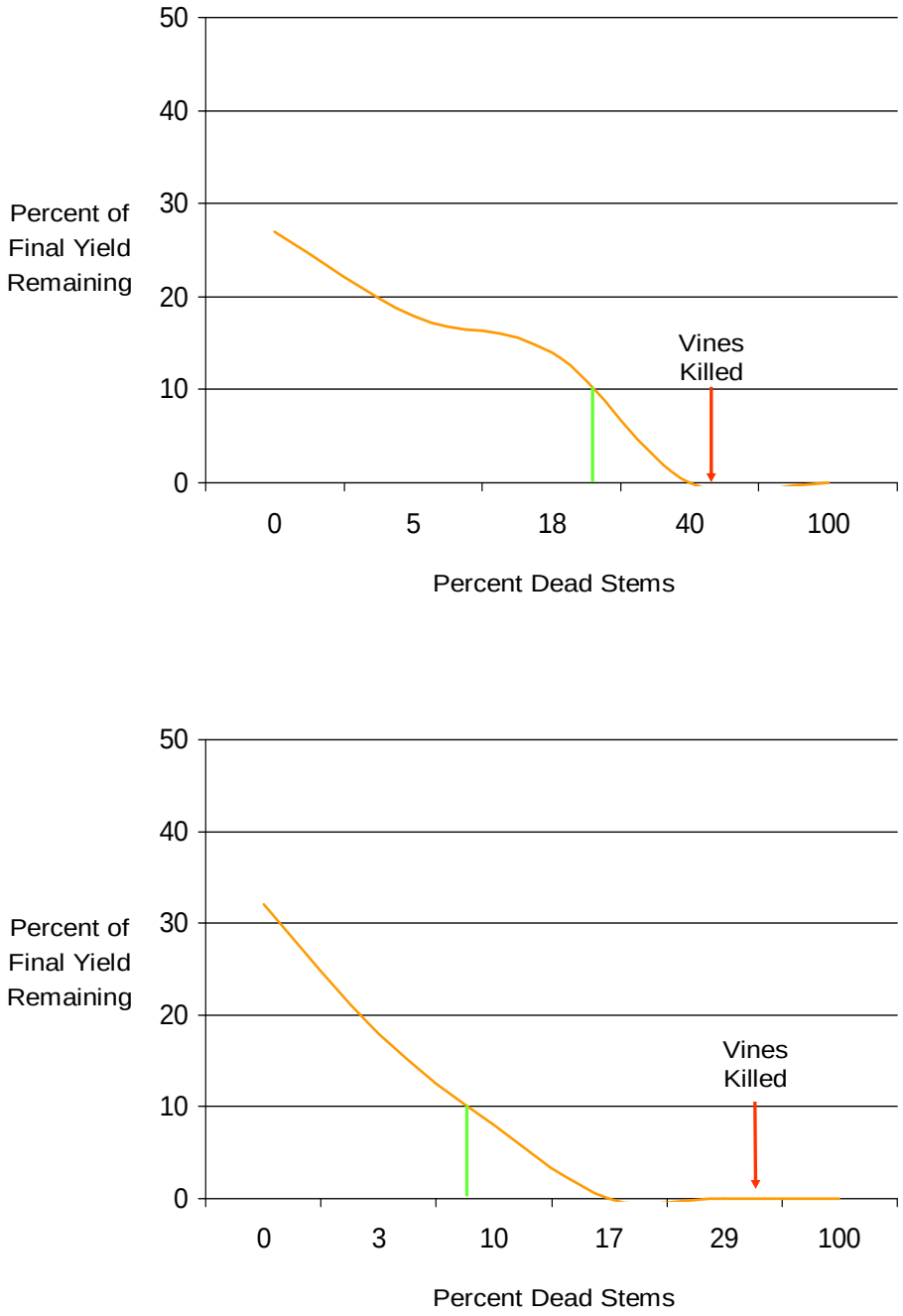


Figure 2. Bulking rate of Russet Burbank potatoes in relation to vine (stem) senescence (death) in three east Idaho grower fields in 2006.