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Andrew Jensen, Editor. Submit articles and comments to: ajensen@potatoes.com
108 Interlake Rd., Moses Lake, WA 98837; Fax: 509-765-4853; Phone: 509-765-8845.

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Toxic Seed Piece Syndrome or a.k.a. IWW (I Wonder What!)

Carrie H. Wohleb[1], Philip B. Hamm[2], Jordan Eggers[2], and Dennis Johnson[1]
Washington State University[1] & Oregon State University[2]

What is Toxic Seed Piece Syndrome or I Wonder What (IWW)?

Toxic seed piece syndrome (TSPS) has been identified in many fields in the Columbia Basin this season. This problem has been seen periodically over the last 15 years. Extensive testing in the past, to look for plant pathogenic fungi, bacteria, and viruses, failed to identify a particular agent responsible. Over the years this problem also has been called IWW (or I Wonder What) due to the failure to find its cause.

Symptoms

This poorly understood disorder allegedly results when breakdown products from the seed piece are transported up the vascular tissue to the leaves. The seed piece does not rot in a typical fashion. Initially the seed piece is firm, though areas of the tuber can have a watery rot. Upon cutting, the internal "color" has a more translucent, gelatinous appearance (Photo 1). With time the seed piece breaks down, but remnants of the translucent seed piece may still be found attached (Photo 2). Rarely are above ground symptoms seen when the seed tuber is hard and has the normal white internal appearance. Generally there is no "rotten" smell associated with these deteriorating seed pieces.

Above ground symptoms can be remarkable and easily distinguished from most other problems. An early symptom is interveinal bronzing of the leaves (Photos 3 & 4). This is followed by wilting of stems. Not all stems arising from a seed piece may be affected (Photo 5). The wilted stems tend to remain erect rather than flopping over when they die. The progression of symptoms is very rapid and can be mistaken for any number of wilt diseases. The vascular tissue is usually discolored brown near the attachment to the seed piece, though this discolored region can extend high in the stem (Photo 6). Plants usually do not survive.

What Else is Known

Not all seed lots are the same. In fields where more than one seed lot has been planted, the amount of damage in each seed lot is often different. More symptomatic plants are seen in stress areas, such as ridge tops, in contrast to lower areas. Lastly, even though rates of symptomatic plants have been reported as high in some fields, the actual percentage of plants impacted is low, generally around 1%. There has not been any indication that state of origin of the potato seed has any relationship to the level of damage.

This problem is difficult to gather additional information about due to the sporadic nature of its appearance. However, a team of researchers in the PNW is trying to piece together the environmental factors and other conditions that may lead to TSPS. If you have seen these symptoms in any potato fields this year, or in the past, would you please fill out the accompanying questionnaire and return to any of the following:

Carrie Wohleb: cwohleb@wsu.edu Phil Hamm: philip.b.hamm@oregonstate.edu
Jordan Eggers: Jordan.eggers@oregonstate.edu Dennis Johnson: dajohn@wsu.edu

Photo 1. A typical seed piece associated with TSPS. Notice the absence of the white internal color of a healthy seed piece. The seed piece is general firm but areas of the seed piece may be soft. There is no smell.

Photo 3. A close-up of the leaves showing the interveinal discoloration.

Photo 2. Remnant of a seed piece still attached to the stem.

Photo 4. Underside symptoms of leaf with interveinal bronzing.

Photo 6. Vascular discoloration in the stem just above where the seed piece was attached to the stem. The seed piece was attached to the stem on the upper left corner of the picture.

Photo 5. Symptomatic plant showing an upright growth pattern. Notice how easily the plant is seen due to the off color of the plant.

Toxic Seed Piece Syndrome/ IWW Questionnaire

1. Have you encountered potato plants with a bronze colored necrosis between leaf veins and a seed piece that is translucent like clear jello, still firm or slightly soft and odorless (see pictures below)?

Yes___ No___

2. When was the field planted?

Month (circle) April May June July August

Week (circle if possible) 1st 2nd 3rd 4th

3. When did you first see these symptoms?

Month (circle) April May June July August

Week (circle if possible) 1st 2nd 3rd 4th

4. Where did the seed originate?

5. In how many seed lots did you see these symptoms?

One____ More than 1____ All____

6. On average, what percent of potato plants in a field had these symptoms?

Less than 1%__ 1 to 5%___ 5 to 10%___ Greater than 10%___

7. If plants from one seed lot showed symptoms did plants grown from the same seed lot but planted in a different field also show these symptoms?

Yes___ No___

8. In what cultivars were these symptoms seen?

9. Did you make any other observations?

10. Other comments?

Thank you. Please return to any of the following:

Carrie Wohleb
35 C Street NW
Ephrata, WA 98823
Or E-mail to:
cwohleb@wsu.edu

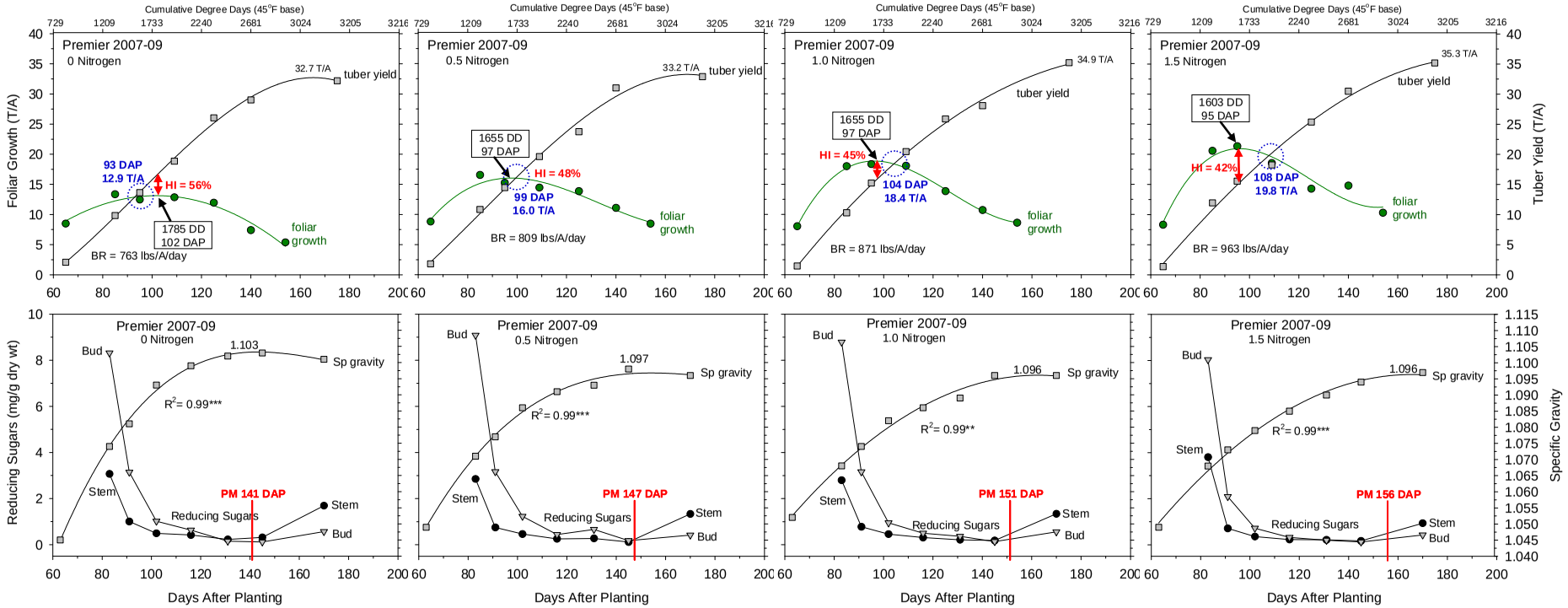
Phil Hamm
2121 South 1st Street
Hermiston, OR 97838
Or E-mail to:
philip.b.hamm@oregonstate.edu

Dennis Johnson:
Johnson Hall
Pullman WA
Or E-mail to:
dajohn@wsu.edu

Effects of N Management on Growth, Yield, Tuber Maturity & Postharvest Quality

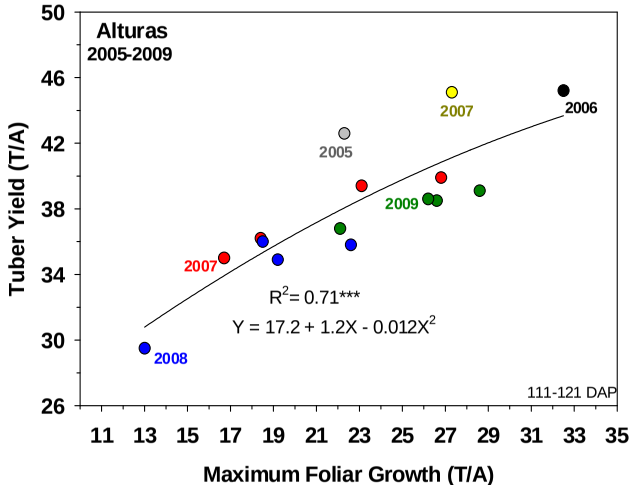
Rick Knowles, Chris Hiles, Mark Pavek, Lisa Knowles, & Zach Holden
Dept. of Horticulture & Landscape Architecture, WSU, Pullman

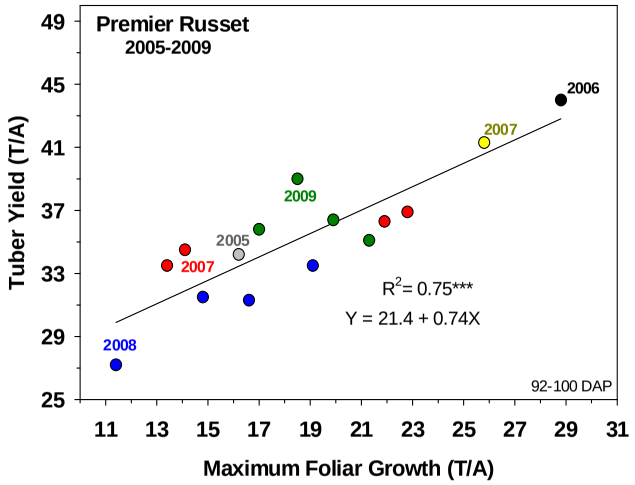
A main focus of our research is to understand and demonstrate how in-season management affects yield potential, tuber physiological maturity (PM) and retention of processing quality during storage for newly released cultivars. Production of a high quality crop with maximum ability to retain postharvest quality requires a holistic approach that combines in-depth knowledge of how the crop grew (stresses and responses to in-season management), matured, and was handled at season end, with determining how best to manage it in storage. The objectives of this work were to define the attainment of PM for Premier Russet and Alturas tubers under Columbia Basin growing conditions and to determine how in-season N management affects growth and development, tuber maturity and subsequent retention of postharvest quality. Detailed crop growth and development profiles were produced for each cultivar over three growing seasons. The profiles revealed the importance of (**1**) optimizing source/sink (foliar/tuber) relationships for maximum yield potential and (**2**) harvesting close to PM for retention of postharvest quality. The effects of four levels of in-season N (0, 0.5, 1.0, and 1.5 times recommended in-season rates) on foliar and tuber growth, specific gravity, and reducing sugar levels in developing tubers of Premier Russet are shown below. DD, degree-days; BR, tuber bulking rate; DAP, days after planting; PM, tuber physiological maturity.



Results

- Harvest index (HI) equals tuber fresh weight as percent of total plant (tubers + foliage) fresh weight. The days after planting (DAP) to 50% HI is indicated in blue (where foliar and tuber growth curves cross). Note that foliar and tuber yields (T/A) are equal at 50% HI and the DAP to 50% HI shifts later in the growing season with increasing N.
- The HI at maximum foliar growth (shown in red) is a mid-season indicator of the source/sink status of the crop. Foliar growth (source) needs to be optimized in relation to tuber demand (sink) to maximize yield and profit potential for a particular cultivar and growing area.
- Foliar growth increased with N rate, and the HI at maximum foliar growth decreased with increasing rate of in-season N (top row).
- Yields of Premier Russet (shown above) and Alturas increased with the amount of foliar growth but decreased with increasing HI (measured at maximum foliar growth) (see graphs on next page).
- Foliar growth is highly dependent on N; therefore, management of N rate and timing are critical to optimizing source/sink relationships to maximize yield and quality.
- Early season N management should be designed to optimize mid-season foliar development to achieve the ideal source/sink (HI) relationship (HI<50%) for maximum yield.
- Physiological maturity (PM) was estimated at 141-, 147-, 151-, and 156-DAP as N increased from 0 to 150% of the recommended in-season rate (bottom row). PM = average of DAP to reach maximum yield, maximum gravity, minimum sucrose, and minimum reducing sugars in tubers.
- The reducing sugar levels in the stem ends of tubers at harvest (172 DAP) and the difference between stem and bud end sugar levels decreased with increasing N. This effect was due to a lengthening of the period between PM and harvest with decreasing N and is an indicator of over-maturation of the crop.
- For maximum retention of processing quality, the time between PM and harvest should be minimized to prevent over-maturation, which can compromise the retention of postharvest quality.





Dependency of tuber yield on foliar growth in Alturas (top) and Premier Russet (bottom). The yield (T/A) of above ground foliage at maximum foliar growth was estimated from regressions of foliar fresh weight vs. days after planting. Data from 5 years of trials (color coded) are shown (***P<0.001).

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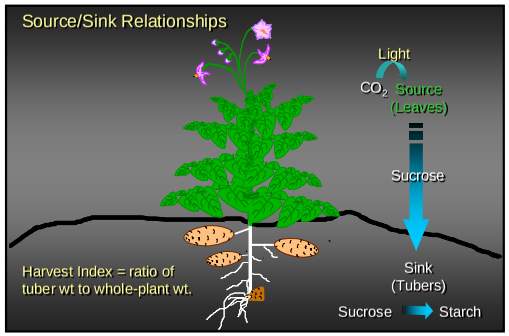
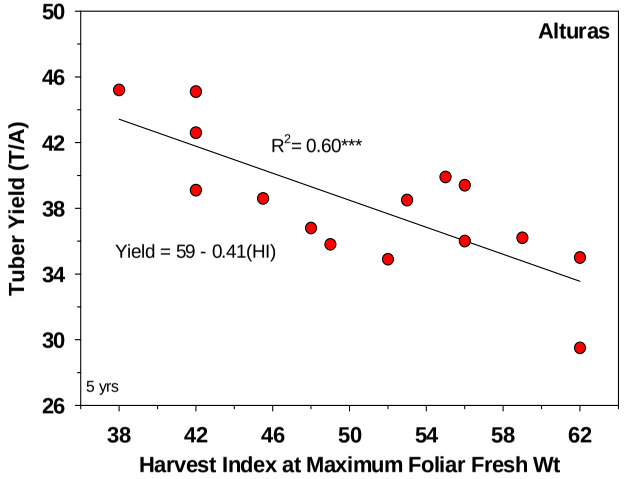
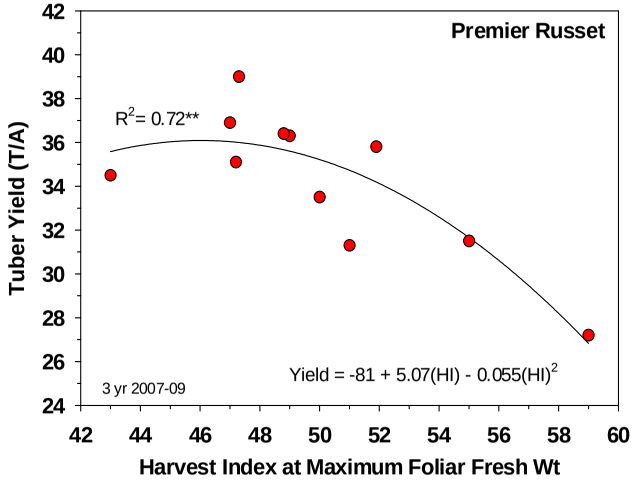


$$HI = \frac{\text{Tuber Yld}}{\text{Foliar + Tuber Yld}}$$





Tuber yield declines with increasing harvest index (HI) in Alturas (top) and Premier (bottom). HI was calculated at the point of maximum foliar growth (~109-128 DAP). HI is tuber fresh weight as % of total plant (tubers + tops) fresh weight. Maximum yields were obtained when tubers accounted for 38 to 47% of total plant fresh weight at maximum foliar growth. A source/sink imbalance occurs if tuber growth dominates plant growth (e.g. HI = 58-62%) at maximum foliar development, resulting in lower yield.