Potato Progress

Research and Extension for Washington's Potato Industry
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Potato Disease Resistance

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Potato disease control should be easier in the years ahead as developing technologies mature. For example, as we learn more about how plants resist disease, it will become easier to provide to growers potato varieties with excellent disease resistance that require minimal maintenance. Another technology with exciting potential is the ability to 'activate' plant defenses by spraying with special compounds. Some readers have probably heard of a fairly new class of products for disease control called 'activators' or 'SARs'.

This type of approach tries to make use of the plant's inducible defenses, i.e. defenses that are normally activated only in response to pathogen attack or environmental stresses such as heat or drought. Plants have different types of inducible defenses, but the most studied is called systemic acquired resistance (SAR). Growers may have observed SAR at work in their fields without realizing it, because SAR is a natural occurrence whereby plants that successfully resist an attack by a pathogen can become highly resistant to subsequent attack, not only by the original pathogen, but a wide range of pathogens. This protection can last for weeks to months in the field. In a way, it is as if the plant recognizes it has been attacked and that enemies are nearby, and it responds by putting its defenses on high alert which might help it survive future attacks. Similarly, plants have inducible defenses that can help them cope with chilling or heat stress. How exactly do these processes work? What is going on inside the plant? By using increasingly powerful molecular and biochemical tools, scientists have made significant advances during the last decade towards answering these questions. Such knowledge can be used to find compounds that when sprayed on the plants tell it "Pathogens nearby! Activate your defenses" or "frost danger, get ready." Over ten companies market compounds that are supposed to activate SAR. It is important to remember that SAR activators are not traditional pesticides and do not act directly against the pathogen, but rather cause plants to activate a battery of their own disease and stress resistance mechanisms. SARs are seen as being environmentally friendly and the EPA has encouraged their development. Crops in which SAR has been used effectively for disease control include tobacco, tomato, spinach and lettuce.

SAR in plants has been an intensively researched subject worldwide, but not in potato. SAR will likely be more effective in some crops than others and will be effective against some, but not all pathogens. Each crop will likely respond somewhat differently to these compounds, so successful utilization of SAR activators will require optimization for use with potato.

As a first step towards trying to make SAR an effective disease control option in potato, we are currently characterizing potato defense gene activation in response to various compounds including

Actigard (Syngenta) and Messenger (Eden Bioscience). We have found significant differences in potato defense signaling compared to other crops. In response to pathogen attack, the concentration of a compound called Salicylic Acid (SA, which is the active ingredient of aspirin) increases in the attacked plant. Normally SA levels in plants are very low and increase only after pathogen challenge. This increase in SA is responsible for activating SAR in plants after pathogen attack (scientists call such compounds 'signal molecules'). However, in potato, SA levels are very high even in the absence of infection. We measured SA concentrations in leaves, flowers, stems, roots, and tubers of Umatilla, Russet Burbank, and Norkotah. These potato varieties have SA concentrations over 100 fold higher than that found in most other crops in the absence of infection (Figure 1). The consequences of these high SA concentrations for potato disease resistance are not yet clear, but are intriguing.

We found that some of the defense genes typically used to determine if a plant is expressing SAR are already turned on in potato in the absence of either pathogen or treatment (whereas in most other crops they are only turned on after pathogen challenge)-once again the consequences of this for potato disease resistance are not clear. Thus, at least some of the genes that are usually turned off until activated by compounds such as Actigard or Messenger, are already on in potato in the absence of any treatment. It is probable that these genes are already activated because of the high levels of SA found naturally in potato. We are now examining whether SAR activators can turn on these defense mechanisms to an even greater extent and are also cloning additional genes that we can use to evaluate how effective SAR activators are in potato.

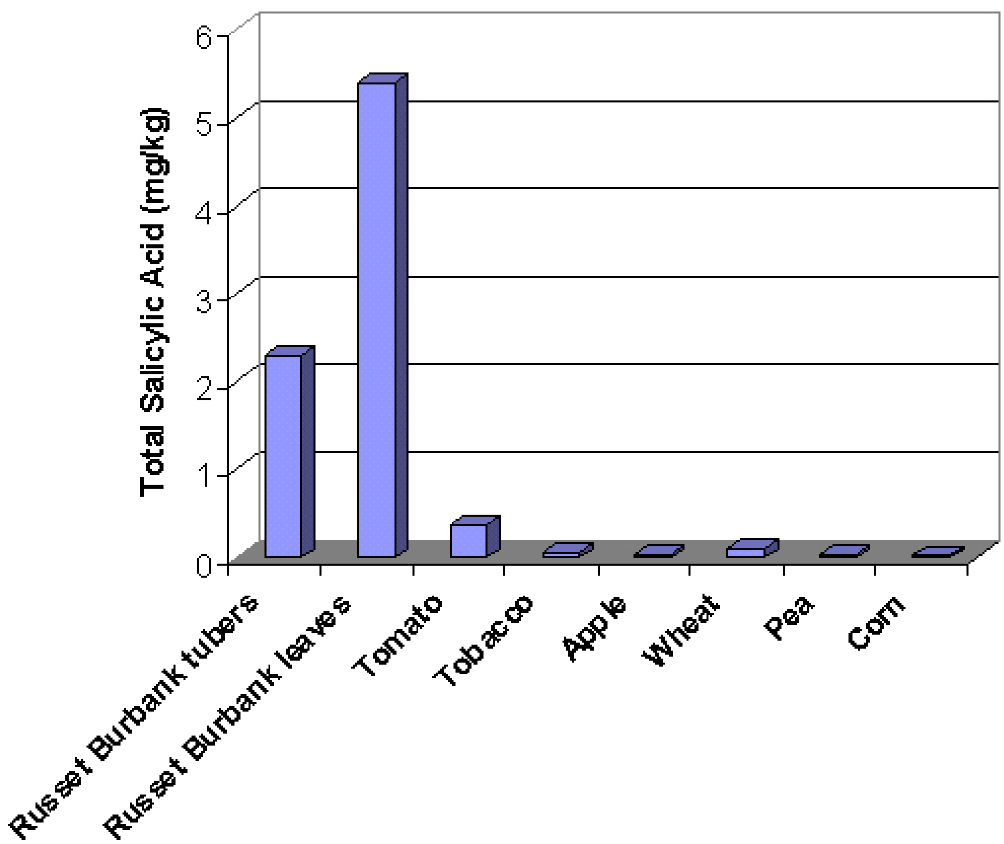

Figure 1: Total salicylic acid concentration in various plants.

A Potato a Day Keeps the Doctor Away?

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Most Systemic Acquired Resistance research (see previous article) focuses on leaves, but we are also interested in other potato tissues. Interestingly, tubers also have high salicylic acid levels and this potentially could be a nutritionally desirable characteristic. Willow bark has high amounts of salicylates and was used for pain relief and fever control by the ancient Greeks over 2500 years ago, effectively the first human use of aspirin. Aspirin is acetylsalicylic acid and is converted to salicylic acid in the body, which is the active ingredient (Figure 1). Aspirin has enjoyed renewed popularity in recent years as a 'wonder drug' and may be effective in reducing the risk of numerous diseases including heart disease, joint disease, certain cancers and Alzheimer's. Additional research is needed to determine if the amount of SA present in tubers is significant for the human diet. Interestingly, in the only study of its kind, a recent Scottish study (a country with high potato consumption) found higher salicylic acid levels in the blood of vegetarians than non-vegetarians.

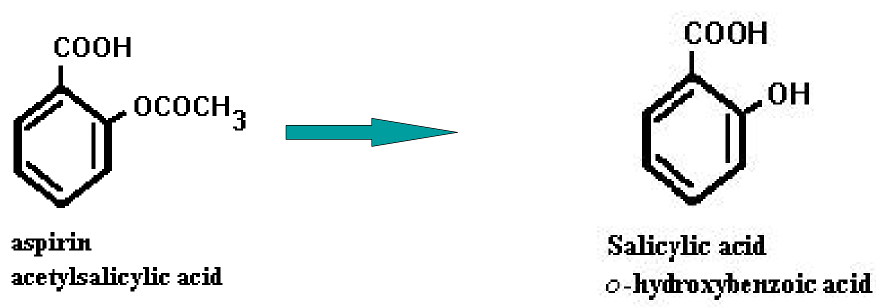

Figure 1. When ingested, aspirin is converted into salicylic acid, which is the probable active ingredient in the body.

Upcoming Educational Events

January 8th	8:00 am - 12:30 pm: Columbia Basin Potato Workshop, Best Western Hallmark Inn, Moses Lake.
January 9th	8:00 am - 12:30 pm: Columbia Basin Potato Workshop, TRAC, Pasco.
February 4th	1:00 - 4:30 pm: Potato Conference Spanish Language Session, BBCC Administration Building Auditorium, Moses Lake. 6:30 - 8:30 pm: Potato Conference Cultivar Performance Workshop, Best Western Hallmark Inn, Moses Lake.
February 5th:	8:30 am - 4:05 pm: Potato Conference, BBCC Wallenstein Performing Arts Building, Moses Lake.
February 6th:	8:30 am - 12:20 pm: Potato Conference, BBCC Wallenstein Performing Arts Building, Moses Lake.

Potato Varieties in the Northwest

Data for the following table were gathered by the National Agricultural Statistics Service (NASS), and summarized here by the editor. In some cases, NASS does not report numbers for certain varieties, and these cases are indicated by the --. Several minor varieties not listed here were reported by NASS on occasion. If you are interested in a larger table including all reported varieties, please contact Andrew Jensen at the WSPC office.

State	Russet Burbank	Russet Norkotah	Shepody	Ranger Russet	Atlantic	Umatilla	Other
Idaho							
1995	83.2%	2.0%	10.0%	2.6%	--	--	2.2%
1996	79.7%	3.7%	10.0%	2.7%	--	--	3.9%
1997	79.7%	5.0%	7.1%	4.0%	--	--	4.2%
1998	77.9%	4.8%	5.6%	6.6%	--	--	5.1%
1999	74.4%	8.3%	4.2%	9.1%	--	--	4.0%
2000	74.9%	8.0%	3.9%	7.7%	--	1.3%	4.2%
2001	70.8%	8.4%	3.8%	11.1%	--	--	5.9%
2002	71.0%	7.5%	3.4%	12.0%	--	--	6.1%
Oregon							
1995	41.1%	17.2%	27.2%	3.3%	--	--	11.2%
1996	35.4%	22.5%	25.8%	3.6%	5.6%	--	7.1%
1997	30.9%	38.8%	18.2%	1.8%	2.4%	--	7.9%
1998	39.5%	24.8%	17.2%	10.3%	1.0%	--	7.2%
1999	42.9%	21.4%	12.5%	12.5%	1.8%	--	8.9%
2000	32.7%	27.8%	9.8%	11.2%	2.1%	3.1%	13.3%
2001	38.9%	12.3%	10.8%	22.5%	--	1.9%	13.6%
2002	24.3%	16.8%	18.8%	19.2%	--	1.8%	19.1%
Washington							
1995	61.1%	11.8%	13.7%	6.4%	--	--	7.0%
1996	50.3%	17.8%	11.3%	8.7%	--	--	11.9%
1997	50.2%	17.5%	7.6%	15.5%	--	--	9.2%
1998	58.1%	13.2%	8.9%	11.4%	--	--	8.4%
1999	41.3%	15.4%	10.8%	17.6%	--	6.7%	8.2%
2000	33.7%	17.2%	10.8%	20.2%	--	12.3%	5.8%
2001	35.3%	19.3%	6.8%	19.9%	--	12.1%	6.6%
2002	34.8%	11.8%	10.3%	22.3%	--	8.1%	0.7%