The Tuber Times

Potato Growing Tips and News from the World of Research

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Early to Mid-Season Potato Cultural and Nutrient Management Tips

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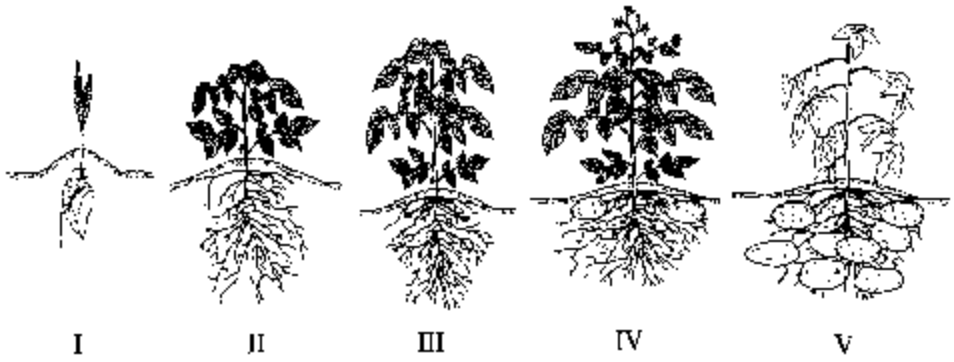
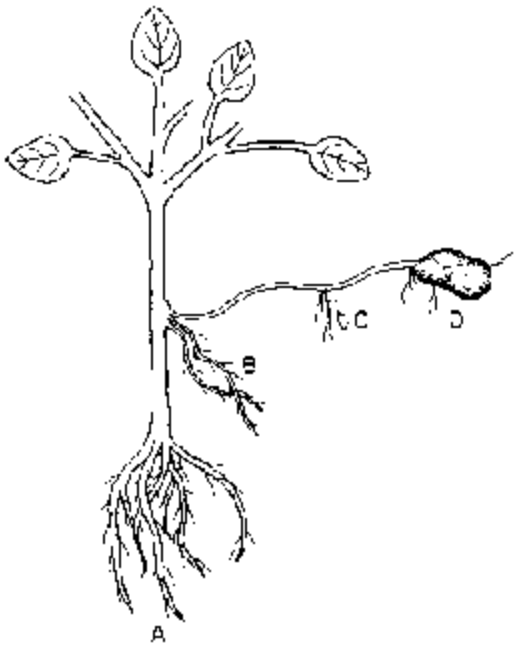
As illustrated below, determinate potato plants and tubers go through five major developmental phases: sprout development, vegetative growth, tuber initiation, tuber development, and plant senescence and tuber maturation. Conditions during vegetative growth (stage 2) and tuber initiation (stage 3) can have a large impact on crop yield and quality. This publication focuses on two practices, hilling and after planting nitrogen application, often carried out during these stages and that influence the bottom line.

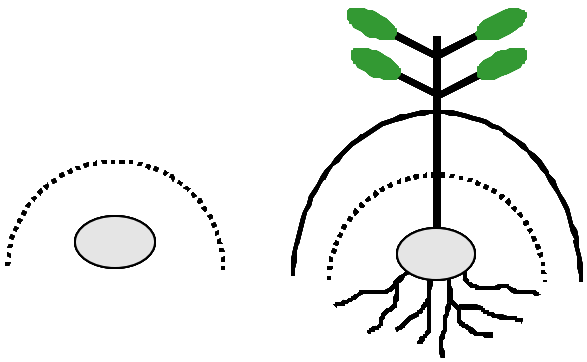


Potato Plant and Tuber Biology are important in Crop Management

Potato tubers are the enlarged tips of stolons which arise from vegetative stems of potato plants. Stolons which give rise to potentially marketable tubers form only between the seed piece or tuber and the soil surface. Therefore, like some refer to the Kentucky Derby as the “richest two minutes in sports,” we can think of the short distance between a seed piece or tuber and the soil surface as the “profit zone.”



A number of factors make it important to manage the "profit zone" carefully. For example, the first stolons develop close to the seed piece and subsequent stolons arise from the stem at points progressively closer to the soil surface. It is also important to keep in mind that stolon length varies within and among varieties. Researchers at the University of Wisconsin-Madison measured stolon lengths of less than one to more than ten inches in eight varieties. Stolon length, while influenced by environmental factors, seems to be under partial genetical control but is unrelated to tuber color or maturity. In addition, potato plants contain four types of roots, three of which may be directly impacted by the condition of the hill. Roots on a potato plant form at the base (main or basal roots), at the junction of the main stem and stolon (stem-stolon junction roots), and from the stolon and tuber (see diagram at left; A, B, C, D, respectively). Past studies documented that water taken up by the main roots bypasses the tubers on its way to the foliage. However, water taken up by the junction, and even more so by the stolon and tuber, roots goes primarily to the tubers. Overall, the quantity of water delivered to tubers by these three types of secondary roots may be small. But, it can be a primary carrier for calcium and possibly other soil-applied compounds targeted for delivery to tubers. High levels of calcium, for example, are reported to reduce the potential for internal quality defects such as brown center and hollow heart. Finally, marketable yield is reduced by sunburning or greening which results from inadequate soil coverage. Rainfall, irrigation, or soil disturbance after planting can breakdown the hill. Therefore, while 3-5 inches of soil coverage over the seed may be sufficient at planting, several more inches of coverage in place by the end of tuber initiation (stage 3) are required to maximize marketable yield (see diagram at right). Although hill shape and dimensions should be tailored to match soil, market, equipment, row spacing, and other factors, peaked or conical hills are undesirable. Hills with an approximately 14-16 inch wide base and a flat or gently rounded top are best.

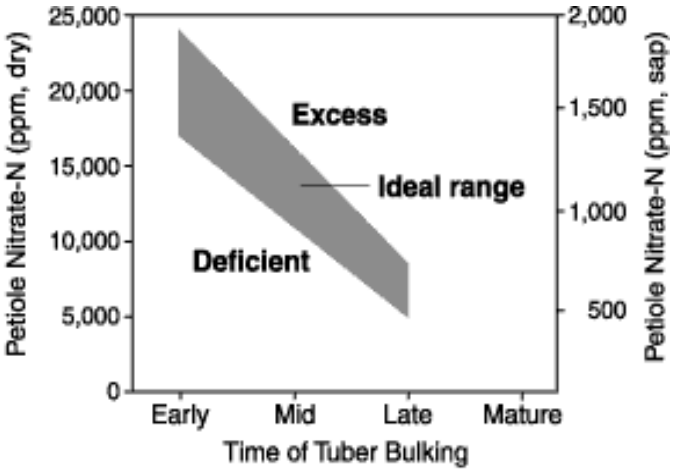


Stolons (and the tubers that form at their ends) develop from the seed piece or tuber upwards. Hills must be enlarged after planting to accommodate stolon and tuber growth and reduce greening.

Potato plants and tubers follow a characteristic sequence of developmental stages and they contain a specific arrangement of roots, stolons, and tubers. Potato plants also tend to take-up nutrients in amounts specific to their developmental stage. Of course, a key to successful nutrient management is to

match crop need with supply. Fortunately, potato growers have several means to gauge crop need and supply nutrients. For the moment, let's focus on assessing crop nitrogen (N) status after planting.

Experienced growers recognize that the appearance or color of the crop is an unreliable indicator of its nitrogen status. In fact, when it comes to nitrogen deficiency, it is often too late to reverse its impact on yield or quality once it becomes noticeable as stunted or yellow plants. Likewise, the negative impacts of excess N are mostly irreversible. This, coupled with the fact that pre-plant nitrogen can be lost if soil moisture remains high after planting, makes it important that crop managers estimate crop nitrogen status using proven methods, in addition to their experience.



Petiole sap and tissue nitrate tests were developed to assist in the management of N availability in season. Both methods require sampling of fully developed leaves (usually the fourth or fifth from the top) and calibration of standard values for local production conditions. Petiole sap nitrate tests are rapid and inexpensive while laboratory-based tissue tests often involve more time and expense. However, tissue tests usually report the levels of up to twelve macro- and micronutrients while in-field sap tests are specific to one ion/nutrient (e.g., nitrate-N). Regardless of method (in-field measurement of sap, lab measure of tissue), results from these measures are compared with research-based reference readings such as those above. Measured values falling below reference values may indicate that the crop is nitrogen deficient. If needed, additional N can be applied by side-dressing during cultivation and hilling operations, through the irrigation system, or, in limited cases, via foliar sprays. In any case, the goal is to maintain a sufficient (but not excess!) supply of N as going too light or heavy has drastic consequences on yield and quality. The same is true of wide fluctuations in N supply.

The crop's total N requirement is specific to cropping history, soil type, market, variety and maturity, weather, and other factors. Regardless of the total amount to be applied, split applications – applying a portion pre-plant and the remainder after emergence and, possibly, through tuber bulking – of N are recommended. A rule of thumb is to apply one-half to two-thirds at planting with the remainder applied at and after emergence. Applications made after planting can be adjusted according to prevailing conditions using methods described above. Caution should be used in applying N after hilling as excess N late in the season can delay maturity, reduce tuber quality, and contribute to environmental contamination. In some areas farming non-irrigated, fine-textured soils, one-third to one-half of the total N is applied in one post-planting application at hilling. In other areas farming irrigated, coarse-textured soils, one-half to two-thirds of the N is applied in several applications after planting through a combination of sidedressing and injection into the irrigation water (fertigation or chemigation).

Research News

Family, friends, and colleagues regret the untimely and unfortunate passing on May 5, 2001 of Dr. Alvin F. Reeves, potato breeder with University of Maine. Many are familiar with Al's numerous contributions to the world of tomato and potato breeding and genetics. Al led the charge in the development and release of a number of varieties which continue to benefit many industries. On a personal note, I remember well the strong interest that people took in Al's display of new and promising selections at the University of Maine Cooperative Extension Annual Potato Conference. And, I appreciate Al's willingness to collaborate on projects under development in Ohio. Al's intelligence, wit, and dedication made him a valued colleague and friend to many. Al will be remembered and missed.

References used in Development of this Publication

Agri-Growth, Inc. 1997. Basics of crop production, understanding the potato plant, Level 1. Figure 1, illustration of potato plant growth stages.

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Kratzke, M.G. and J. P. Palta. 1985. Evidence for the existence of functional roots on potato tubers and stolons: Significance in water transport to the tuber. Am Potato J 62:227-236. Figure 2, four types of roots on a potato plant.

Kratzke, M.G. and J. P. Palta. 1986. Calcium accumulation in potato tubers: role of the basal roots. HortSci 21(4):1022-1024.

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Scherer, T.F., D. Franzen, J. Lorenzen, A. Lamey, D. Aakre, and D.A. Preston. 1999. Growing irrigated potatoes. North Dakota State University, NDSU Extension Service AE-1040. Figure 3, reference petiole nitrate levels for irrigated potatoes in North Dakota.

Previous Issues of this Newsletter:

Factors to Consider when Sidedressing, volume 1 number 1, June 2000
Potato Storage Management Tips, volume 1 number 2, November 2000

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