Crop and Soil Science 322
Principles of Potato Production

XV. Fertilization

Fertilizer should never touch seedpieces because of **salt injury (dehydration) and sprout death.** Never band fertilizer on, or directly above seedpiece. Always to the side and below. Seasonal broadcast and nitrogation are not concentrated enough to cause dehydration.

In short-season areas, half of the fertilizer complement can be broadcast and incorporated before planting and the rest banded beside and below (2" x 2") the seed pieces at planting.

In long-season areas, only a small percentage of the fertilizer is applied at planting. The bulk of the P and K can be applied before, some P in bands at planting would help. Nitrogen, especially, is applied through irrigation systems during the season in the Co. Basin, for example. Applications based on petiole analyses and/or soil analysis.

Fertilizer applications should always be based on **soil and/or petiole analysis – and commonsense! Consider field history, preceding crop, expected length of season, etc.**

--Fertilizer should never touch seed pieces because of **salt injury (dehydration) and sprout death.** Banded fertilizer should always be placed beside and below seed pieces, never above them. Seasonal broadcast of various nutrient elements and nitrogation typically do not build salt concentrations high enough to cause plant injury.

--in long season areas: only a portion of the N complement (maybe half?) is applied before or during planting; most is applied during the season either as granular or liquid material. Nitrogation is a preferred vehicle when available.

Typical fertilizer rates for Oregon, lbs/acre

Location	N	P2O5	K20	S	B
W. Valley 1?	80-200	140	200		40
C. Basin	200-400	150	200	25	1
C.Or., K. Falls 1	60-270	175	225		65
Treas. Valley	120-220	140	200	25	1

Question: why only 60 lbs of N. in some areas of the Klamath Basin? Organic soils typically release high amounts of N during the growing season due to the breakdown of organic matter.

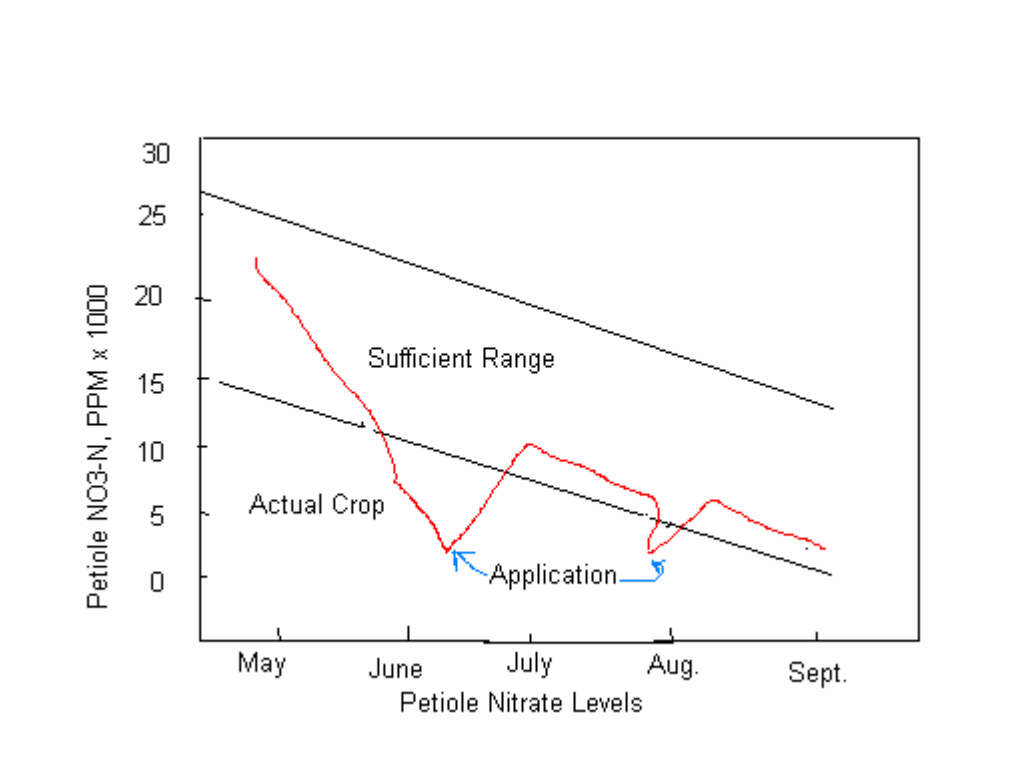
--Optimum fertility rates are influenced by:

- The preceding crop
- The crop planted
- Residual nutrient levels
- Soil type, organic matter and pH
- Expected length of cropping season
- Irrigation/rainfall patterns

--How does a farmer decide how much of what nutrients to apply?

- Preplant
  1. Field history
  2. Past experience
  3. Soil test

- In-season
  1. Soil test
  2. Petiole tests, esp. for nitrogen applications
  3. Crop appearance
  4. Precipitation?



Question: what is petiole analysis and how does it apply here? Basically, petiole analysis allows the farmer to know exactly howm juch nitrogen his crop tissues contain at any given time. By comparing his levels with sufficiency ranges as illustrate above, he can manage nitrogen applications very precisely, and to a lesser extent phosphorus and other materials, especially nutrients which are highly soluble. The combination of petiole analysis and in-season soil analysis provide growers a very precise picture of not only current tissue levels but expected changes based on soil availability. Such data allows for so-called “spoonfeeding” in long-season areas. Spoonfeeding is typically not as highly recommended for short-season areas. Soluble fertilizer elements are typically applied throughout the cropping season in the Columbia Basin but typically only in the planting season or shortly after in the Klamath Basin. Terms such as “fertigation” and “nitrogation” are often used to denote fertilizer applications through irrigation sprinklers. Center pivots provide very handy vehicles for “chemigation” as well as fertigation.

XVI. Irrigation

Regardless of the production area, good yields and quality require that **available soil moisture remains above about 65%.**

Soil Effects on Irrigation Methods

Soil type? Soil texture does not measurably impact total seasonal crop water requirement but significantly impacts irrigation methods in terms of **how fast**, **how much** and **how frequently** fields must be irrigated and how much water can be applied at one time.

Compared to sands, for example, heavier soils have greater **water-holding capacity** but a much slower **infiltration rate**. Some sands in the Columbia Basin may hold less than 1.0 in/foot of available water. If available soil moisture is then held above 65% for good potato yield and quality, and since 90% of the potato roots are in the top foot, the field must be irrigated after only about 0.4 inch has been evapotranspired. This may call for daily irrigation under the worst conditions.

In contrast to Columbia Basin sands some silt loams and clays may hold more than 4 inches/foot of available water. Such fields would clearly require irrigation much less frequently. Silt loams in the Willamette Valley may require irrigation only twice, or even once, per week even in midsummer.

The rate (inches/hour) at which water is applied depends heavily on soil texture. Because of these textural-determined differences in infiltration, furrow irrigation is not ideally suited to sands because of the relatively short runs required (the water infiltrates before it can travel very far down the furrow); likewise, center-pivots are not ideally suited to heavy soils because of the extremely high water application rates at the end of the pivot. Center pivots are used almost universally on potatoes in the Columbia Basin.

Example based on the above water use curve for the Columbia Basin and assuming a sandy soil, growers can lose only about 0.4 in. before irrigation is needed (irrigate lightly, daily!). On silt loams in the W. Valley (about 0.3 in/day maximum water use) growers can lose well over an inch before irrigation may be necessary.

Available Soil Moisture is basically that amount of moisture held between **field capacity** and that available at the **permanent wilting point** for the crop in question.

Irrigation methods—Water may be applied in any of several ways including:

- flood irrigation,
- furrow irrigation,
- impact sprinklers (solid-set; big guns, lateral move, center-pivot), and
- drip

Solid set (sprinklers) is mandatory for dependable **frost protection** through irrigation. For frost protection, water is applied before the temperature falls below 32F and continuously until all ice melts the following morning. In some situations, solid-set frost protection can protect potatoes down as cold as 23F. One potato grower at Midland, Oregon (Klamath Basin) recently irrigated 19 nights in July to prevent freeze out. Needless to say, crop yields and quality did not fare well, but much of the crop was saved.

Solid set sprinklers, like all other sprinkler systems, can deliver fertilizers and various other agrochemicals quite effectively.

Center pivot is the sprinkler system of choice in the Columbia Basin and other areas requiring frequent irrigation and having light-textured soils. The center pivot is especially well adapted to soils with high infiltration rates because of extremely high water deliver rates at the ends of the pivot arms. The center pivot provides a convenient vehicle for delivering fertilizers and all manner of agrochemicals as frequently as every 18 hours in a pinch.

Drip irrigation is currently not widely used in Oregon because of expense and aggravation; however, it may increase in popularity as the availability of water and energy to pump it decline.

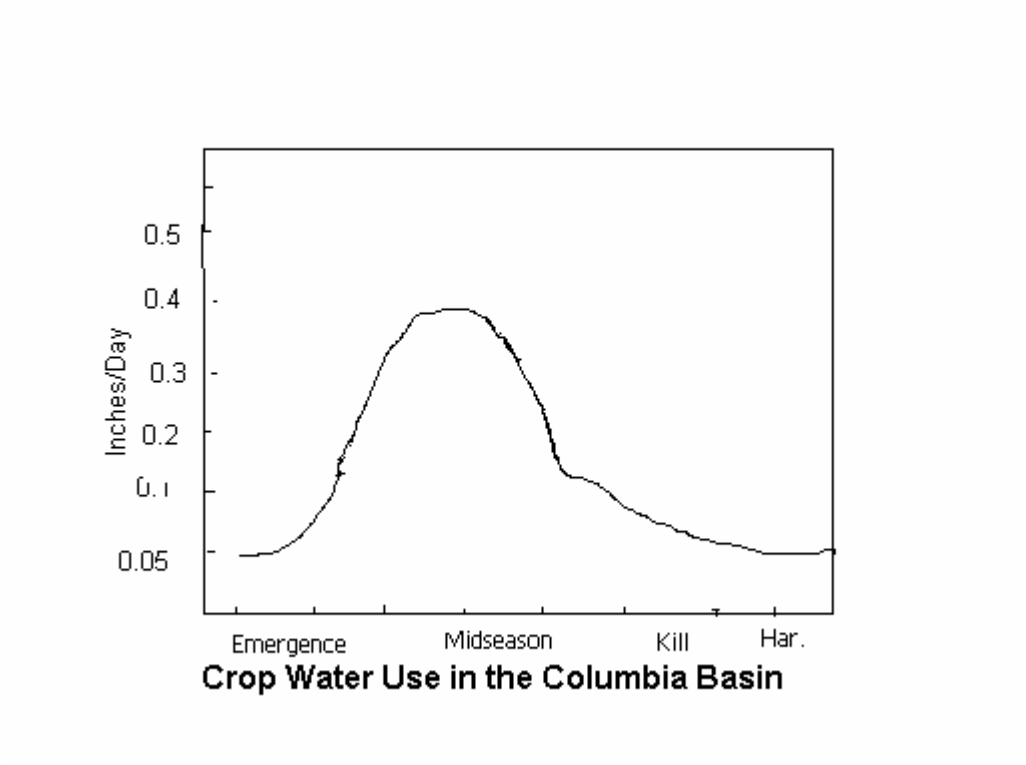
Scheduling Irrigation

Growers use a number of tricks to schedule irrigation, ranging from shoveling to nuclear radiation.

Checkbook (evapotranspiration) – this method is widely used in the Columbia Basin and depends on the extrapolation of open pan evaporation readings to evapotranspiration (evaporation plus transpiration, or crop water use) values. Crop water loss is basically equivalent to evapotranspiration which, in turn, is often a predetermined percentage of pan evaporation corrected for time of year and plant growth stage. Water use depends on time of year (canopy size & vigor), weather (wind, humidity, temperature), variety, other.

A typical Columbia Basin **crop water use curve** is shown in the following figure. Water use typically averages about 0.3 inches/day but may shoot up to 0.5 in/day in warm, windy weather in midseason. Usage in the Willamette Valley probably averages about in. less/day.

Pan evaporation and crop water loss readings are frequently provided by consultants who also recommend irrigation regimes which account for crop species, soil type, stage of growth, time of year and so on. A great deal of precision can be achieved using this approach but occasional measurements of actual soil moisture are required for insurance.



Crop Water Use in the Columbia Basin

Soil Water Content --Evapotranspiration provides a good, but indirect, method for estimating crop water use and remaining soil moisture. Soil moisture can also be estimated directly by use of the:

1. Feel method – stickiness, ribboning, shovel feel & color; demands experience
2. gravimetric – A soil sample is collected, weighed, oven dried to virtually zero moisture content and then reweighed. Soil moisture can be calculated based on the before and after weights.
3. neutron probe – neutrons are emitted and counted to determine the amount of reflection which is related to soil moisture.

Soil water potential -- Is measured as tension (pressure or vacuum) or electrical conductivity.

1. tensiometers (actual soil suction on a water column, etc., is measured directly as pressure/vacuum.
2. gypsum blocks (electrical conductivity)
3. granular matrix sensors (electrical conductivity)

Cultivation and Ridging – The potato crop is typically cultivated and ridged at least twice during the emergence – layby stage. Both procedures offer a fair degree of mechanical weed control and also the opportunity to apply other materials such as fertilizer, systemic insecticides (**Thimet, Furadan, Temik,**

Di-Syston), herbicides (**Dual, Prowl, Sencor, Eptam**) and so on as needed in conjunction with the cultivation/ridging passes. Ridging provides additional soil cover so that the environment at the level of roots, stolons and tubers is much cooler, moister and less stressful. Crop performance is improved and tuber greening is decreased because of additional protection from sunlight. Ridging also aids harvest.