# WATER AVAILABILITY AND WATER QUALITY

Water management is an essential part of ginseng production. Optimum yields can be obtained only where a reasonable measure of control of the water in the soil and for other purposes has been achieved. The effectiveness of most, if not all other management factors, varies in direct proportion with the degree of control of water quality and availability. The availability of water is important in all production aspects and is generally distributed in a garden by a solid set irrigation system (see Irrigation Section page 53). Although ginseng is considered a low water requirement plant it still must be there when needed.

## Water Availability

Water is required in the ginseng industry for four varied but important uses:

- site preparation requirements
- irrigation of the plants during each growing cycle
- cooling of plants in extreme heat situations
- application of pesticides

### WATER DEMAND FOR SITE PREPARATION

During the preparation year, water demand will be greater as a grower potentially does a variety of things:

- reduces weed populations by encouraging germination
- prepare land for fumigation when soil water percentage is very critical for good results
- possibly to grow a cover crop to build up organic matter in the soil
- break down large pieces of organic matter such as alfalfa roots, as they will decay much faster in moist soil.

All of the above would require considerably more volume of water than a first or second year garden and possibly more than a four year-old garden as well. There are two reasons for this:

- the climate modifications of shade and mulch of a ginseng garden considerably reduce the requirement of water by reducing evapotranspiration from plants and soil
- the nature of the ginseng plant itself especially in the first two growing seasons when the plant has little vegetative growth, as well as doing the majority of its vegetative growth in the first three weeks of the growing season

### WATER FOR GINSENG IRRIGATION

Given the shade structure, mulch and the small plant, irrigation may still be required up to six times per year. Sites that are very hot and dry and have well drained soils will require considerably more water than sites that are cooler, with heavier soils. Another factor to consider is that ginseng will not tolerate saturated soils for any amount of time so growers only apply what is needed to keep the root zone moist. This is accomplished by irrigating more often with less volume per setting. It is also a shallow rooted plant so water penetration to subsoil level is not so important.

### WATER FOR HEAT STRESS COOLING

There are days during the summer in the Interior of British Columbia when the temperature will rise to the high 30s or low 40s (°C). The ginseng plant, indigenous to areas with cooler climates and higher relative humidities (RH) can suffer stress to the point of damage or death during these periods. Any amount of wind speed during this time may aggravate the damage because of increased evapotranspiration.

The damage will show up very quickly as white or light brown papery spots on leaves or even whole leaves will be affected. If enough tissue damage occurs the top portion of the plant may die. This generally happens late enough in the season that the bud for next year's growth is developed. If it is, the root likely will sit and grow again next spring, assuming other damage doesn't occur. The root growth, however for the balance of the season is lost.

The temperature trigger for preventative action is in the range of +35°C (95°F) under the tarp. Over this temperature you can expect some damage to start to occur. The reason for damage is that the plant cannot bring water from the roots to the leaves fast enough to cool the plant. (See Physiological Disorders section page 117).

To protect for heat stress, turning on the irrigation system for ten to twenty minutes in the garden will reduce the actual temperature and will also increase the RH under the shade cloth, cooling the plants themselves. The fact the soil may have adequate water to grow ginseng is not a large factor as the plant cannot move water through it's system fast enough once the temperature reaches a certain point, but if the soil is on the dry side, this may aggravate the problem by reducing the amount of water available to the root system.

Watering for ten to twenty minutes will not add water to the soil zone as almost all of this will be absorbed into the straw or will sit on the plants and slowly be evaporated, increasing the RH.

This short term irrigation may need to be done one to four times a day. This makes it imperative that:

- adequate water capacity is available
- sections of gardens can be irrigated separately
- the irrigation system is able to support this on-off cycling
- manpower must be available during the warmest part of the day

The windward side of the garden will be hardest to control as hot dry air may be constantly moving into the garden. Good irrigation systems should be designed to take this into account. Heat also builds under tarps and the larger the area covered, the problem is potentially increased. Having gardens no larger than five acre blocks, then an opening, roadway, etc. will help to let this hot air escape. Sites with a slope may also see the higher elevation sections of the garden heat up faster because of the chimney effect where warm air moves upwards, under the tarp, heating more as it goes.

## WATER FOR SPRAYING PESTICIDES

Almost all of the pest control chemicals used and some fertilizers are applied in a water solution. Granular chemicals are the exception but these are typically incorporated into the soil with water, thus water is a very important part of pest control.

Water used for these purposes should be:

- clean
- pH balanced to a proper level
- warm (not ice cold)
- balanced for dissolved salts (EC)

Clean water means it is free of suspended soil and organic particles. Some chemicals will adhere to small colloidal particles and will not be released to do what they were meant to do. Bits and pieces of soil and organic matter will also wear on sprayer parts, and if enough are present can clog sprayer nozzles. See your dealer for products to change the pH of water. See also the label for specific directions.

# Water Quality

The average soil salinity of the root zone is closely related to the quantity and quality of irrigation water. Irrigation water quality is important, because as plants remove moisture from the soil, the salts in the soil water become more concentrated, as salts largely remain in the soil solution. Waters with an electrical conductivity (EC) of less than 0.75 dS/m (dS/m = deci Siemens per meter = millimho per centimetre) usually present no problems. Those with an EC ranging between 0.75 and 3.0 dS/m increase possible problems significantly. Water with conductivities greater than 3 dS/m present severe problems.

In addition to water conductivity, its sodium absorption ratio (SAR) value should be considered in evaluating its quality for irrigation. SAR values should be significantly below 10. Laboratories listed in the Ginseng Industry Directory and Supplier Guide can do irrigation water quality analysis. This will provide required information re: the concentration of salts in solution and some possible toxic level elements in the water or salts in the water that could accumulate in soils over time.

As noted above water quality for irrigation has to be within certain ranges to be acceptable. There are about eight specific chemical aspects of water that are tested for. Some of these are listed in table 15.

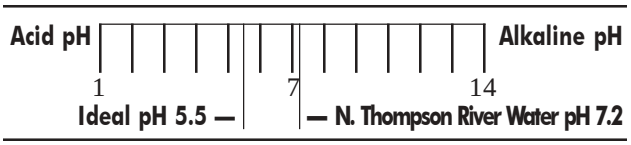
### TABLE 15. Guidelines for irrigation water quality

| Test | safe for all plants | safe for most plants | Injurious to most plants |
|---|---|---|---|
| SAR | < 6.0 | 6.0 - 9.0 | > 9.0 |
| EC | < 1.0 dS/m | 1.0 - 3.0 dS/m | > 3.0 dS/m |
| B | < 0.5 ppm | 1.0 - 3.0 ppm | > 3.0 ppm |
| Cl | < 70 ppm | 70 - 350 ppm | > 350 ppm |
| $HCO_3$ | check $HCO_3$ Bicarbonate levels, and calcium and magnesium. Use calculation in *Trickle Irrigation Manual* to determine if $HCO_3$ will precipitate on plants. | | |
| Ca | > 20 | > 20 | N/A |
| $NO_3$ | < usually only of concern in contaminated water. | | |

**Note:** *No absolute data is available for ginseng and the above ranges are generally acceptable levels for average crops.*

Water used for spraying should be balanced to an acid pH, in the 5 – 6 pH range with a maximum of 7 for any chemical. Check with the label or the dealer in are not sure. Water, depending on what is dissolved in it can either be acidic, neutral or alkaline. If it is too far off the optimal level, the effectiveness of chemicals can be altered, often to a large degree. The only way to know where your water pH registers is to use a pH kit or send it to a laboratory for analysis. Some sources of water can change over time or during a season so this needs to be taken into account. An increase in one point on a pH scale is a 10 fold change in the acidity or alkalinity, thus water at 7.5 for example is very different in its content than one at 4.5, a 1000 fold change. See table 16.

### TABLE 16. Water pH scale showing ideal pH for spraying chemicals




There are buffering chemicals available that you can use to modify the pH to a desirable level. See the Appendix for a list of Laboratories that test and give advise on water quality. The product label will often give you some information as well.

Low pH (i.e., 5) has an abundance of hydrogen ions in solution (acidic) and high pH, over 7 have excess hydroxyl ions (alkaline). Most chemicals are affected, often a great deal, by the hydroxyl ions. Chemicals can be rendered ineffective very quickly by high pH. This process is called alkaline hydrolysis.

It is important therefore to adjust the pH of the water in the tank **BEFORE** the chemical is added. The half life of some chemicals is very short at high pH. See the following information on pH requirements of some spray tank solutions.

## PH REQUIREMENTS OF SOME SPRAY TANK SOLUTIONS

As chemicals and / or nutrients are added to the spray tank, the pH of the solution is affected. The chemicals can also be affected by the original pH of the water, as well as the turbidity (suspended solids) of the water. Roundup, as an example, is greatly affected by suspended soil in water as well as improper pH. Many chemicals can rapidly decompose and become ineffective at pH greater than 6.5 to 7.0, for example:

- Aliette — very acidic product and is most stable @ pH 7. May drop pH in tank by up to 1 point i.e., 7.5 to 6.5.
- Rovral — most stable at pH 7 and a pH of 8 or higher causes rapid hydrolysis.
- Roundup — ideal pH 5 - 6.

Generally pH of spray tank solutions should be between 5 - 6.0. Check with a swimming pool pH kit — use vinegar 1 gal / 300 gallon or commercially available acidifers at label rates.

## HARD OR SOFT WATER

Do not confuse hardness of water with pH as they are completely different things. The hardness of water, is determined by the amount of Calcium and Magnesium salts in solution. The type and amount of these salts will determine the resistance to change by a buffering agent, but it should be done if water is tested as hard. Chemical distributors sell products that will buffer water to increase efficiency of the pesticide chemical used. Water from a well can vary a great deal so must be checked before use.

## SOURCES OF PATHOGEN INFECTION

If you have spent considerable time and money fumigating your site, consider water as a potential contaminant along with other factors. Pathogens can gain entrance to the soil by:

- Planting infested seeds or plants.
- Wind-blown or water-splashed pathogens.
- Irrigating with dirty water.
- Movement of infested soil.
- Using contaminated tools, containers, footwear, etc.

***Note:*** *Please check with authorities to see if you have water available under licence in the area you are planning to grow. Water is not a given entity in British Columbia.*

*This shows an average 4 year old root freshly dug and ready for drying.*

*A typical 2 year old British Columbia garden using steel posts with a 30 ft. wide span of shade cloth.*