



University of Nevada
Cooperative Extension

Special Publication 09-01
Replaces SP 04-04

Vegetable Gardening in Moapa and Virgin Valleys

by

Dr. Sylvan Wittwer,

*Director Emeritus of the Michigan State University Agricultural Experiment Station
and Professor of Horticulture*

*Edited by Alice M. Crites, Extension Educator, and
Pamela Proctor, Program Officer, Horticulture*



Sylvan and Maurine Wittwer in their Logandale garden

About Dr. Wittwer

Dr. Sylvan H. Wittwer, Director Emeritus of the Michigan State University Agricultural Experiment Station and Professor of Horticulture, retired and moved to Moapa Valley in 1996. He has traveled all over the world and spent his entire career and most of his life in agriculture research, resource management and education. He has experimented with different vegetable and fruit crops in this area and elsewhere. University of Nevada Cooperative Extension encouraged him to share his findings with local residents. His garden is a showplace and he has proven that with proper planting times, fertilization and watering, many varieties of vegetables grow and produce exceptionally well in this area, especially in the fall, winter and spring.

Dr. Wittwer was chairman of the Board of Agriculture and Renewable Resources of the National Research Council of the National Academy of Sciences from 1973-77 and a member of the Climate Research Board 1978-81. He has served as a consultant for all International Agricultural Research Centers, all federal agencies relating to agriculture and environment, the United Nations Development Program and the World Food Bank. Dr. Wittwer is the scientific pioneer who conducted the original studies on atmospheric carbon dioxide enhancement of the production of food crops, foliar feeding of plant nutrients and early tomato production and is the author of more than 750 peer-reviewed studies. He is an author of *Feeding a Billion: Frontiers of Chinese Agriculture* and also author of *Food, Climate, and Carbon Dioxide*, published in 1995 by CRC press.

Dr. Wittwer was born and reared in Hurricane, Utah. He received his undergraduate training in horticulture at Utah State and a Ph.D. from University of Missouri. He was presented an honorary Doctor of Science degree from Utah State University in 1982 and an honorary Doctor of Agriculture degree from Michigan State University in 2002. He received the Distinguished and Meritorious Service Award from the American Farm Bureau Federation in 1984. In 2004, he was elected to the American Society for Horticultural Science Horticulture Hall of Fame.

He and his wife Maurine were married for nearly 70 years, until her passing at age 90 in May 2008. Maurine was the recipient of the Silver Beaver Award in 1972, a great honor in Scouting. She was one of the world's longest survivors of breast cancer, having been diagnosed in 1947, a testament to the benefits of healthy eating. Dr. Wittwer credits his alertness and good physical condition to healthy eating and the exercise of gardening. From September through June, his garden in Logandale, Nevada is a showplace to behold.



Sylvan and Maurine Wittwer, April 2008

Index

	<u>Page</u>
Introduction	1
Vegetable Gardening Quick Tips	3
Irrigation	5
Soils and Fertilizers	8
Pest Control	11
Planting Schedule	13
Harvest Schedule	14
Asparagus	15
Beans, green	17
Beets	19
Broccoli	21
Carrots	23
Corn, Sweet	25
Melons	28
Onions	30
Peas	32
Peppers	34
Potatoes, Red and White	36
Potatoes, Sweet	38
Spinach	40
Tomatoes	42
Conclusion	47
Summary Chart	48

Introduction

The Moapa Valley has long been known as one of the garden spots of the Southwest. Tomato and onion plants were produced here during the late '40s and early '50s and shipped as far east as Michigan, New Jersey and Indiana, which were the major producing areas 50 years ago. Moapa Valley also competed briefly with Georgia as a source of vegetable transplants for the Northern states.

This account of vegetable gardening in the Moapa and Virgin Valleys is not intended as a complete treatise neither as to crops which can be grown nor the cultural, soil fertility requirements and amendments or climatic conditions under which they should be grown. The intent has been to select some of the major vegetable crops, outline methods of culture both new and longstanding, and answer some of the most commonly asked questions. While only selected vegetables that have proven particularly successful for the author are included herein, the reader is encouraged to experiment with other vegetables that may be of interest. Successful gardeners are encouraged to sell excess produce at a local farmer's market or health food store.

Since the fertilizer requirements, height, flower set, rate of maturity, etc., of all plants, including weeds, respond to conditions such as photoperiod (length of day) or base temperatures, gardening is not an exact science. It is an art as well as a science. All vegetable crops have a base temperature at which growth begins. For beets, carrots, chard, onions, peas, radish, spinach, etc., it is 40°F. For green beans, peppers, sweet corn, tomatoes, etc., it is 50°F. For melons it is 60°F and for sweet potatoes 70°F. Naturally, the timing of these temperature conditions will vary from year to year, and thus the frost-free planting and transplanting dates.

When preparing the garden, seed should not be in direct contact with fertilizers. Work fertilizers thoroughly into soil before planting seeds. Most seedlings benefit from the use of a "starter solution" high in phosphorus, added at the rate of one ounce per gallon of water. There are commercial starter solutions available such as "J. R. Peters Inc. Jack's Classic®" or "Miracle-Grow®", but an all-soluble, and less expensive, ideal starter solution is monoammonium phosphate (12-61-0).

Disease resistance is often listed by initials on starter plant labels and seed packets, such as "VFN" on tomatoes, indicating a resistance to Verticillium wilt, Fusarium wilt and nematodes. If bulk seed is purchased, buy and use only "certified" seed.

Poor, salty, high-alkali soils must be improved and water quality reasonable to grow vegetables. Poor soil conditions may dictate which vegetable will be most successful, i.e., asparagus vs. lettuce. Irrigation is required to grow vegetables in Nevada.

Selected varieties or cultivars (seeds/plants) of a particular vegetable may perform better than others in an area. Production of seed by seed companies may be and has been discontinued for varieties well adapted for these valleys, i.e. the "President" tomato, "Earliserve" green bean and "Sweet Georgia Brown" onion. Hybrid seed may give higher yields or have unique qualities, but don't harvest seed for planting next year as offspring will not carry the hybrid qualities.

Alkaline, inorganic, nutritionally poor and biologically limited soils common to Nevada often need amendments and fertilizers to reach their productive potential. Where drainage is poor – caliche, hardpan, compacted or naturally heavy soil – adjustments must be made to successfully grow vegetables.

Take advantage by site selection of the climatic resources of the Moapa and Virgin Valleys. Extend the spring season by transplants, row and plant covers and variety selections. With row orientation, take advantage of the sun as well as protection from it by shade covers. Plant rows north and south for wind protection.

Take advantage of fall, winter and early spring production for cool-season crops to avoid weeds and most all insect damage, and for reduced water requirements, improved quality and the privilege of working outdoors in cool temperatures rather than the heat of summer. The majority of garden-fresh vegetables are produced from September through June.

There are some vegetable crops such as asparagus, beets, broccoli, carrots, garlic, green beans, onions, spinach and sweet potatoes that are admirably adapted for production in the Moapa and Virgin Valleys. No serious diseases or insect pests have thus far been observed on these crops, and they thrive in our alkaline soils and are of excellent quality.

Finally, be ever mindful of the proper management and the most efficient utilization of our natural resources of soil, water, energy and climate. Climate is a resource that should be used wisely, or a hazard to be dealt with.

Suggestions which follow will enable successful production of major vegetable crops without the use of chemical pesticides that are toxic to people and beneficial insects such as honeybees and ladybird beetles.

Vegetable Gardening Quick Tips

1. Prepare soil and irrigation system well in advance of planting.
2. Use a drip irrigation system. Water thoroughly and less frequently.
3. PLAN IN ADVANCE. Order seed, fertilizer, transplants and compost well in advance of anticipated need. New and improved seed varieties are generally available only through mail or Internet order.
4. Consider growing asparagus, green beans, onions, peas, peppers, spinach, sweet potatoes and tomatoes. They will tolerate alkaline soils, are generally pest free and are preferred by most people.
5. Avoid the use of toxic pesticides – harmful to people and to beneficial insects. Use natural insecticides and biological controls as alternatives.
6. Plant cool-season crops (beets, broccoli, cabbage, carrots, lettuce, onions, peas, radishes, lettuce, spinach, etc.) for fall, winter and early spring. There are fewer weeds and insect pests, quality is superb, less water is required and it's a cool, pleasant environment for working outdoors.
7. Grow vegetables such as red/yellow peppers, tomatoes, sugar snap peas, beans (scarlet runner), Swiss chard, globe artichokes, pumpkins and Indian corn for ornamentals as well as food.
8. Strive for a weed-free environment. Use culinary water; irrigation water picks up weed seeds as it moves down open irrigation ditches. Avoid use of large (horse or cow) animal manure, as seeds can still be viable after passing through their digestive systems. Weeds are much easier to remove when they are small – pull or cut them out as soon as you can see them—the earlier the better.
9. “Harden-off” transplants (tomatoes, broccoli, etc.). Place outdoors in full sun for 10 days to two weeks before transplanting; place in a protected area or be prepared to bring them indoors in case of frost. Spread apart so leaves don't touch, keep plants dry, and water only when plants begin to wilt; water with an all-soluble starter solution high in phosphorus for strong root growth, such as soluble mono-ammonium phosphate (12-61-0).
10. Use mulch liberally to conserve moisture, control weeds, ensure clean produce, hasten maturity and increase yields.

11. Provide protection from the wind and sun. Plant in north-south rows, adjacent to buildings or walls or provide protection with natural or artificial windbreaks (e.g., hot caps, low/high tunnels, plastics, straw bales, shrubs). Trellising and fencing can increase productivity, but can be more labor intensive.
12. Fertilize through the irrigation system using all-soluble forms of fertilizer such as monoammonium phosphate (12-61-0), especially during flowering and fruit setting.
13. Grow fresh vegetables year-round. Grow four to five successive crops of pesticide-free vegetables such as beets, carrots, leaf lettuce, spinach and radish in one year on the same garden area by concentrating on fall, winter and spring production.
14. Reserve July and August for pepper, sweet potato and melon production.
15. Foliar application of nutrients is suggested for improvement of both quality and the production of all fruits and vegetables and for efficiency in use of fertilizer.
16. Longevity of seeds should be kept in mind if you are going to hold and store them for more than a year. New seed should always be used for parsnips, lettuce and sweet corn. Seed for all other vegetable crops may be carried over one year to the next, but not beyond three to five years. Store vegetable seed under cool, dry conditions and in the dark.

Irrigation – Watering Gardens in the Moapa & Virgin Valleys

When to water? How often to water? How much? How long? By what method? These are the continuing questions asked by those interested or active in gardening. Even experienced gardeners ask these questions.

There are no easy or quick answers. It depends on the season of the year, the soil type, the crop or plants being grown, the stage of plant development, the temperature (both daytime and nighttime), and plant exposure (the presence or intensity of wind, rainfall, sunshine and slope). To know when to water and how much and for how long is both an art and a science. It requires experience and careful observations of plants.

In this hot, dry climate the tendency is to over water. The usual symptom of too much water is a yellowing of plant leaves. A lack of drainage and resultant lack of aeration and oxygen in the root zone may be as important as the amount of watering. Remember, roots only grow where there is water and oxygen, where nothing is toxic and where there are no barriers.

Stage of Plant Development: The stage of plant development is crucial as to when to water. All annual plants go through progressively increasing rates of growth and dry matter accumulation when flowering, forming pods, producing seeds and setting fruit. When this occurs for sweet corn, green beans, peas, tomatoes, peppers, eggplant, melons, squash, cucumbers and strawberries, the demand for water and fertilizer increases enormously. This is also true when head formation occurs in cabbage and broccoli. During this period the soil should not dry out; it should remain moist, but not wet. Daily watering—or even watering twice a day in hot, windy weather—may be necessary. Following planting seeds of sweet corn, peas, beans, carrots, onions or beets, etc., the soil must be left moist until seedlings emerge. Keeping the soil moist is a much better alternative than soaking the seed before planting. If the soil dries out during germination or early seedling growth, the plants will not survive.

Plant Type: Fruit trees and many ornamental trees and shrubs do not require the frequency of watering as do vegetable crops and annual flowers.

Water requirements vary greatly with the type of crop and season of the year. The soil should be kept moist for green beans, peas, peppers, strawberries, sweet corn and tomatoes during the flowering, fruiting and harvest period. One should not delay watering until the leaves begin to wilt. Asparagus requires less frequent but more thorough watering than other crops, coupled with good drainage. Many local residents recall harvesting asparagus along ditch banks, which provided both moisture and drainage.

Sweet potatoes thrive best with sandy loam soils low in both fertility and moisture. They should not be grown in the clay soils found in parts of the Moapa and Virgin Valleys. There is no place on earth too hot to grow sweet potatoes, and they require the least water and fertilizer

of any crops in these valleys. Over watering and too much fertilizer will result in heavy vine growth with small or no sweet potatoes. Sweet potatoes of high quality can be a delightful crop and they can usually outgrow the weeds. They are in the same family as wild morning glory (field bindweed), one of the noxious weeds that grow here.

Irrigation Techniques: Plastic pressure-compensating drip lines one-half inch in diameter are recommended. (These are not soaker hoses! No soaker hose will give equal distribution of water.) Emitters, each with built-in internal filters, may be 12, 15, 18 or 24 inches apart. I prefer 12-inch spacing with delivery rates of one gallon per hour per emitter, with drip lines spread three feet apart. In the case of sweet corn, cabbage or broccoli, one plant is placed at each emitter; or in the case of green beans, peas, carrots, beets or onions, the equivalent of 10-15 plants per running foot are suggested using double rows, one on each side of the drip line. Various networks of drip lines can be adjusted to fit the space available using Ts, elbows and extenders or connectors. Tie the line in a figure eight or use an end cap to terminate or cut off the end of the row. "Figure 8s" are commercially available and by far the most convenient.

An advantage of drip hose irrigation systems is that the water is placed only where the roots are. It is by far the most efficient and economical use of water for crop irrigation. It can be on at any time during the day. At the same time you are irrigating, you can harvest and conduct other cultural practices such as training, trellising, weeding, cultivating or spraying. Using drip irrigation avoids soil compaction and greatly reduces weed growth. I recommend using only culinary water in vegetable gardens. This helps prevent salt buildup and the distribution of weed seeds that can travel in ditch irrigation water.

Up to 1,000 feet of line can be adapted to a single hose line using culinary water. Equal distribution will result over the entire area being irrigated, even when the water pressure ranges from 55 to 80 psi (pounds per square inch), which is typical of the Moapa Valley. Each emitter or dripper has a built-in interior filter. After 10 years of experience I have had no clogging or plugging up of emitters and the same drip lines purchased 10 years ago are still functional with no leakage or plugging. The pressure-compensating drip line is available locally and can be found at many hardware stores or irrigation supply stores. It comes in 100, 250 or 1,000 foot rolls.

It is best to do day-to-day visual observation and use a soil probe to check soil moisture. Also consider the crop being grown, unpredictable weather conditions and stage of plant development to decide when and how much to water. I fasten the drip lines to my house hose bibs, which I manually control. I feel that there are too many variables for use of timed irrigation programming. Duration of timing for the drip lines may vary from ½ hour to overnight, depending on the crop and its stage of development, with a frequency of watering varying from twice a day to more than two weeks. An all-soluble fertilizer high in phosphorus and adequate nitrogen (12-61-0) can be applied by inserting a fertilizer dispenser or injector between the bib and the hose line. To prevent backflow of fertilizer into the domestic water supply, install a backflow preventer. These are available at hardware and plumbing supply

stores. Plants need both water and fertilizer at the same time, especially during the flowering, seed formation and fruiting stages. Adding fertilizer to water has been called “fertigation” and is highly recommended for all vegetables.

If you have a small garden or don't have time to monitor your garden as often as you should, you can still use the drip system Dr. Wittwer uses and operates it on a timer. The key to success is to read the information provided with the equipment you purchase. Note whether the drip line amount emitted is in gallons per hour or inches of water per half hour. Run the system for ½ hour and note the width and depth of the water spread. Based on the results, add more time to get the water where you want it; then program your system for that amount of time each day in the summer and every other day or twice a week as the temperature changes. Remember that when the temperature changes drastically or if we have a lot of wind, you might need to add more time or increase the frequency of watering. Your garden can go a few days without attention on an automatic clock, but you still need to monitor what is going on and if possible look in on it every day to make sure the system is functioning properly. Don't forget to add organic matter to the garden before planting and to mulch once the vegetables are up and growing, as that will improve water-holding capacity, ensure clean fruit, control weeds, increase yields and reduce saltiness.

Soils and Fertilization

Soils and organic matter. Soils to be used for vegetable production in these valleys should have organic matter added. This can be done with compost (I prefer compost produced from a mixture of turkey manure and wood shavings), with green manure by plowing under green crops or with well-composted animal manure (horse, steer, poultry) before planting. The problem with manure is that it can be a source of weed seeds and also of salt. One should carefully check the feed used for animals that produce the manure. If turkey compost or other comparable composts are used, a recommended amount is about one and one-half to three cubic yards per 100-foot-by-hree-foot-wide area (300 square feet), which is enough to provide a depth of 1½-3 inches. A 60-foot by 20-foot garden would require six to 11 cubic yards for the same coverage. This should be worked into the soil by tilling or spading. Organic matter as compost or composted manure should be added annually—preferably during the fall, winter and early spring months. Green manure (alfalfa, clover, sudan grass) is best used in winter and is generally not a useful source of organic matter for smaller gardens.

Fertilization prior to planting. In general, vegetable crops respond well to high levels of commercial fertilizer. The recommended fertilizer is the same commonly used for alfalfa production, monoammonium phosphate. In the granulated form it has a composition of 11-52-0 and in the all-soluble form 12-61-0. The granulated form is applied by broadcast spreading before planting or seeding. Fertilizer should not be planted with the seed or placed in contact with it. The recommended amount of fertilizer varies from one to 25 pounds per 100 feet of row, depending on the crop. The highest recommended level is for asparagus at 10 to 25 pounds per 100 feet of row. A high level of 10 to 12 pounds per 100 feet of row is recommended for tomatoes and sweet corn. A moderate level of three to five pounds per 100 feet of row is recommended for beets, broccoli, carrots, cabbage, cauliflower, green beans, onions, peas, peppers, potatoes and spinach, while sweet potatoes, melons, cucumber and squash have a lower requirement of one to three pounds per 100 feet of row. Both the granulated and soluble forms can usually be purchased in 50-pound bags from garden centers. Note that potassium (potash) is absent from this fertilizer. There is no need for potash in the soils in these valleys. The soils are already loaded with sufficient quantities to take care of all plant needs. The most important ingredient in fertilizers used in these valleys is phosphorus. This is based upon the fact that phosphorus as a plant nutrient is biologically, chemically and physically fixed when added to the soil of these valleys. Large quantities are required to overcome these fixation processes and to meet needs for optimal crop production, especially of asparagus, beans, potatoes, tomatoes, onions and sweet corn. The so-called complete fertilizers, often with the composition of 20-20-20, are not as useful as the simple salt formulation of monoammonium phosphate. In general, the sandy loam soils found in these flood plain valleys when supplemented with organic matter are good for almost all vegetable crops. Most all vegetables, particularly

asparagus, onions, tomatoes, peas, beans, broccoli, cabbage, cauliflower, carrots and beets, respond well to our local soils' high salt content. The only exception would possibly be for sweet potatoes which perform best in soils of relatively low fertility with minimal amounts of organic matter added.

Use of all-soluble fertilizer. The all-soluble form of monoammonium phosphate (12-61-0) is also recommended to be added to the irrigation system during crop production and for use in watering prior to, during and after transplanting. It is particularly important that high levels of water, as well as fertilizer, be added through the irrigation system during periods of rapid plant growth, especially at the time that flowering and fruit setting occur. This is true of peas, beans, cucumber, melon, sweet corn, tomatoes and peppers. This is also true during the bulbing of onions, tuber formation in potatoes, root production in sweet potatoes and during head formation in broccoli, cabbage and cauliflower. The demand for fertilizer and water increases precipitously during these periods, and it is convenient to supply them together through the established irrigation system. This method of fertilization is sometimes called "fertigation." The all-soluble monoammonium phosphate (12-61-0) is also very effective as a starter solution in transplanting of tomatoes, peppers, cabbage, broccoli, cauliflower, onions or any other crop suitable for transplanting, including melons and cucumbers. This is used at the rate of about one ounce per gallon of water and applied at the time of transplanting to enable the plants to get an early and quick start in their new location. This same fertilizer is very useful in watering young plants before transplanting at the rate of one-half to one ounce per gallon, especially during the "hardening off" period that is desirable for tomatoes, broccoli, cabbage, peppers and eggplant.

The simplicity of the recommended crop fertilization should be emphasized. Only one fertilizer, monoammonium phosphate, is the most effective. It should be used in the granulated form prior to transplanting or planting. The all-soluble form should be added through the irrigation system during the periods of rapid plant growth, signaled by the fruiting and flowering periods. Compost, as well as fertilizer, should be applied each year that planting or crop production occurs.

Foliar Feeding. Foliar feeding of plants is becoming a common practice in vegetable and flower gardening and fruit production. Discovery of foliar feeding was related to original studies at Michigan State University concerning possible hazards of residues from fallout blasts then occurring in Nevada being absorbed through leaves. In early research in Michigan, radio isotopes of carbon, phosphorus, potassium, calcium and other radionuclids were used to follow the path of nutrients sprayed on the leaves of beans, strawberries and tomatoes. It was observed through autoradiograms that all foliar-applied nutrients were truly absorbed very rapidly by leaves and within hours translocated to all parts of the plant, including the roots. It is the reverse of what happens when we apply fertilizer nutrients to

the soil. Other studies followed in which it was noted that many substances – nutrients (both organic and inorganic), hormones and herbicides – were absorbed by leaves and distributed very rapidly throughout the plant. A typical example now well known is the use of the herbicide Round-Up® which, being absorbed by leaves, kills by being translocated to the roots.

Our original studies on foliar absorption of nutrients were conducted as early as 1952. Though published in reputable scientific and trade journals, they were not accepted by the then traditional scientific and agronomic communities. There was great resistance to the idea of foliar feeding when originally introduced, but now it is an accepted practice for commercial growers. Our research results have since been validated and confirmed by many field and greenhouse studies and grower observations, and we now definitely recommend foliar spraying of nutrients to enhance the growth, productivity and quality of vegetable, flower and fruit crops. Foliar application of nutrients—organic and inorganic—constitutes the most efficient use of fertilizers and in some instances with trace elements (iron, zinc, manganese) is the only way to correct nutrient deficiencies, as well as get quick results. However, the total nutrient requirement for plants cannot be provided by foliar feeding alone.

Many nutrient formulations are now available for applying to the foliage of flowers, fruits and vegetables. They include such products as Miracle-Gro® and Peters®. There are also all-soluble formulations of monoammonium phosphate (12-61-0), ammonium sulphate (21-0-0) and urea nitrogen (42-0-0). Spray concentrations for the leaves of most plants are about one-half to one ounce per gallon of water with weekly applications, or follow the manufacturer's recommendations.

Foliar feeding may be particularly beneficial and is recommended during winter and spring months when soils are cold and moist and of low fertility. During times of high temperatures, foliar feeding may burn the leaves of certain vegetables.

Pest Control

The Moapa and Virgin Valleys are not only used for livestock and crop production but are wildlife habitats for rabbits, quail, gophers, wild turkeys and many species of birds, all of which pose problems of protection for garden-grown produce. Additionally, there are weeds and an abundance of insects and diseases. Many of the most noxious weeds of the world can be found in these valleys. It has been observed that in general, insect pests and disease and especially weeds are much less prevalent during the late fall, winter and early spring than in the late spring, summer and early autumn. Weed growth is subject to both temperature and day length. Short days and low temperatures are not conducive to growth of most weed species in the Moapa and Virgin Valleys.

Strive for a weed-free environment. Use culinary water for irrigation and avoid use of large animal manure. Weeds are much easier to remove when they are small. Pull or cut them out as soon as you can see them—the earlier the better.

Weed control. The worst weeds of the valley do not grow during the short days and cool temperatures of the fall and winter, making gardening then more enjoyable and less work.

Many annual weeds will produce seed in 30 days or less after they germinate. That's why it is so important to control annual weeds as soon as you see them. Pulling or using a hoe is an excellent way to control annual weeds. A hoe that cuts the stems of annual weeds just below the soil's surface is very effective and does not disturb the roots of other plants growing in the area. The secret for controlling annual weeds is weekly hoeing in the areas where they are a problem. Most weeds will not survive more than a year if the green growth is eradicated as quickly as it emerges.

Mulches are very effective on annual weeds. Using mulches in planter beds, vegetable gardens, under fruit trees and in desert landscapes is a good idea. Mulches act much like a competing plant to help reduce the germination of annual weeds. They also can help to keep the soil cool and conserve water. Mulches can be wood chips in planter beds, compost in vegetable gardens, milled rock or gravel in desert landscapes, plastic (in some cases like vegetable gardens, but never under rock), shredded paper, untreated, seed-free grass clippings and the like.

The non-application of water can be a very effective weed control tool in the desert. Applying water only where it is needed, using drip irrigation and scheduling it properly, can be very effective at controlling weeds that might otherwise grow if spray or flood irrigation is used.

Weed seeds can lay dormant for many years waiting for the right conditions to sprout. Many of the weeds coming up in our yards and gardens are from seeds that fall off dried stems of plants that break loose from the soil and blow around. If you are thinking of starting a new garden area and can wait one season before planting, you can apply water, let the weeds come up and then mechanically remove or spray them with chemical weed killers. This will reduce the

number of weeds that come up after you plant your garden. Repeating the tilling and soaking cycle several times between crops will bring weed seed deep in the soil to the surface and eventually create a soil layer several inches deep nearly free of weed seed. This, and keeping each crop weed free, will greatly eliminate weeds in the garden.

Non-selective killers like glyphosate (Roundup®) will kill all plants they come in contact with including grasses. Perennial weeds like Bermuda grass and nutgrass usually represent a very small percentage of our weed problems, but once they get established they are the most difficult to control and even Roundup® may take several applications to kill them. Chemical weed killers should be applied when there is no wind and in cooler morning hours. When working with chemicals, always read and follow the label recommendations.

Insect and Disease Control. These valleys are relatively free of some major insects and diseases that are prevalent on vegetable and fruit crops grown elsewhere. There are few if any problems in growing onions, garlic, sweet potatoes, green or shell beans and peas. Aphids will occur in abundance on spring crops of broccoli, cabbage and peas.

Insects and diseases prevalent in other locations that have not been observed here include the Mexican bean beetle, asparagus beetle, Colorado potato beetle, asparagus rust and anthracnose and verticillium and fusarium wilt on tomatoes. Even the tomato horn worm, which also infests peppers, is absent if birds are present.

Integrated Pest Management is the utilization of cultural practices, management or destruction of pest-infected plant residues, adjusting to changes in climate and environmental conditions, use of resistant crop varieties and use of natural parasites and chemical treatments non-toxic to beneficial insects such as honey bees and ladybird beetles. Plants grown under optimal conditions are less susceptible to the ravages of insects and diseases. A possible exception is the squash bug (a glorified stink bug) which afflicts all cucurbits in the order of cucumbers, watermelons, muskmelons and cantaloupes. Summer and winter squash are the most susceptible. The other example is the European corn borer which may infest sweet corn at any stage of vegetative or reproductive development.

There are chemical treatments that are effective and safe. One is pyrethrin, formulated as Pyola®, derived from flowers of the pyrethrum plant grown in Kenya and other African nations. Pyrethrum is a relative of the marigold and will effectively control aphids of all kinds. There are also bacterial insecticides which will provide control of the European corn borer. Timing of treatment is critical and must be with the first appearance of the pest. There is no effective chemical control of the mature squash bug. Hand or vacuum removal coupled with appropriate cultural practices, especially related to management of soil moisture, offer some relief.

~ Planting Schedule ~

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Asparagus												
Beans, green - bush/pole												
Beets												
Broccoli seed												
Broccoli transplants												
Brussels Sprouts												
Cabbage transplants												
Cauliflower transplants												
Carrots												
Corn, Sweet												
Cucumber												
Eggplant												
Garlic												
Kale												
Kohlrabi												
Lettuce												
Melons												
Onion seed												
Onion sets												
Onion plants/transplants												
Peas												
Peppers*												
Potato, sweet												
Potato, white or red												
Radish												
Spinach/Chard												
Squash – summer												
Squash - winter												
Tomato*												
Turnip												

*Transplants

Note: These are suggested ideal planting dates. Refer to individual sections on specific vegetables for more detailed planting information.

HARVEST SCHEDULE

<u>Crop</u>	<u>Expected Harvest Period</u>
Asparagus	March 1 – May 15
Beans, Green	April 20 – July 10 October 1 – November 20
Beets	November 15 – June 30
Broccoli (From Transplants)	October 15 – April 30
Cabbage (From Transplants)	October 15 – May 15
Cantaloupe	July 1 – November 15
Carrots	November 20 – June 20
Cauliflower (From Transplants)	November 15 – May 15
Corn, Sweet	May 10 – July 1 October 1 – November 20
Lettuce (Butterhead, Leaf, Romaine)	October 15 – May 1
Onion (seeded)	May 1 – June 30
Onion (sets)	May 15 – June 15
Peas (Shell and Sugar Snap)	April 1 – May 31
Pepper-Eggplant	June 1 – November 20
Potatoes, Red or White	May 15 – July 1
Potato, Sweet	August 15 – September 25
Radishes	October 15 – May 15
Spinach	November 1 – May 1
Swiss Chard	November 1 – July 1
Squash (summer)	May 15 – July 15
Squash (winter)	September 15 – November 15
Tomato	May 1 – June 30
Watermelon	August 15 – November 1

Asparagus

Asparagus is rarely considered a hot, dry-weather crop. However, some unique growing conditions in what at first glance might seem like a relatively inhospitable location may change that way of thinking.

An Egyptian Climate. The climate here is comparable to that of Egypt, the likely home for the origin of asparagus. In this area there is a 10-month growing season, and rainfall averages around four inches per year. Precipitation is both unpredictable and localized. Average daytime temperatures during July and August usually peak above 100°F, with readings often 110°F to 120°F during early afternoon, and nighttime temperatures range from 65°F to 95°F.

The differences between day and night temperatures at ground level may be as much as 50°F. The soil is alkaline with a high salt content, which is not a disadvantage because asparagus is very salt tolerant.

Asparagus is commercially produced in the mild, cool climates of Northwestern Europe and in the U.S. in Michigan, Wisconsin, New Jersey, Washington, Oregon and California. It is also very productive in the hot and humid climates of Taiwan, in the Fujian and Guangdong provinces of China and the hot desert climate of the Nile Valley in Egypt.

Observations made in China, Taiwan, and Egypt and now in the Moapa Valley suggest that asparagus responds well to the long, 10-month growing season and the hot weather occurring from mid-June through mid-September. In fact, the first commercial crop grown some 80 years ago in the Moapa Valley was asparagus. Many local residents recall harvesting remnants of this early production growing wild along the irrigation ditch banks into the 1960s.

Winter Production. For the past 10 years, large asparagus spears have been harvested in one year from either one- or two-year-old roots planted in January or February. A very significant first harvest can begin a year after planting the roots and may extend from February to May.

The longevity of asparagus plantings in this area has now been determined. Productive plantings under good cultural practices and with good weed control have been noted to extend to 10 years. Currently, there are no large-scale commercial plantings of asparagus in the Moapa or Virgin Valleys, but the ingredients for high productivity in home gardens and for local sale are available. The quality of the asparagus that can be produced is unequalled.

Cultural Practices. Significant harvests can be achieved if well-developed, all-male, one- or two-year-old hybrid roots are used. *Jersey King* and *Jersey Knight* are good examples. These varieties can be purchased in January and February at some local nurseries, but generally not from mail order seed companies. Mail order companies will seldom supply roots before April 1 and this is too late for good production. The roots should be set in deep (10 to 14 inches) furrows or trenches at least a foot wide and deep. A high level of granular monoammonium phosphate fertilizer (11-52-0) or any other combination high in phosphate should be worked into the trench area below where the roots are to be placed. The suggested rate is 10 to 25 pounds per 100 feet of row. Cover the crowns initially with approximately two to four inches of soil. As the plants

grow, the trench or furrow should be filled in with additional soil. A sandy loam soil is ideal. After the first year, add water-soluble fertilizer (12-61-0) through the irrigation system about four to 10 times during the growing season, or approximately every two to four weeks.

Water, preferably by drip hose, should be supplied as needed, with occasional more thorough soakings throughout the growing season. Production should peak in two to three years.

Harvesting, Handling and Storage. An enormous fleshy root system is rapidly developed from the fern that grows as high as 6 feet by mid-November during the first year after planting the roots. Asparagus spears of sufficient size in diameter (3/8 to 1/2 inch) and length (10 to 12 inches) are produced the next spring. This is comparable to crops grown in the milder areas of California, New Jersey, Michigan, Western Europe and China, but where at least two to three years of fern growth are required before the first harvest. Fiber-free asparagus is achieved by “field snapping.” This is done by grasping the 10- to 12-inch spears with the thumb and index finger and giving a quick snap, breaking the spear near the ground level. The snap or break occurs where there is no fiber. You cannot tell where the fiber ends if you use a knife to harvest. Following harvest the asparagus spears should be held under moist, refrigerated conditions until consumed. Storage in a refrigerated crisper is ideal. All spears that come up can be harvested normally until about May 15. Stop picking if the spears become smaller or spindlier.

A Disease/Insect-Free Crop. Plantings of asparagus in the Moapa Valley have been observed in home gardens with no disease or insect problems. No asparagus beetles have been detected and there is no rust. Beetles may be quickly identified because they attack both the young shoots (spears) as well as fern growth. Likewise, rust may be quickly identified by the browning of the spears and stems. Rust is not likely to occur under the hot-dry conditions that prevail.

Hazards. A major constraint in this valley for asparagus production is weed control. The beds should be started only in weed-free soil in the absence of Bermuda or salt grass and other nuisance weeds such as Johnson grass and field bindweed (wild morning glory). A major advantage of the new, all-male hybrids is that no or few red berries are produced which produce asparagus seedlings. Asparagus seedlings have been the major weed problem in the traditional Mary Washington (heirloom) asparagus plantings. Since the roots are very deep it is difficult to remove them.

Solarization of the planting bed may be helpful for weed control. Moist tilled soil is covered for four to six weeks with 4.0-6.0 mil plastic in mid to late summer, followed by a green manure crop until roots are planted in late winter or early spring.

A further precaution for home garden production is that the luxuriant fern growth, when it turns yellow, must be removed and the soil surface cleaned up in late fall or early winter. Excessive moist plant residue on beds is a likely harbor for mealy bugs which can quickly devastate the entire planting. Keep the soil surface clean and dry during mid-winter.

If mealy bugs are a problem, use ultra fine horticultural oil for control, following clean-up and thereafter. Do not use dormant oils as they will damage the buds in the crown.

Green Beans

Plant green beans—the epitome of good eating—in both spring and fall. They are the elixir of kings and queens. The pods are straight, green and tender. They can be eaten either raw or cooked using your favorite recipe.

Planting and Harvesting. Green beans can be planted as early as the last week of February or the first week in March. They should be planted in north-south rows to minimize wind damage and maximize light exposure. Harvesting can be as early as the first week in May. Some early varieties will germinate in relatively cold soil. The base soil temperature for seed germination of most varieties is 50°F. Young emerging plants are resistant to frost and freezing temperatures as long as the young seedlings remain in the crook or curl stage. What is listed in seed catalogs as 50 days to maturity requires about 60 days from early spring planting. Later plantings will mature in 45 days or less. Continuous harvesting of spring-planted green beans can be extended from April 20 to July 10. Successive plantings of seed at 10-day or two-week intervals will make this possible.

Green beans can be equally as successful as a fall crop; seed can be sown beginning about July 20 and continuing with successive plantings to the first week in September. Harvests will be from about October 1 to November 20. The short days and cool temperatures result in quality equal to, or better than, spring plantings; yields, however, will be less.

Cultural Practices. Green beans can be grown from either bush or pole types. The most successful, earliest, productive and least labor-intensive are the bush types. Plastic drip irrigation lines with emitters a foot apart are suggested. A double row beside each drip line with 10-15 seeds per running foot will provide a good stand of plants. The seed should be planted about one inch deep. Soil should be kept moist until the seedlings emerge from the crook stage.

Beans can be grown in most any relatively weed-free soil in this area. Sandy loams are preferable. Beans, as do most other vegetable crops, respond to fertilizers high in phosphorus. Little else is needed since they tend to biologically fix their own nitrogen from nodules on their roots. A granular fertilizer high in phosphorus such as 11-52-0 should be worked into the soil before planting. Bean seed should not be placed in direct contact with fertilizer. About three to five pounds of fertilizer per 100 feet of row should be used annually. Supplemental feeding can be accomplished by injecting an all-soluble fertilizer high in phosphorus through the irrigation system as needed during the flowering and pod-setting period. Monoammonium phosphate (12-61-0) is recommended.

Watering is critical. When flowering and when the pods begin to set, the soil should be kept moist but avoid soaking or puddling. This may require watering daily or two to three times per week, depending on soil type and temperatures. This is also the time to add fertilizer through the irrigation system.

Pest Control. During the past 10 years of growing green beans in this valley, no serious insect or disease problems have been noted. However, an abundance of ladybird beetles has always been present. No Mexican bean beetles have been observed. Some flea beetles, leafhoppers, aphids,

thrips and white fly have been observed. If they do occur, they can easily be controlled by pyrethrin formulations (Pyola™) or bacterial insecticides that leave no harmful chemical residues. Neither will harm beneficial insects such as ladybird beetles or honeybees. Beans do not require insects for pollination or pod set. Some of the usual diseases that affect beans and plague many other green bean growing areas have not been observed. These include mildew or molds, mosaic virus, anthracnose, halo blight or common mosaic.

Other Considerations. Green beans should be harvested when the pods are fully developed and still green, with immature soft seeds. Pods harvested with distinct, swollen seeds along the pod are over mature for harvest and of poor quality. This is particularly true for the vining pole beans, more so than for the bush varieties that tend to mature more uniformly. Pods in the cluster mature in pairs from the stem end first. When harvesting, remove the pods that are ready very carefully so the pods that are younger and further out in the cluster will not be damaged and will continue to mature. They will be ready in another few days. Never just yank the pods from the cluster or you will reduce the total harvest. Harvesting should be in the early morning, before sunrise if possible, while temperatures are cool. Freshly harvested beans should be refrigerated until used. Two to three harvests, spread five days to a week apart, from a single planting are possible. Under good cultural practices, total yields can be the equivalent of one pound of beans per running foot of row.

Following harvest, till in any plant residues while still green, along with any weed growth, and keep the area clean until a fall garden is planted. This is equivalent to green manuring and should be done before weeds set seed, if possible.

The following varieties are suggested for either early spring or late summer and fall plantings: *Contender* (a favorite), *Florence*, *Top Crop* or many other similar selections and bush *Blue Lake*. *Venture* is a recently introduced variety that is early, productive and very high quality. Promotion of certain varieties in seed catalogs is not reliable; they, for sale purposes, promote all varieties listed. (*Contender* may perhaps have a preferred taste but *Venture* is earlier, will germinate better in cold soils, has a higher harvest index and a more concentrated harvest—you can pick them by the handfuls!)

Pole Beans. Pole beans can be a wonderful addition to a home garden if grown as a fall crop. Seed should be planted during late July and the first week in August. It's a crop that can follow tomatoes. Maturity will be over a six- to eight-week period beginning in early October and continuing through November, depending on the first freezing temperature. Pole beans require a longer time (10 days to two weeks) to harvest than bush types. Maturity can be expected to begin about 60 days after planting. There are varieties that are stringless and dark green in color. The only requirement is that the six- to eight-foot vines need support with a trellis, fence or poles. The same support system for tomatoes can be used for pole beans. Suggested varieties are *Blue Lake*, *Kentucky Blue* and the long-time heirloom *Kentucky Wonder*. There are also pole-type *Romanos* with their favorite "beany" flavor.

The yard-long bean, mung bean, vegetable soybean and Scarlet Runner may also grow well in the area. The Scarlet Runner could be grown as an ornamental vegetable.

Beets

Beets had their origin in Europe. They have been cultivated in some form since the third century, but it wasn't until the 19th century that they became accepted in the U.S.

Unlike most other vegetables, beets are two tasty treats in one. Freshly harvested beets have an earthy-sweet flavor that even the kids like. You get twice as much for your efforts because the tops ("greens") as well as the roots are nutritional delicacies. Some people "love the beet greens," others the beets from baby size to those of baseball dimensions. Some like both.

Nutritionally beets, especially the greens, are a good source of folate, which boosts immunity and prevents fatigue, and manganese, which improves calcium absorption. The bright red color of the roots consists of anthocyanins, believed to prevent cancer. In addition, beets are a good source of vitamin C, iron and phosphorus.

Climatic Requirements and Adaptability. Because beets had their origin in Northern Europe, they are generally considered a cool-season crop and adapted to a cool, moist climate. They are adapted to a very wide range of temperatures. They will tolerate frost and the freezes of these valleys. Beets can be planted with success at almost any time of the year in the Moapa and Virgin Valleys. The seed germinates readily and within a few days if the soil is kept moist. You can have continuous production every month of the year of this highly nutritious, high-quality vegetable from both the greens and the roots, with the possible exception of July and August when their quality deteriorates. Excellent and rapid root formation will occur from either spring or fall planting. Planting is recommended anytime from early August through April. However, beets planted in September and October and even into November and allowed to over-winter as small beets will by April and May tend to bolt, produce seed stalks and go to seed. Bolting, or flowering, in beets is a response to cold temperatures and the progressively longer days in springtime. Once they have bolted, their food value deteriorates and they become woody.

Culture. Beets prefer a well-drained, sandy loam soil with liberal amounts of organic matter. They are grown directly from seed planted in the soil. Do not attempt to transplant beets. Sow seed in rows 15 to 25 inches apart and ½ to an inch deep. A double row alongside a drip line is suggested. Planting beds two to three feet wide also work well for beets, lettuce, onions and carrots using four to six drip lines down each bed. A pre-planting fertilizer application of three to five pounds of granular 11-52-0 per 100 running feet of row is recommended, with additional all-soluble fertilizer applications with irrigations as needed. Water, preferably from drip lines, is critical for successful growth of beets. The soil should not be allowed to dry out. Rate of seeding is critical. A packet of seed may contain from 200-500 seeds; an ounce of seed, from 1,500 to 2,000. About 200 seeds should be planted in a 10-foot row. Sow them thinly or be prepared to thin them once they begin to grow.

Please note that a beet seed is in reality a cluster of two to four seeds. It is important to thin the seedlings to 1-2 inches apart after the first true leaves develop to prevent over crowding. When

small beets develop, thin again to 3-4 inches apart. You can use the thinnings for greens with the small baby beets attached. With salt and butter, the young plants are delicious.

Varieties. There are many varieties of garden beets. For this area I suggest an improved selection of the well-known *Detroit Dark Red* is suggested. The author prefers the *Detroit Supreme*. It produces, from late fall or early winter plantings, globe-shaped beets with roots up to one-half pound in size by mid-April. There should be no “zoning” (circular patterning) when the root is cut in half through its mid-section. *Such beets are in a prime condition for showing at the Clark County Fair in early April.* Zone-free roots are not woody and can be used raw or for dicing, canning or pickling. New super beet hybrids are also available such as *Red Ace, Warrior* and *Red Cloud*. There are varieties especially suited for greens, baby beets, dicing and storage. Variety is a matter of grower’s choice. Some may perform better than others at different times of the year. Don’t be afraid to try several different types to see what you like. This is one time that preference and quality are up to the consumer. Be sure to keep good records so that you can produce the “excellent” varieties again next year.

Harvesting, Handling and Storage. Beets can be harvested at almost any stage of growth, depending on the desire for greens or beet size—baby beets, salads, slicing, pickling or storage. In cool weather, beet roots that are topped can be left in the ground until needed. Otherwise, they can be kept in plastic bags in the refrigerator for several months. There is hardly a need for storage in these valleys since they can be produced fresh almost every month of the year.

Broccoli

Broccoli is a superb vegetable for production in the Moapa and Virgin Valleys. In these valleys it can be harvested with superior quality from October to May. It is nutritious, delicious raw or cooked, freezes well and is relatively easy to grow. Broccoli is a member of the cabbage family and indigenous to the southern countries of Europe—Italy and France—that border on the Mediterranean coast.

Broccoli is a nutritional powerhouse. It belongs in everyone's garden and grows in popularity each year. It is an excellent source for both beta carotene (a vitamin A precursor) and vitamin C. Both are important anti-oxidants and linked to reduced risk of heart disease, cancers and cataracts. Broccoli is also a source of phosphorus and iron. It has an excellent distribution of amino acids in a highly digestible protein. It is a rich source of fiber, half of which is insoluble and half soluble. Its fiber is helpful in preventing constipation, hemorrhoids, diverticular disease and colon cancer as well as diabetes and obesity. In addition to all of this, broccoli and kale contain sulforaphane, the most significant anti-cancer agent found in plants. It helps to nullify cancer-causing agents in the body.

Climatic Requirements and Culture. Broccoli is a cool-weather crop. It can be sown from seed from February 1 through March 15 and August 1 through October 30. It can be started from transplants from February 15 through March 31 and from August 15 through November 30. Such a schedule of planting or transplanting will provide a continuum of harvest of large, beautiful heads from mid-October through April 30. The best in quality and production is achieved if the heads mature in cool weather. Broccoli will withstand the freezing winter temperatures of Moapa and Virgin Valleys. Pest problems – insects and weeds – are minimized during the fall, winter and early spring. Much less water is required for irrigation and the quality of broccoli is superb. Single compact heads in excess of a pound each are typical. Production from a single planting in the fall or winter can extend for several weeks by first harvesting the large center head, followed by the tender side shoots.

An effective planting design for broccoli would be a spacing of one foot for plants in a row, with rows three feet apart. This would call for a plastic drip irrigation line with spacings of one foot between the emitters, with rows oriented north to south. A liberal application of a phosphate fertilizer (granular 11-52-0) consisting of three to five pounds per 100 running feet of row should be worked into the soil before planting. Broccoli, as with many other crops, grows best in a rich, loamy soil with organic matter added. A large vegetative plant before head formation is essential for producing large, dark green, solid heads of broccoli. Water and fertilizer requirements are greatly increased during head formation and should be applied accordingly. Broccoli is a long-day plant and will tend to produce flowers rather than edible heads under the long, hot days of late spring and early summer.

Broccoli plants in 6-packs should be purchased from a nursery beginning in late August and continuing with new plants at three-week intervals until November. Such plantings continue to

produce from tender side shoots through the winter. For spring plantings, begin with transplants in February and continue through March 31. Broccoli is a rather hardy plant and will respond to the hazards of transplanting better than many other vegetable plants. If broccoli is to be started from seed, it should be sown about six weeks before field transplanting is anticipated.

Varieties. All commercially available varieties are hybrids. There are many to choose from— *Green Comet*, *Green Goliath*, *Early Dividend*, *Packman*, *Southern Comet Hybrid* and *Premium Crop*. All have vigorous, tender side shoots and are adapted for fall, winter and early spring plantings in these valleys. The author's preference is *Premium Crop* with its large (1 pound or more), compact green heads, vigorous growth and tender side shoots. Seeds of these varieties are available from several seed companies.

Pest Control. Aphids and cabbageworms may infest early fall and late spring plantings. They can be kept free of worms and aphids by the use of derivatives from *Bacillus thurengensis* (for worms) and pyrethrum formulations (for aphids). Both are non-toxic to people and beneficial insects (honey bees and ladybird beetles). They leave no harmful or toxic residues.

Harvesting and Handling. Broccoli should be harvested when the heads are firm and dark green (the greener the better). Maximum size of heads may exceed one pound each. Keep broccoli cool and moist until consumed. **Do not wash** before storage in a refrigerator, and use it as soon as possible. Store in a crisper in a perforated plastic bag or a plastic bag that is not sealed tightly. When preparing broccoli for use, especially just out of the field (if out of the refrigerator let it stand a few minutes), douse it in a bowl of cool, salty water for a short while. This helps rid the head of aphids. Rinse it well afterwards. The intent, however, is to grow aphid-free broccoli, which can be done with a minimum of effort. Broccoli is now the most popular of all vegetables after potatoes and tomatoes and by far the most healthful. Experiences in producing broccoli in this valley have been very positive. Yields have been excellent and quality superb, with little if any problems with insects or disease.

Carrots

Carrots and beets are often grown as companion crops in a garden. Both have been cultivated for centuries in Europe. Carrots probably developed and originated in Central Asia and the Near East from the wildflower Queen Ann's Lace.

Carrots can adapt to a wide variety of soils and climates. They produce straight, uniform roots in light silt loam and sandy soils. Addition of coarse organic matter improves drainage, water-holding capacity and tilth of soil, which improves root growth. They grow best and are of highest quality during the cool weather that prevails in the Moapa and Virgin Valleys from October through April. Eating quality is superb from harvests extending from mid-November through May.

Nutritionally, carrots are extremely rich in vitamin A (Beta Carotene). Carrots are also rich in dietary fiber, antioxidants and minerals. Fresh, homegrown carrots taste better, are sweeter and have higher vitamin A and B content than their store-bought cousins. Eaten fresh from the garden – raw, cooked or juiced – they add color, flavor, variety and important nutrients to our diets. This is especially true of some new hybrid varieties developed during the past 30 years which are packed with 50 percent more vitamin A, have a deep rich orange root, are essentially coreless and have extra sweetness.

Culture. A stone-free, light, sandy soil is best for carrots. The pre-planting application of three to five pounds of granulated high phosphate fertilizer (11-52-0) per 100 feet of row is recommended. In areas with heavy soils, raised beds with minimal compaction work best. In heavy or stony soils, irregular, odd-shaped roots will form. Where soils are tight and clay-like, shorter varieties such as *Nantes*, *Chantenay*, *Danvers* or *Little Finger* are advisable.

Carrots are not easy to grow. The seeds are small and very fine and usually of low germination. Germination is slow and often occurs only after two to three weeks. A packet of seeds, 1/32 of an ounce, will plant about 20-30 feet of row. The soil should be kept moist until seedlings emerge. It may be helpful to dust over the seed with soil or cover with less than 3/16-inch of fine vermiculite (insulation grade) and then sprinkle immediately to tack it down. Plant every two to three weeks for a continuous supply. Thinning will then need to be done. For best germination, seed should be covered lightly but deep enough to prevent excess drying out. Some have suggested soaking the seed before planting. Pelleted seed will reduce the need for thinning the seedlings, but pelleted seed is even more difficult to germinate and more costly. There has been excellent success with pelleted seed and eliminated the need for thinning.

Quality in carrots is achieved as a delicate balance between crispness, sweetness and what could be called harshness or bitterness. Super quality in carrots in the Moapa and Virgin Valleys can best be achieved if maturity and harvesting occur from November through April. The very best quality will usually be with harvest from February to mid-April. During growth, roots should be kept covered with soil to prevent "greening" of the shoulders.

Varieties. There are four main types of carrots: (1) *Chantenay* has short and tapered roots which at maturity are about 6-1/2 inches long and 2-1/2 inches wide at the shoulder; (2) *Danvers*, or *Danvers Half Long*, which is two inches wide at the shoulder, tapering to a blunt end and seven to eight inches in length; (3) *Imperator* – 1-1/2 inches wide at the shoulder and tapering nine to 10 inches to a pointed tip; and (4) *Nantes* has a small top with cylindrical blunt-ended roots six to eight inches in length, is very crisp, almost coreless and has a delicate flavor.

There are now many improved hybrid carrot varieties typical of all the above types. They are sweeter and crisper, with higher nutritional values, especially in vitamin A. Included are *Hybrid Sweetness*, *Tendersweet* and *Nantindo* that are *Nantes* type. *Hybrid Pot of Gold* is an *Imperator* type with 50 percent more carotene. *Kuroda* is an improved *Danvers* type with some heat resistance. The author prefers pelleted seed of *Hybrid Sweetness*, *Nantindo* and *Pot of Gold*. All are supreme in quality, sweetness and color and have a high carotene content.

Harvesting and Handling. Carrots may be harvested at any acceptable size. Newly harvested baby carrots combined with fresh garden peas in late March and early April are a delightful treat. For best quality, size, taste and nutritional value, they should be allowed to fully mature in the soil. Those planted from November to February and harvested from February through mid-May are of the highest quality.

For storage, remove and discard the tops and keep carrots in a refrigerator crisper or in cold temperatures ranging between 35° and 50°. Effective cold storage life under moist conditions can be up to three or four months.

Sweet Corn

There is no vegetable that is harvested from your own garden that is more delectable or gourmet. The quality is something supermarkets have not duplicated. Sweet corn, until recently, was strictly an American vegetable. Even today it is still a rarity in China and Europe. Many of you may remember from your childhood days roasting ears picked from immature field corn rather than sweet corn. Some will recall Golden Cross Bantam, the first improved and widely grown sweet corn hybrid that was introduced in the late 1930s.

Planting and Growing. The pre-planting application of 10-12 pounds of granulated high phosphate fertilizer (11-52-0) per 100 feet of row is recommended. Sweet corn may be successfully grown as both a spring crop and in the fall. Plants for fall crops are shorter in height because corn is affected by daylight or photoperiod. Days in the fall during maturation are much shorter than in spring plantings. Plant the first seed as early as March 1, with harvest for early varieties by Memorial Day. Successive plantings may be continued to about May 1. Fall plantings should continue from July 15 to September 25. Varieties of different maturities may be planted at the same time for successive harvests over a two- to four-week period. The alternative is to plant the same variety at seven- to 10-day intervals.

Sweet corn thrives in full sunlight with light saturation exceeding 10,000 foot candles (that of noonday sun). Problems occur when temperatures exceed 105°F, accompanied by hot, dry winds. This occurs each summer in Moapa and Virgin Valleys. The result is a shriveling and “blasting” of the tassels. The tassel then produces no pollen. Corn is monoecious—the male (tassel) and female (silk) sexes are located on different parts of the same plant. Without pollen, ears will have no corn kernels or may be only partly filled out, ending in crop failure. This means that sweet corn plantings, both spring and fall, should be scheduled to avoid the extremely high late spring and midsummer temperatures during the pollen-shedding period. Accordingly, sweet corn as a fall crop should not be planted before mid July.

Sweet corn is wind pollinated. While honeybees may be found frequenting the pollen-bearing tassels, they are not effective in pollination. Because of wind pollination, isolation of sweet corn varieties is necessary if you want to keep them separate. One could also adjust planting dates to avoid pollination overlap.

For effective pollination of a given variety, sweet corn should never be planted as a single row. It should be planted in blocks of two or more rows side by side. Rows should be about three feet apart with single plants a foot apart in rows that are oriented north and south. This is equivalent to about 10,000 corn plants per acre, which is the optimum plant population.

It has been the author’s observation in the Moapa Valley and elsewhere that when people plant sweet corn in a home garden it is planted too thickly, in rows too close together and in soils too low in fertility. Corn should be planted with a population of about one-tenth that of green beans,

in full sunlight, in soils of high fertility and with extra water and fertilizer when tasselling and silking occur.

Time of maturity for sweet corn is not a function of time as given by seed catalogs. They designate each corn variety by days to maturity. For example, varieties may be designated as 60, 65, 72, 74, 78, 82 or 90 days from seeding to maturity. Time to maturity is a function of "heat units" or "heat sums." The summation of degrees of temperature above 50°F (the base temperature for growth) is the criterion. For time of maturity, the heat units for each variety of sweet corn are determined. Processing companies then schedule plantings to adjust to spreading out harvest periods. As an example, three varieties of sweet corn were seeded on March 8, 2003. The 74-day sweet corn was harvested May 31, or after 84 days. This is because the spring was relatively cool. By contrast, an 82-day corn variety planted July 17, 2002 matured by September 20, after only 64 days.

Varieties and Types of Sweet Corn. Varieties of sweet corn differ greatly in their ability to germinate in the cold soils of late winter and early spring, in their tolerance of heat and searing winds, in vigor of early growth, in sweetness, in earliness of maturity, in plant height and in lodging by the strength of anchor roots to resist wind damage. Super sweet and some late varieties are sensitive to the cold soils of late winter and early spring. They should be sown only when soil temperatures are above 55°F.

There are many varieties each of white, yellow or bicolor with days to maturity from planting varying from 60 to 90 days. Corn varies in sweetness beginning with normal sugar, the standard sweet corn grown for many years. Next there is the sugar enhanced, containing a gene that increases the original level of sugar in the kernels. There are then the supersweets or extra sweets having a gene that increases the sugar content to even higher levels. All three sweet classes are available in white, yellow or bicolor varieties. A major consideration for our area is finding varieties that will germinate in the cold soils of late winter or early spring. In these valleys, Harris® Seeds' bicolor selections of *Sweet Rhythm* (74 days), *Sweet Symphony* (76 days) and *Delectable* (80 days) are among the best. This is especially true of *Sweet Rhythm* which also produces a preponderance of double ears accompanied by vigorous early growth. *Sweet Rhythm* is also an abundant pollen producer and somewhat resistant to "blasting" and produces ears full of kernels. One of the earliest sweet corns is *Seneca Arrowhead* (62 days). The sweetest varieties of sweet corn are usually late in maturity (80+ days). Here, excellent selections are *Sweetie 82*, *Illini Extra Sweet* or *Candy Store*, an 81-day bicolor. The variety as to color, earliness and sweetness in sweet corn is the grower's choice. Yellow or bicolor sweet corn is more nutritious than white; the carotene content is higher. Select yours and enjoy it!

The European Corn Borer. Sweet corn grown in this area is generally free from most of the pests that frequent major corn-producing areas such as mosaic, smut, Southern corn leaf blight and Stewart's bacterial wilt. There is a major exception—the European corn borer. It is not an insect like the hornworm on tomatoes that can be controlled by hand picking or kept in check by birds or a natural parasite. The damage occurs before you see the insect. The larvae overwinter in the corn stubble and the moths are back in business laying eggs as the early sweet corn is emerging

in the spring. They attack at all stages of growth, first in the whorls of the leaf of the young plants. This is accompanied by brown and graying blotches on the leaves and shotgun-like holes in the whorl. A residue of worm "sawdust" accumulates around the borer holes. If not controlled early, the tassels are eaten off and/or disintegrate, eliminating pollination. As soon as silking of the ears occurs, the eggs are deposited. Hatching seems to occur within hours with worms that burrow into the tips of the ear, then into older parts of the ear, often devastating the entire ear of corn before full maturity. There is rarely a planting of sweet corn—spring or fall—in this valley that is not affected. Wormy corn is the sad consequence.

Control of European Corn Borer can be effectively maintained by vigorous spraying, at two- to three-day intervals, of bacterial insecticides coupled with summer oil* over the entire plant, beginning with early growth through harvest. Some effective pesticide formulations have been derived from *Bacillus thurengensis* such as Dipel® and especially from a bacterial product called Bulls Eye™. These materials leave no toxic residue harmful to people, and beneficial insects such as honeybees and ladybird beetles are not injured. These sprays can also be applied right up to harvest. Neem oil and ultra fine horticultural oil are also effective and recommended. Check product labels as some oils are not recommended for use in high temperatures. The inevitable difficulty is that the European Corn Borer will, with time, become resistant to all controls yet devised.

Sweet corn is not an easy crop to grow in the Moapa and Virgin Valleys. This is aside from the devastation of the European corn borer. It is often planted too thickly and in single rows, improperly irrigated and under-fertilized. Over watering results in yellow, stunted and poorly rooted plants. There are very small windows of time, both for spring and fall crops, when temperatures are optimal for growth, pollination and ear development.

Post Harvest Handling and Storage. Sweet corn is the most perishable of all vegetables. Its quality will deteriorate very rapidly after harvest, especially during high temperatures. For the best in sweet corn, harvest just before eating. Store sweet corn in the refrigerator.

*"Summer oil" sprays consist of plant-based oils such as cottonseed oil. These can be applied during the growing season or at any season without harm to sensitive foliage, beneficial insects, people or the environment. They do not kill by poisoning but by suffocating the insects and their eggs.

Melons – Muskmelons, Cantaloupes and Watermelons

It is hard to distinguish between muskmelons and cantaloupes. The names are used interchangeably. The name cantaloupe is of more recent origin, dating back to the middle of the 18th century. It is usually assigned to muskmelons with deeply grooved rinds such as *Rocky Ford* or *Hales Best*. Melon culture dates back to very ancient times in Asia (probably India), Africa and the Nile Valley in Egypt. They grew them during the times of the Pharaohs. Currently, the world's largest consumers of watermelons are the Chinese, with over five billion kilograms per year – equivalent to over 12 pounds per person! The Chinese love watermelons.

Watermelon flesh may be red, pink or yellow. Cantaloupes can range from green to white, yellow or orange. Melons are refreshing and a delight to eat, especially during the hot summer and early fall months in our Valleys. They are also very nutritious, being a source of vitamin C and the carotenoids and a high concentration of the lycopenes. These are coupled with many other healthful phytochemicals. Watermelon with red flesh is a significant source of the same cancer-protective lycopenes characterized by ripe tomatoes and both sweet and hot red peppers. Cantaloupe are a good source of potassium, vitamin A and folate.

Culture. Melons are admirably adapted to growing in the Moapa and Virgin Valleys. Historically they were grown extensively and commercially in the Moapa Valley some 50 to 60 years ago. Currently, many people are familiar with the “Bundy Melons” grown in the Bunkerville area. They are selections of the Casaba and Crenshaw melons. They are a warm-weather crop and need to have a minimum of at least 60°F within the top four inches of soil for good germination and growth. Watermelons are well adapted to high temperatures. Seeding or transplanting of melons should not occur before the middle of April. Melons can be seeded at any time between April 15 and up to the first of August for summer and late fall harvests.

Melons should be planted in hills or on ridges spaced five to six feet apart and running north and south, with plants or hills two to four feet apart in the row. North-south orientation is important since all vine crops are very sensitive to wind damage and require as much light as possible to produce fruit abundantly. The soil should be a well-drained, sandy loam common to the Moapa and Virgin Valleys. Both very sandy and heavy soils should be avoided. *To alleviate disease, pest and other residue-related problems, do not plant where melons were grown previously within the past three to four years.* Apply only moderate levels of a granulated 11-52-0 fertilizer ranging from one to three pounds per 100 feet of row. The soil should be thoroughly watered to a good depth before planting. Irrigate thereafter with drip lines having emitters one, two or three feet apart spaced eight to 12 inches away from each side of the plant row. Avoid watering near the plant stems. This will reduce later problems with squash bugs. During early growth and fruit setting, water thoroughly but as infrequently as possible, at two-week or more intervals. Drip lines should be spaced progressively further away from the plant stems. Discontinue watering after the melons reach a mature size typical for the variety being grown. A bee population is essential for good pollination and fruit set, as is also true for squash and cucumbers.

Varieties. Everyone has their favorite. There are many varieties to choose from. Among the muskmelons, the author prefers *Hales Best*, *Rocky Ford*, *Hearts of Gold* and *Ambrosia*. There are many others of both open pollinated and hybrid varieties. The *Crenshaw* is the most delicious and the standard for quality for all melons, but it tends to sunscald in these Valleys. There are many excellent varieties of watermelons. *Sugar Baby* is the favorite in China and performs adequately in this area. *Crimson Sweet* is an excellent, locally grown variety. Other well-known varieties are *Charleston Grey*, *Tom Watson*, *Navajo Sweet* and *Klondike*. There are also the seedless or triploid watermelons. For the average consumer the most readily acceptable watermelons have a dark red flesh and black seeds. Worldwide, the magnitude of watermelon consumption is directly related to temperature.

Pests. Squash bugs (a type of stink bug) are a menace in growing melons, squash or cucumbers in the Moapa and Virgin Valleys. All members of the cucurbit family are attacked, beginning with all types of squash, then muskmelons and finally watermelons and cucumbers. Irrigation techniques are important in their control. Keep water away from the plant stems as melons begin to form. There is no way, except mechanically, to control or kill the adult squash bugs. Many local methods have been devised, all of which are rather inadequate. One adult will produce hundreds of nymphs. The nymphs can be controlled by rigorous spraying or dusting with pyrethrum and possibly some other plant-derived or bacterial insecticides. The time of year, season, location, soil type, irrigation techniques and weather appear to have much to do with the prevalence of squash bugs. No native parasites that can be successfully cultivated have been identified that are effective. However, the assassin bug has been observed as a possible natural predator.

Harvesting and Storage. As muskmelons, cantaloupe and watermelons mature, they change in size, color, ribbing, netting (skin surface) and rate of growth. Maturity in many muskmelons and cantaloupes is evident when the stem slips (separates) from the melon completely. A ripe odor with a yellow undercover beneath the netting will be evident with many muskmelons. The blossom end will first begin to soften as the fruit ripens. These ripening characteristics may be evident for the well-known *Rocky Ford*, *Honey Rock*, *Hales Best*, *Ambrosia*, and *Hearts of Gold* varieties. Other varieties or types such as the *Crenshaw* (the gourmet of all melons), *Casaba*, *Honey Dew* and the Chinese *Hami* melon are harvested by size, color or season of the year. Watermelons are harvested by the appearance of a yellow “ground” color (where the melon has rested on the ground), size, thumping (when thumped, the sound is clear, ringing—not dull), drying of the spoon and curl (where the stem meets the melon) or prescribed days to maturity. Melons should be harvested only when ripe and should be consumed shortly thereafter or kept refrigerated. They can be held in a refrigerator for several days in the ripe condition.

Onions

There is no place on earth more climatically suited as to day length (photoperiod) for growth, bulb size, overall appearance, sweetness and productivity of onions than the Moapa and Virgin Valleys of Nevada. This is providing the appropriate planting dates, variety selection, cultural practices and post-harvest procedures are followed.

Winter production of onions planted as seed in November and sold as plants for transplanting in early spring was a thriving industry in Moapa Valley some 50-70 years ago. However, as with tomato plant production, marketing and distribution from such an isolated area, coupled with limitations in volume of production, restricted development. The opportunity is still here for home production and for limited commercial output.

It is hard to think of a day without onions. They are essential ingredients of many salads, soups, and stews, being packed with flavor and fiber. Onions and other members of the onion family – leeks, chives and garlic – contain sulphide compounds and other phytochemicals. They are reported to reduce high blood pressure and the risk of stroke and heart disease. They may have other microbial effects. They also contain quercetin that has anti-inflammatory properties. Clinical trials are being conducted on specific health claims made for the effectiveness of onions for specific conditions.

Climatic Adaptation and Plant Characteristics. There are almost innumerable types and varieties of onions. They can be grown from seed, sets or plants in every state in the U.S. and almost all countries. They respond in both growth and bulbing to temperature and length of day (photoperiod). Some varieties, such as the Walla Walla, bulb best when grown during the long summer days of Northern states. Others perform better when grown during the shorter summer days of the Southwest. Yet others are less influenced by day length. Hybrid onions, which were introduced about 70 years ago, are more uniform and productive than their open-pollinated counterparts. Both hybrid and the open-pollinated onions are grown extensively in the U. S. and elsewhere around the world.

Culture, Soil Type, Fertilizer, Irrigation. Onions should be grown in full sun and in fertile, well-drained, loose, sandy or sandy loam soils. A loose soil is essential for good bulb formation. Onions are also big feeders of water (uniformly and frequently applied) along with nitrogen and phosphorus fertilizer. I suggest the use of monoammonium phosphate granulated (11-52-0) with application of three to five pounds per 100 feet of row before planting. Fertilize close to the bulb as onions have a coarse, small root system. Apply supplemental fertilizer (seven- to 10-day intervals) during growth either by foliar feeding (spraying) or through the irrigation system to encourage early top growth. Top growth means larger bulbs will form. Discontinue fertilizing when top growth reaches maximum and bulbing begins. When the tops begin to turn yellow and tend to fall over, discontinue watering. Mature onions can lie in the sun or remain in the ground for several days and up to two to three weeks as long as the weather is arid through the nights. This is usually no problem for our area.

Onion Types and Varieties. Onions can be grown from sets, plants or seed. They come as white, red or yellow, with whites preferred for slicing, reds for salads and yellow for cooking and storage. Onion sets are cold-hardy and disease resistant and emerge in almost any type of growing environment. Onions from sets quickly produce mild, pungent-tasting green onions in two to three weeks. Onion sets may be planted as early as February 15 or with the first semblance of spring. Plant one pound of 3/4-inch sets per 50 feet of row in late winter or early spring.

Onion plants or transplants produce green onions in just three to four weeks if transplanted in early spring (March 1-15). Onion seeds for growing your own transplants should be sown October through November. When planting transplants, space them three to four inches apart in rows three feet apart. Large, mature bulbs will be produced by May 25 to June 10.

To produce onions from seed, plant seed from types that are adapted to Southwest conditions from October 1 to November 30. Thin the plants to three to four inches apart for bulbs that will weigh one to two pounds for each onion harvested May 1 to June 10. If the bulbs of onion plants become too large during the cold of winter, seed stalks will form in the spring. If they do appear, break them off or bend them over to prevent seed formation. Onions will have a hollow area where the stalk grew.

In addition to propagating onions by sets, plants or seeds, there are the perennial multiplier onions. They are heirloom type onions known as "Egyptian Tree" or "Walking" onions. Clusters of very small bulbets or sets are produced on the top of the leaf stalks. They can be harvested as sweet, pungent scallions in the spring or as small pickling onion topsets in summer, leaving the rootstock for a hardy perennial scallion bed.

The preferred varieties of onions for growing in this area are the yellow *Texas Granex Hybrid* grown and marketed as *Vidalias* in Georgia and the *White Granex Hybrid* which is the white version of the yellow *Vidalia*. Both the yellow and the white *Texas Granex* have attractive color, are short-day in photoperiod and are deliciously mild and sweet. They are both large in size, globe shaped and disease resistant with good storage quality. Onions weighing a pound each or more can easily be produced. The mild-tasting *Walla Walla* onion grown and preferred by some in Moapa Valley is a long-day variety, fails to bulb properly in the spring in this climate and has poor storage capacity, making it a very short keeper. The *Linda Vista*, a recently introduced white sweet hybrid onion, is superior to any onion variety observed. It is admirably adapted to these valleys as to temperature and day length. It is globe shaped with light brown skins. It is larger, sweeter and will keep longer in storage. Bulbs harvested will average one to 2½ pounds each and will keep in a cool ventilated room (temperature 60-75°F) until as late as February or March.

Pest Control. Onions grown in these valleys are remarkably free of any insect pest or disease. The usual problems in other onion-growing areas, such as the onion maggot and thrips, do not prevail here. There is no need or justification for the use of any pesticide on onions.

Harvesting, Post-Harvest Handling, Storage. When the tops of onions begin to die back, turn yellow and drop over, finish the job by rolling tops over or lightly stepping them down. This expedites the process and makes harvesting easier and more uniform. When the onions are dry, harvest by simply cutting or clipping off the yellowing or dead tops and roots. Place in well-ventilated mesh bags or well-ventilated boxes and store at room temperature or in any cool, dry environment.

For those who don't have shelf space, try hanging onions to store. You can leave the tops on, braid them together and then hang the bunches to store them. Another way to hang them is to cut the leg off an old pair of panty hose. Place an onion in the toe, tie a knot, place another onion in and tie another knot and continue to the top. Hang them in a cool, ventilated area and just cut under the bottom knot as you use the onions.

Peas

Peas are one of the oldest cultivated vegetables. They had their origin in the Mediterranean countries. Sweet and tender, fresh peas are more like a dessert than a vegetable. Their delicately sweet flavor and tender texture make them a favorite for eating fresh, canning and freezing. Peas are one crop in which I have great difficulty keeping guests and visitors on my walkways. They freely, and often without permission, help themselves to this appetizing gem in early spring. They seem irresistible in flavor and sweetness when eaten raw directly off the vine. Peas are not only good, but also good for you.

Culture. All recommendations found in official textbooks, bulletins or seed catalogs as to when to plant peas and under what climatic conditions do not apply to the Moapa or Virgin Valleys. The usual recommendation is that since peas are a hardy cool-weather crop, they should be planted in the spring as soon as the soil is dry enough and can be worked. Further, if a fall crop is desired, some sources suggest it should be planted in September or early October. Such planting dates for either spring or fall crops do not fit the climatic conditions of our Valleys.

Peas grown in the Moapa and Virgin Valleys are more successful if planted in the fall of the year. The recommended planting dates lie between November 1 and November 20. Earlier planting results in large vines and flowering during the late fall and winter, with no peas developing. In other words, the pods are hollow. Freezing temperatures, while not killing the vines, kill the ovules in the flowers and prevent development of the fruit (seeds) in their pods. The base temperature for the vegetative growth of peas is 40°F, and they respond in growth to the lengthening days of spring. If there is no, or very little, rainfall during the winter months, irrigation is necessary. As quickly as wintertime freezing temperatures cease, peas will begin to form in the pod, with the first harvest beginning in early April. Freshly harvested, locally grown garden or sugar snap peas are the ideal crop for display at the annual Clark County Fair held each year in Logandale the second week in April.

Peas planted in the fall will continue to grow and may flower through the winter months. In early spring, the flowers begin to produce the most delectable of all garden vegetables. Production can be equal to or higher than the spring-planted crops in the major pea-producing areas of the Pacific Northwest (the Puget Sound area) and the eastern and north-central states. The finest pea crop was in the Matanuska Valley near Palmer, Alaska. Peas respond to cool temperatures and long days. As with other crops (green beans, sweet corn), extra watering and supplementary fertilizer are suggested during flowering and during development of the pods and seed.

I suggest that peas be planted in double rows eight to 10 inches apart that run north and south, with drip line for irrigation in between the two rows, and four to five feet between each set of double rows. Even dwarf varieties of peas will develop large, spreading vines under good cultural conditions. One pound of seed should sow between 50 and 100 feet of a double row, depending on the variety. Seeds should be planted about one inch apart and an inch deep and

the soil kept moist until seedlings emerge. Do not presoak pea seeds for planting as they will not germinate. The pre-planting application of three to five pounds of granulated high phosphate fertilizer (11-52-0) per 100 feet of row is recommended.

It is important to order or purchase pea seed by early or mid-summer. Many seed companies do not have pea seeds for sale in late summer, fall and early winter, and seed for the new crop may not be available until spring—the usual pea-planting season of the year for other locales.

Types and Suggested Varieties. There are two major types of peas. These are the old-time garden or English pea—the peas are shelled to remove them from the pod which has a string and is generally tough and inedible—and the snap or sugar podded pea which produces tender, edible pods that are usually harvested when the peas are small or undeveloped. The snap pods and peas will stay tender and sweet when fully developed. Both types of peas can be eaten fresh and raw right off the vine or shelled or snapped and cooked briefly (about three to five minutes). There are many varieties and types of both, including bush (needing no netting or staking) and pole (which need support). There are also both early- and late-maturing varieties. The early bush type of both the garden (shelled) and the sugar snap peas are preferred. *Greater Progress*, *Laxton Progress* or *Progress No. 9* do well in this area, but *Knight* is a favorite early shell pea. The variety *Lincoln* also shows promise. These are dwarf, of about equal maturity, and perform well from November plantings. There are many sugar snap peas to choose from of both dwarf (bush) types and tall or pole types that will vary in maturity. *Cascadia* is by far a favorite. The important consideration is that early varieties, shelled or snap, should be selected to mature under the cool conditions of early spring (March and April) and before the onset of warm or even hot temperatures that can begin as early as late April or early May. Pea flowers often abort or do not set when temperatures are high, particularly nighttime temperatures.

Pest Control. During the years of growing November-planted peas, there have been no disease or insect problems in the Moapa Valley. It appears that aphids have been no problem because of the ever-present ladybird beetle. While white fly, leafhoppers, flea beetles and thrips have been observed, they have not been destructive. There are exceptions. Because of the unusual weather patterns in the spring of 2008 with cool temperatures followed by very hot days, a severe outbreak of pea aphids occurred. Good control was achieved by pyrethrum sprays and the invasion of hoards of ladybird beetles.

Harvesting, Handling and Storage. Peas should be harvested at the grower's discretion as to maturity. Some like them tender and sweet, others prefer pods well filled out. This applies to both the garden pea and the sugar snap types. Many prefer to pick and eat them on the spot, or they can be harvested, shelled and then cooked, canned or frozen. Freshly harvested peas are very perishable just like sweet corn. If not consumed directly, pick them early during the cool morning and refrigerate immediately until eaten or processed.

Peppers

Peppers, like tomatoes, are indigenous to Central and South America. They are among our greatest food treasures and display an amazing diversity of colors, sizes, shapes, flavors, spiciness, plant architecture and especially “hotness.” They are staples in world cuisines from Thailand, Japan, India and China to the Southwestern U.S. and the chili and jalapeno dishes of Mexico.

Sweet peppers of the familiar architectural bell-shaped, blocky California Wonder types are the most widely grown in the U.S., Canada and Northern Europe. They are crisp, sweet and juicy when served raw in salads and mellow and meaty when stuffed and roasted. Harvesting can occur when green or ripened into colors of yellow, orange or red. Sweet peppers are more flavorful, sweeter and more nutritious when fully mature. The color of peppers develops adequately only when they are ripened on the plant.

Hot peppers are popular in Mexican, Asian and Mediterranean cuisines. They also come in a variety of flavors, colors, sizes and shapes and range from very mild to scorching in heat level. Red hot peppers, like tomatoes and sweet peppers, are loaded with vitamin C and lycopene. Hot peppers contain a substance called capsaicin that makes them “hot.” It is found in all peppers but in different amounts. The degree of hotness relates to the amount of capsaicin contained in the fruit, particularly the seeds. Ripe red peppers contain the most capsaicin. Herbal health sources credit capsaicin with many health benefits.

Climate, Adaptation and Culture. Following 10 years of experience in trying to grow vegetables in Moapa Valley, sweet peppers are one of the greatest challenges. Yet the opportunity for success is there, coupled with a delicious crop in return. Peppers, especially the hot types, are really more adapted to the rigors of our climate (hot-dry) than either tomatoes or sweet corn. They respond best to frequent irrigation and high levels of soil fertility. During the hot summer days and nights, peppers, especially the hot ones, will tolerate limited watering and fertilizing. This valley has a climate comparable to the hot-dry regions of the Mediterranean, India, China and Mexico which are the most famous for pepper production.

Peppers are most productive in rich (highly fertile), loamy soils, high in organic matter that are kept moist. The pre-planting application of three to five pounds of granular high phosphate fertilizer (11-52-0) per 100 feet of row is recommended. Plant in rows oriented north and south with plants a foot apart and rows three feet apart. Peppers, both sweet and hot, may be set out as transplants in the garden shortly following tomatoes (or about March 15 to April 1) and continued through May or even later. Temperatures for ideal growth are slightly higher than for tomatoes and comparable to eggplant, which are of the same family. Unlike tomatoes, sweet peppers will set fruit continuously right through the spring and the heat of both days and nights of summer. Bees and other insects are not necessary to set the fruit. Hot peppers are even more tolerant of hot, dry weather than the sweet cultivars. Furthermore, the fruit from both peppers, if

left on the vine, will continue to ripen and develop good color and quality until frost or freezing temperatures occur.

A good foliage cover over the developing fruit is essential to prevent, or at least minimize, sun scalding of the fruit; a dry, grayish brown spot develops on the surface most exposed to the sun. Particularly the sweet, but also hot peppers, will sunscald. As with other summer-grown vegetable crops, both soil fertility and moisture should be maintained at optimal levels during the fruiting period. If the plants become unwieldy and tall and fall over or break off in late summer or early fall, they can be cut back and new growth will develop for a late fall crop. This is a bonus crop of fruit that is far better than can be achieved with tomatoes. Fall peppers that develop in the cool of autumn are often the best. Because of the widespread home processing of salsa and use of many peppers in other Spanish American and Mexican cuisines so popular in this area and our exceptionally good climate, the valley should be growing its own jalapenos and chilies.

Varieties. Varieties are innumerable. Sweet peppers come as both open pollinated and hybrids. Heart shaped pimientos come both as hot and sweet and of different sizes. The *Yolo* and *California Wonder* are common sweet varieties grown as transplants and provided by local nurseries. All can be grown in this area. The author prefers *Red Beauty* or *Crispy Bell* for early spring planting. They mature early. The plants are stocky and sturdy but upright and provide excellent foliage cover for the developing fruit. Jalapenos, or almost any variety of chili pepper that you prefer, will do well.

Small, sweet ornamental peppers may be grown as borders around the home. This parade of green, yellow, orange and red prevails from late spring until November frosts. They are sweet, mild and considered by some as edible.

Pest Control. As with tomatoes, there are very few insect pests or diseases on peppers in our valleys. The unsightly tomato hornworm will attack and devastate pepper vines and fruit. Control worms by hand picking. If hornworms are in high numbers, *Bacillus thuringiensis* (BT) may be used as a biological control. Peppers can also get virus diseases like Tobacco Mosaic Virus (TMV) and Potato Virus Y STIP. They are usually seedborne. You may tolerate the virus or you can plant resistant varieties. The tomato hornworm has been no problem the author's plants, presumably because of the high bird population.

Harvesting and Post Harvest Storage. Peppers are harvested as to the grower's preference for having them green or leaving on the vine till ripe. Ripe (red) sweet peppers, as with tomatoes, are more flavorful, sweeter, colorful and higher in vitamin C, lycopene and other health promoting phytochemicals than the green. Hot peppers become hotter and more flavorful as they ripen and develop their red, orange or yellow color, especially during long, hot days. Peppers are best stored in the refrigerator crisper. Always harvest peppers with a short, 1/4-1/2 inch stem (clipping works best) to prolong their storage life.

Potatoes – Red and White

The potato ranks fourth as the world's most important food crop behind rice, wheat and corn. It may be produced commercially and in home gardens in every state in the U.S. including Alaska. Potatoes are a staple food in China, India and especially in Germany, Poland, Russia and other Northern European countries. Potato blight in the middle of the 19th century resulted in a major famine in Ireland. Potatoes originated in the highlands of the Andes of Central and South America. The potato is a complimentary food in the U.S., prepared as chips, fries, baked, fried, boiled, mashed and dumplings. Potatoes are a good source of calories. For those who are overweight they could take the place of bread. An equal amount of baked or boiled potato has one-third the calories. Potatoes are also a source of fiber, potassium, B vitamins and iron (with the skin) and also have some vitamin C even when cooked. They are also grown for forage, extraction of starches and the production of alcohol.

Climate, Adaptation and Culture. Potatoes can be successfully grown in the Moapa and Virgin Valleys if planted in late winter or very early spring. Certified seed in the form of small tubers of about egg size may be planted whole. Cut larger tubers into pieces so that each piece contains two or more eyes (buds) and weighs between one and four ounces. Pieces should be cut with plenty of flesh around the eyes to provide their growing food source. Seed pieces can be planted immediately or dried for a day or two before planting. An even better procedure is to "green sprout" the seed pieces before planting. This is done by spreading the seed pieces into a flat or box one layer deep and keeping it at room temperature for two to three weeks. This will stimulate the growth of strong sprouts, that in the presence of subdued light remain short and stubby, green in color and are not easily broken off. Such green-sprouted seed pieces or small tubers will give a better stand, earlier maturity and heavier yields for a home garden. One pound of seed either as whole small tubers or cut pieces will plant eight to 10 feet of row at 12-inch spacings. Rows should be three feet apart and oriented north and south. Planting should be in late February or early March and at a depth of two to four inches. After the green leaves emerge and the stems are about six to eight inches high, gently "hill" about the shoots with a hoe or rake, bringing soil up on both sides of the plant. Cover all but the last inch or two of the shoots. Hilling cools the soil and provides space for tuber development. The potato tubers form between the seed or seed pieces and the surface of the soil. Later hillings should be done at two- to three-week intervals. Hilling is crucial for a good crop. If a killing frost occurs after the green leaves emerge, little harm is done because new sprouts or leaves will soon emerge. Leaves can be covered temporarily with soil if a frost is predicted. We do not recommend the use of potato sets consisting of only the eye or bud with a small amount of flesh around the eye. Many seed companies will not provide seed pieces until late April or May; this is too late.

A good soil for potatoes must be of high fertility, well drained and at the same time retain moisture. A sandy loam soil, as for any other root or tuber crop, is ideal. The pre-planting application of three to five pounds of granular high phosphate fertilizer (11-52-0) per 100 feet of row is recommended. Potatoes will rot in waterlogged soil. Raised beds may be necessary in

some locations. For soils that are shallow, rocky or compact, or if space is limited, potatoes can be grown in mulch.

Weeding is essential during the early part of the season, as it is with all vegetable crops. Check or kill the weeds while they are seedlings. Later, the potato plant canopy shades the soil and weed problems are slight. Irrigation is important. It can be by drip lines with emitters spread a foot apart. The soil should be kept evenly moist from the time of emergence until blossoming and for two to three weeks thereafter until the tubers mature. Over watering will result in knobby tubers, splits and hollow heart. Harvesting in dry soil is preferred as the potatoes are more easily cured (the tuber skin is thickened and hardened by drying) which is better for storage. Do not store rotted, damaged or diseased tubers.

Varieties. The *Red Pontiac* is well adapted to the area. It has a red skin with white flesh and is early to mid-season in maturity. It is very productive. I have produced a bushel per 10 feet of running row with “green-sprouted” seed planted in mid-February and harvested June 20. Other varieties that have been suggested for our Valleys are *Yukon Gold*, which is also early and has yellow flesh, and the *Red LaSota*, which is red skinned and provides almost half of the red market in the U.S. It has a round tuber, smooth skin and deep eyes. There are literally hundreds of potato varieties ranging in maturity from early to mid-season to late-season. There are those that are red and white with tubers of various shapes, white fleshed and yellow and there are fingerlings. There are also hundreds of wild types still found in the Andes of South America and Peru where potatoes had their origin. It is highly recommended that growers (gardeners) purchase certified seed potatoes rather than using cuttings from those purchased in a market. Those sold in the market for food may have been treated with a sprout retardant. Consequently, they are very slow to sprout after they are planted. Certification of seed potatoes means they are certified against several serious viral diseases.

Pest Control. No serious pests on potatoes have been observed in the Moapa or Virgin Valleys. The Colorado potato beetle seems to be nonexistent. Leafhoppers and flea beetles abound but seem to do little damage. Major leaf and tuber diseases (late blight, early blight, scab) and virus diseases have not been observed. Rotate potato plantings to new locations each season to avoid contaminating the soil with soil-borne diseases.

Harvesting/Storage. Potatoes should be harvested before July to avoid the hot summer temperatures that exceed 100°F. Ideal storage should be at about 40°F. If potatoes are stored above 40°F, they tend to sprout. If below 40°F, the starch will turn to sugar and they will turn unpleasantly sweet.

Potatoes - Sweet

There is no crop that is easier to grow, requires less in soil, fertilizer and water and is less afflicted by any insect or disease than sweet potatoes. They are admirably adapted for growing in the Moapa and Virgin Valleys. Their origin is uncertain as to American or Asiatic. They are widely grown in China for prevention of famine. Nevertheless, there is no place on earth too hot or too humid to grow sweet potatoes. Their successful culture in the U.S. is limited to the southern and mid-Atlantic states and the Southwest.

They thrive in light sandy or loamy soils. In fact, their quality and resistance to cracking seem to be improved under conditions of low soil fertility and moisture. One should not attempt to grow sweet potatoes in heavy clay or wet, poorly drained soils. Sweet potatoes are a high-yielding hot-weather crop. Their culture should not be attempted until day and night temperatures exceed 70°F. This is usually by mid-May.

Sweet potatoes belong to the morning glory family and are a close relative of wild morning glory. However, it is very seldom that you will see the morning glory-like flowers on sweet potatoes. It is one crop that can successfully compete with the major nuisance weeds of our valleys, including wild morning glory (field bindweed).

(Please note: Sweet potatoes with deep orange flesh and of large size are often called yams. The true yam, however, is grown only in the tropics and is light yellow, almost white, in color and of much lower nutritive value.) There are literally hundreds of selections of sweet potatoes grown in China, Taiwan, Indochina and throughout the tropics of Asia, Africa, and South and Central America. They thrive under a great variety of soil, moisture and climatic conditions. You seldom see them in Europe. Nevertheless, on a global scale the sweet potato is one of the 20 crops that stand between people and starvation. Nutritionally, it is a good substitute for the common potato with which it shares some properties.

Harvest of the edible roots can begin within 60 days. Sweet potatoes are grown successfully in China, the world's top producer. There they are a great preventative of famine. Freshly baked sweet potatoes are sold as a delicacy on the streets of the major cities in China. Roots can be harvested while the plants are still growing. When the rice crop fails, the Chinese turn to sweet potatoes. Historically, they served a similar function in these Valleys. Sweet potatoes are a great source of edible energy. With the new varieties now available, they are also an excellent source of the vision-enhancing vitamin A. A single serving will provide more than three fourths of the recommended daily amount.

Culture. Botanically, the sweet potato is an underground root covered with adventitious buds that under warm, moist conditions will produce an abundance of shoots or slips that root at every node. This can be observed if a sweet potato is placed in a glass of water and kept at room temperature for a few weeks. Sweet potatoes, like other roots, have basal (end attached to the plant) and apical ends. The apical end produces the most buds. It's the buds that form the slips

or shoots. After roots are formed on the slips, they are suitable for transplanting. These slips, or shoots, are available from local nurseries or seed houses packed and sold in bundles. One may propagate one's own slips by placing sweet potatoes in a moist bed of compost or peat moss and keeping the temperature at 70°F or above for a few weeks. Transplanting of the slips should begin about May 15 in rows four to six feet apart with plants spaced in the row two to three feet apart. Plant in ridges oriented north and south. Drip lines for irrigation alongside each row are suggested, or field water run in furrows between the rows. Loose sandy loam soils that are low in fertility are tolerated and even recommended. The pre-planting application of only one to three pounds of granulated high phosphate fertilizer (11-52-0) per 100 feet of row is recommended. Excess soil fertility or water will result in wild vegetative growth with few, if any, potatoes. Over watering should be avoided. Harvest can begin by early August and continue through September.

Varieties. *Centennial* is America's leading sweet potato. It is moderately early, has an orange-colored flesh and copper-colored skin and excellent cooking qualities. It's what you often see for sale in supermarkets. Similar varieties are *Georgia Jet* and *Beauregard*. All these produce vigorous vegetative growth and strong runners requiring much space. *Verdaman* and *Puerto Rico* by contrast are bush types with weak runners. They also have a deep orange flesh.

Harvest and Handling. Sweet potatoes may be harvested at any stage when the roots are large enough for eating. Like bananas, they should not be stored in the refrigerator but kept dry and at room temperature for at least 10 days or two weeks after harvest before eating. This is essential for the starch to turn to sugar. Storage may be two to three months or longer under cool, dry conditions. The eating quality of sweet potatoes grown in the Moapa or Virgin Valleys may be equal to those produced any place on earth.

Spinach

Spinach is the ideal crop for winter production in the Moapa and Virgin Valleys. It should be a part of everyone's winter garden. The tender leaves can be harvested crisp, delicious and nutritious every day from October to May using successive two- to four-week plantings. It is a green leafy vegetable of such quality that you will not tire in eating it raw or cooked, and it is excellent as a major component in green salads. Spinach is known as a rich source of iron, calcium, magnesium, vitamins A, C, E, and K and several vital antioxidants. There is no need to spray with any pesticides since it has always been observed as free of any damage from insects or disease in a winter garden.

The capital of the world for spinach production is Crystal City, Texas, with its statue of Popeye the Sailor Man. Some may remember this famous cartoon character of some 50-75 years ago, and the great muscular bursts of energy he derived following the consumption of a can of spinach. There was a message then, as there is now, that spinach is good for you.

Culture. Spinach is a cool-season crop that develops superior quality during cool temperatures and short days. Under the increasing length of days occurring in spring and early summer, it will bolt to seed. Spinach is a long-day plant for flowering, which you don't want, and a short-day plant for abundant vegetable growth. Most weeds will not grow in wintertime because the days are too short and temperatures too cold. Spinach on the other hand will grow very well under these conditions, making it an ideal crop for wintertime production.

Spinach, unlike most other vegetables, is dioecious, producing both male and female plants. This can be noted when the plants "bolt" or go to seed under long days and high temperatures. Spinach in this area can be planted in both the fall and spring and anytime in between. Fall plantings will overwinter and continue to produce through the winter and spring. I would suggest a continuum in fall, winter and spring production. Begin seeding about August 20 and continue with successive plantings until April 1. New hybrid varieties have been selected for slowness of bolting.

Spinach prefers a rich, well-drained soil. It responds to frequent irrigation, even in wintertime if there is little or no rainfall, and, as with other vegetables, a fertilizer high in phosphorous. A pre-planting fertilizer application of three to five pounds of granular 11-52-0 per 100 running feet of row is recommended, with additional all-soluble fertilizer applications with irrigations as may be needed. A drip irrigation system is recommended with emitters spaced one foot apart. Plant seed $\frac{1}{2}$ to $\frac{3}{4}$ inch deep and about two to three inches apart in two double rows on each side of the drip irrigation line in a north-south orientation. Leave $1\frac{1}{2}$ to two feet of space between each set of double rows. Seed should be kept moist until germination occurs, usually after seven to 14 days.

Varieties. There are two main types of spinach—those with savoy (crinkled or crumpled) leaves and those with smooth leaves. Both have excellent quality, are about equally productive and

have equivalent harvest times and nutritional value. Most traditional spinach has the savoy leaf, the typical example being *Longstanding Bloomsdale*. Other savoy-leafed varieties are *Melody* and *Avon* hybrids. *Melody Hybrid* is preferred, but the *Longstanding Bloomsdale* is a good standby and easy to harvest. Smooth-leafed hybrid varieties are gaining in popularity, especially in restaurants and salad bars. They include *Olympia Hybrid*, *Hybrid Tyee*, *Medania*, and *Space Hybrid*. The *Olympia Hybrid* is an excellent, smooth-leafed variety with leaves easy to wash.

Harvesting and Handling. Harvesting of spinach should begin with its largest plants. Merely cut off the entire plant at the ground level. The harvest may be in row sections or progressively selecting the larger plants in the row. The more upright the leaves are, the easier the harvest. For those who have a small garden or want to harvest early, you can harvest by cutting off the larger leaves of several plants, leaving the rest of the plant to continue growing.

Spinach should be harvested fresh as needed. Otherwise, after washing store in a crisper in a refrigerator for a few days. Do not keep at room temperature.

Tomatoes

Tomatoes are the world's most widely grown and popular vegetable. In reality, it is a fruit and a perennial. However, we grow the tomato as an annual vegetable. It is cultivated throughout Europe, the Mediterranean countries, the Middle East and the southern hemisphere, either in greenhouses, the countryside or in city gardens. It is a basis for specialty dishes in Italy and Spain. Tomatoes thrive throughout the Middle East and had their origin in the highlands of Peru in South America. Methods of cultivation may vary from those grown hydroponically in greenhouses over a 12-month period to those in open fields in the U.S. with mechanical one-time harvest, to raised beds in the desert Southwest, to extensive plantings in open fields in China, Russia, India, Spain, France and Italy. They may be staked, caged, trellised or allowed to spread or run on the ground. So-called "fresh" tomatoes are available in supermarkets, specialty, and health food stores and at farmer's markets. They are sold as hydroponic, stem, cherry, grape, Roma or "vine ripened" slicers. Processed, they come in the form of whole tomatoes, sauces, soups, juices, catsups or salsa. They can be dried, frozen, canned or eaten fresh. Specific health and disease preventive features have been ascribed to them. They are high in vitamin C and an excellent source of lycopene, specifically prescribed as being "preventive" of prostate cancer.

Plant Growing. You may either grow your own plants from seed, purchase "starts" from a local nursery, or if you need a large number of plants, you can contract with local nurseries to grow them for you. Successful plant growing is both an art and a science of its own. Special equipment and facilities are required. For early tomatoes, which are always a premium in this valley and elsewhere, seed should be started the last week of December or the first of January. Seedlings are then transplanted into either six-packs or three- or four-inch pots or containers. If you are growing your own plants (or can persuade the nursery you are contracting with), lower the night temperature to about 50°F for 7-10 days just after the first true leaves have formed; more abundant early flowering and fruit setting will result. This is known as the "cold treatment." A more robust seedling will also result.

Planting in the garden or field should be about March 1. (The average last frost date for Moapa Valley is about March 20, so be prepared to protect/cover tomato plants if frost is predicted.) Purchase transplants about 10 days or two weeks before transplanting outdoors. Take the pots out of the tray to spread out the plants that are usually compacted in the tray by the nursery and allow enough space between plants that they have room to spread out so their leaves don't touch plant to plant. Hold them in a protected, sunny area for 10 days to two weeks to "harden off" or "toughen up" before permanently setting in the open field. Keep on the dry side and water only with an all-soluble fertilizer (one ounce per gallon of water), high in phosphorus and with some nitrogen (12-61-0). This should be done daily or as often as needed.

A tomato plant before field transplanting should be as wide as it is tall. They should be transplanted just before or with the appearance of the first flower buds. If flowering is too far advanced, one or two small fruit will ripen early but the plants will be dwarfed and produce

little thereafter. Pick off any fruits when setting them out or transplanting. It is better to transplant just before flowers form. A preferred method for garden plantings is to set the transplants a foot apart in north-south rows on the east or northeast side of a house, barn or wall, using clothes line stretched between iron stakes spaced 10 feet apart for support [see photo]. Add additional line higher up the posts as the plants grow taller. The vines are trellised, with no pruning, in rows spread three feet apart. An alternative would be individual wire support for the plant to grow up through, called wire cages. Sold at garden centers everywhere, they keep the fruit off the ground and can be reused in subsequent years. When transplanting, the tomato plant should be set about an inch or two below the soil level for wind protection and watered with the all-soluble starter solution high in phosphorus, one ounce per gallon of water. The greatest climatic hazards for newly transplanted tomato plants are the wind and untimely frost or freezing temperatures. Use hot caps for an earlier start and protection from both wind and frost. Also, Walls of Water® are effective for the same reasons but are expensive and labor intensive. However, they can be used year after year.



Cultural Practices – Watering, Fertilization, Mulching, Weed Control, Cultivation. When tomato plants or any other fruit or vegetable plants begin to set fruit, the water and fertilizer requirements are greatly increased.

Irrigate by using a network of rows of ½-inch plastic drip lines with emitters a foot apart (one for each plant). Each emitter or dripper delivers about one gallon per hour. Two-gallon-per-hour emitters may plug less. Several are made that can be individually set at one, two or five gal./hr. They are a little more expensive but very accommodative. The extent and frequency of watering depends on the soil type, the temperature, wind velocity, season of the year and the stage of plant development. When fruit setting begins, increase the frequency and amount of water and fertilizer. Keep the soil moist but not waterlogged. Tomatoes respond to good drainage. Blossom-end rot and cracking, common problems in these Valleys, usually are a result of *inadequate or irregular watering* during the early stages of fruit development, immediately following fruit set.

It is suggested that 10-12 pounds of a granular fertilizer high in phosphorus (11-52-0) per 100 feet of row be tilled into the soil before planting or transplanting. During fruit setting and fruit development, periodically add the all-soluble fertilizer (12-61-0) through the irrigation system. When and how much is according to visual observation of the vigor of the plants. The art and science of tomato growing is to create a balance between fruiting and vegetative growth to maintain continuous growth and fruit setting during that narrow niche of time in April and May

when night temperatures range between 60 and 70°F. The so-called heat tolerant tomato varieties that are advertised to set fruit during high summer temperatures in this valley have not been proven productive.

Tomatoes thrive best in a rich, well-drained soil high in organic matter. The basic topsoil of the flood plain of this valley is a good soil to begin with. Various organic mulches or composts should be added. Various green manure crops can be used where plenty of water is available. The author uses liberal applications (1½ to 3 inches a year) of what is designated as Nutri-Mulch® or Premium Landscape Mulch, a turkey manure compost. It is commercially available in bulk at about \$1.50 per cubic foot in cubic yard quantities. This compares with about \$4.00 per cubic foot for mulches sold by the bag and available from local nurseries and garden stores.

Weed control is seldom a problem, and cultivation is of little value when using the drip irrigation system.

Varieties. There are literally hundreds of varieties to choose from. Select your favorites and grow them. Some like them large, some small; some want the Roma, cherry, pear or grape types. Some want them red, green, pink, orange or yellow. Some want them acid, others sweet. Some prefer bush (determinate), others pole type (indeterminate) and some want them halfway between.

The author grows those that are determinate or semi-determinate, red and large (two to three tomatoes per pound). Preference is for the varieties *Celebrity*, *Champion*, *Early Girl* and the so-called heat tolerant *Sunbeam*, *Sun Leaper* and *Sun Bright* greenhouse types. All are red, large sized, globe shaped (round), have small green cores with a minimum of cracking and are free from blossom end rot.

Fruit Setting and Ripening. Successful tomato production in our valley is confined to a very narrow window of time determined by night temperatures. The most effective night temperature ranges between 60 and 70°F. This will usually be from about mid-April to mid-May. This may also occur again in the fall from mid-September to mid-October. While fruit setting will occur in the fall, the fruit will seldom ripen before frost and before temperatures are too low for the fruit to ripen (color) properly. Bees have nothing to do with pollination or fruit setting. Tomatoes are wind pollinated. Please note the special report which follows on fruit setting of tomatoes.

The ideal average daily temperature for fruit ripening (red color development or lycopene synthesis) ranges between 60 and 75°F. This explains why tomatoes fail to develop good color and flavor when it is either too hot or too cold. It also means that the best storage temperature for green or partly ripe tomatoes is room temperature, and only fully ripe tomatoes should be put in cold storage or refrigerated. There are locational microclimates relative to day and night temperatures. Night temperatures are usually a few degrees lower in the Moapa and Virgin Valleys than in Las Vegas, and daytime temperatures usually higher.

The nighttime temperature effect on fruit setting is demonstrated when the nighttime temperatures exceed 70°F. The result is that there is very little fruit setting though flowers are abundant. This further means tomato harvest will terminate about mid July unless temperatures change dramatically. It takes about 45 days during hot weather for fruit to ripen after it sets.

Pest Control. Tomatoes in the valley are surprisingly free of insect and disease problems. During some years, they may be frequented by the tomato hornworm which will quickly devastate both fruit and foliage if allowed to multiply. While unsightly, they can be controlled by hand picking in the early morning when they can be seen or with the use of the non-toxic *Bacillus thuringiensis* (BT) formulations such as Dipel® or with other bacterial insecticides, one known as Bulls Eye™. White fly can, on occasion, become a problem because they thrive under hot-dry conditions. Aphids seldom gain a foothold because of the presence of ladybird beetles. The usual problems that occur in other tomato-producing areas such as anthracnose, early blight, late blight, *Fusarium* and *Verticillium* wilts and bacterial canker have not been observed in this Valley. The major disorders of tomatoes in this area are blossom end rot, sunscald and fruit cracking. All can be easily identified and can be corrected or the effects minimized by careful management of irrigation and fertilization schedules, row orientation, plant spacing and appropriate trellising or training to provide good foliage covering of the fruit.

Harvest and Storage. The quality of tomatoes sold in the U.S. in supermarkets as a “ripened” commodity is a sad commentary. They are either picked green and ripened artificially with ethylene or its derivative, or they are sprayed with ethylene or its derivative in the field before harvest. The so-called vine ripened tomato is a tomato picked green. The resultant quality, color, flavor and texture are poor. Even the so-called hothouse or hydroponic tomato is picked green or with the first blush of color and does not reach its quality potential. The fruits sold that are nearest to being vine ripe are the stem tomatoes, some cherry tomatoes and the grape tomato. With the so-called vine ripened tomato the red color is cosmetic only; the quality, flavor and health components and phytochemicals associated with tomatoes ripened on the vine are not there. Only tomatoes that are ripened on the vine and grown locally or in your own backyard garden until they are fully ripe will have the color, taste, texture and health components you are looking for. Locally grown tomatoes can be left on the vine until fully ripe and then harvested, marketed and consumed as desired. Fully ripe tomatoes can be refrigerated until used. Green tomatoes or tomatoes beginning to color should not be refrigerated.

To have early tomatoes is not so much selecting an early variety such as *Early Girl*, coupled with early planting and provision for frost protection, but it is to have tomato plants of the variety of your choosing at the proper stature, stage of development and vigor to take full advantage of the first night temperatures approaching 60°F in early spring that will enable the fruit to set. It is most important to use the science and art described herein as “A Special Report on Fruit Setting of Tomatoes.”

By following the above guidelines you should pick your first ripe tomatoes by the first week of May.

A Special Report on Fruit Setting of Tomatoes

There are literally hundreds of chemicals that stimulate fruit setting of tomatoes and to some extent peppers and strawberries. Many of them occur naturally in developing seeds, fruits and flowers such as the auxins and gibberellins. Others are analogous to those naturally occurring.

During the early 1940s and 1950s it was established by Dr. F. W. Went at the California Institute of Technology in Pasadena that fruit setting in tomatoes occurred only at *night* temperatures ranging between 59 and 68°F or from 15 to 20°C. Concurrently, through original research conducted at the University of Missouri in the early 1940s and at Michigan State University in the 1950s, naturally occurring extracts of plant growth regulating chemicals isolated from reproductive plant parts such as immature fruits and seeds were used. Immature corn kernels were an excellent source from which was isolated indole-3 acetic acid. Another was gibberellic acid. They had fruit-setting properties for tomatoes, peppers, strawberries and seedless table grapes such as the *Thompson Seedless* variety. From these naturally occurring plant growth hormones, others were synthesized and are now being used on a variety of crops. Good examples are the large seedless grapes of many varieties which are now being marketed and widely consumed in this country and abroad.

Some of these plant hormone and hormone-like materials can also be used to greatly improve fruit setting in tomatoes when night temperatures are too cold for normal fruit setting. This almost always occurs during March and early April in the Moapa and Virgin Valleys. Walls of Water® jackets or other types of plant protective covers do not solve the problem. The tomato plants may be protected from frost and freezing temperatures by these structures, but the flowers do not set fruit. The results are large, lengthy tomato plants but no fruit. Special application techniques and effective timing and use of the right hormonal combinations and concentrations will solve the problem of fruit setting when night temperatures are otherwise too cold for normal fruit setting. Some farm and garden supply houses and nurseries are marketing such products. One such product consists of a combination of indole acetic acid and gibberellic acid, two naturally occurring plant growth regulators. Another type of blossom set contains the active ingredient beta-naphthoxyacetic acid. Hormonal sprays are not effective for setting fruit if night temperatures are excessively high, as they are through July, August and mid-September. Only when they become 70°F or lower does this occur. This seldom happens in time for fruit to ripen in the fall before the first frost.

The effective control and management of fruit setting in the tomato, and foliar applications of nutrients to improve yields, quality and productivity in all vegetable crops, suggest that successful gardening is not only a science but an art and is worth striving for.

Conclusion

Those who have observed the garden beginning in late August of one year extending to July 1 of the next year have been amazed at the high productivity and quality obtained in small areas when the recommendations in this volume are followed. These valleys have a naturally occurring semi-tropical desert climate where temperature, day length, soils, sunlight, water resources and growing season make this possible. The potential productivity is comparable to the Nile Valley of Egypt during its most prosperous era. The challenge is to manage the natural resources of land, water, energy and climate. Climate is both a resource to be used wisely and a hazard to be dealt with. Crops can be largely pest and pesticide free through the fall, winter and spring months. This is true of asparagus, tomatoes, green beans, broccoli, cabbage, onions, sweet corn, carrots, beets and spinach. They can be freshly harvested on a daily basis with the bonus that they will be free from toxic contaminants shipped in from distant places such as those recently reported for spinach and hot peppers.

This book has brought together the best practices observed in every major vegetable-producing area on earth including all of the United States, the People's Republic of China, Taiwan, Japan, New Zealand, northern Europe, Israel, the Mediterranean countries, India, Canada, Mexico and Central and South America. Gardening is the world's most important hobby. The dividends are needed physical exercise in an outdoor environment and the potential of a greatly improved diet.

Summary of Recommendations for Vegetable Gardening in Moapa and Virgin Valleys

Crop	Recommended Varieties	Planting Times	Fertilizer Before Planting	Plant Spacing	Space Between Rows	Planting Depth	Fertilizer Afooter Planting	Days to Harvest Or Harvest Dates
Asparagus	Jersey King Jersey Knight	January or February	11-52-0 10 to 25 lbs. per 100 foot row	1 foot apart	4 to 5 foot	10 to 14 inches	12-61-0 in irrigation system every 2-4 weeks	Spring next year after planting thru 5/15
Green Beans	<u>Bush varieties</u> Contender, Florence, Top Crop, Blue Lake, Venture <u>Pole varieties</u> Blue Lake, Kentucky Blue, Kentucky Wonder	3/1 – 4/30 7/20 – 9/10	11-52-0 3 to 5 lbs. per 100 foot row	10 to 15 seeds per running foot	Double rows on each side of drip line 1 foot apart with 3 to 4 feet between double rows	1 inch	12-61-0 in irrigation system during flowering and pod setting	4/20 – 7/10 10/1 – 11/20
Beets	Detroit Dark Red, Detroit Supreme, Red Ace, Warrior, Red Cloud	8/1 – 3/31	11-52-0 3 to 5 lbs. per 100 foot row	200 seeds per 10 foot row	15 to 25 inches apart	½ to 1 inch	12-61-0 in irrigation system every 4 – 6 weeks after emergence	11/15 – 6/30
Broccoli	Green Comet, Green Goliath, Early Dividend, Packman, Southern Comet Hybrid, Premium Crop	Seeds planted in ground 2/1 – 3/15 & 8/1 – 10/31 Transplants 2/15 – 3/31 & 8/15 – 11/30	11-52-0 3 to 5 lbs. per 100 foot row 12-61-0 at 1 oz. per gallon when planting	1 foot apart	Rows 3 to 4 feet apart	Seeds ½ inch Plants, 1 inch deeper than container soil level	12-61-0 in irrigation system at 3 week intervals until harvest	10/15 – 4/30

Crop	Recommended Varieties	Planting Times	Fertilizer Before Planting	Plant Spacing	Space Between Rows	Planting Depth	Fertilizer Afooter Planting	Days to Harvest or Harvest Dates
Carrots	Short Varieties: Nantes, Chantenay, Danvers, Little Finger Hybrid Sweetness, Tendersweet, Nantindo, Pot of Gold, Karoda	8/15 – 3/15	11-52-0 3 to 5 lbs. per 100 foot row	1 packet 1/32 oz. per 20- 30 foot row. Thin to 1 inch apart	Double rows on each side of drip line 6 – 8 inches apart with 3 feet between double rows	3/16 inch	12-61-0 in irrigation system every 2 to 4 weeks	11/20 – 5/31
Sweet Corn	Sweet Rhythm, Sweet Symphony, Delectable, Seneca Arrowhead, Sweetie 82, Illini Extra Sweet, Candy Store	2/15 – 4/30 7/15 – 9/15	11-52-0 10 to 12 lbs. per 100 foot row	1 foot apart	Two or more rows 3 feet apart side by side in blocks	½ to 1 inch	12-61-0 in irrigation system during tasselling and silking	60 – 90 days from planting
Melons	<u>Cantaloupe:</u> Hales Best, Rocky Ford, Hearts of Gold, Ambrosia Crenshaw <u>Watermelon:</u> Sugar Baby, Crimson Sweet, Charleston Grey, Tom Watson, Navajo Sweet, Klondike	4/15 – 7/31	11-52-0 1 to 3 lbs. per 100 foot row	2 feet to 4 feet apart	5 feet to 6 feet	½ inch	none	<u>Cantaloupe</u> 7/1 – 11/15 <u>Watermelon</u> 8/15 – 11/1

Crop	Recommended Varieties	Planting Times	Fertilizer Before Planting	Plant Spacing	Space Between Rows	Planting Depth	Fertilizer Afooter Planting	Days to Harvest or Harvest Dates
Onion	Texas Granex Hybrid, White Granex Hybrid, Linda Vista,	<u>Seeds</u> 10/1 – 11/30 <u>Sets</u> 2/15 – 3/31	11-52-0 3 to 5 lbs. per 100 foot row	<u>Seeds:</u> Sew sparsely then thin to 3 to 4 inches apart. <u>Sets:</u> 1 lb ³ / ₄ inch sets per 50 foot row 3 to 4 inches apart	3 feet apart	<u>Seeds:</u> ¹ / ₄ - ¹ / ₂ inch <u>Sets:</u> 1 inch	12-61-0 in irrigation system till bulbing begins	<u>Seeds:</u> 5/1 – 6/30 <u>Sets:</u> 5/15 – 6/15
Peas	Cascadia, Greater Progress, Laxton Progress, Progress No. 9, Knight, Lincoln	11/1 – 11/20	11-52-0 3 to 5 lbs. per 100 foot row	1 inch apart	Double rows 8 to 10 inches apart with 4 to 5 feet between double rows	1 inch	12-61-0 in irrigation system during flowering and pod formation	4/1 – 5/31
Peppers	Red Beauty, Crispy Bell, Yolo or California Wonder	3/15 – 5/31	11-52-0 3 to 5 lbs. per 100 foot row	1 foot	3 feet apart	1 inch deeper than container soil level	12-61-0 in irrigation system during fruit setting and development	6/1 – 11/20
Potatoes	Red Pontiac, Yukon Gold, Red LaSota	2/15 – 3/15	11-52-0 3 to 5 lbs. per 100 foot row	1 foot apart. 1 lb cut pieces to 8 - 10 foot row	3 feet	2 to 4 inches	12-61-0 in irrigation system every week to 10 days when tubers begin to form	5/15 – 7/1

Crop	Recommended Varieties	Planting Times	Fertilizer Before Planting	Plant Spacing	Space Between Rows	Planting Depth	Fertilizer Afooter Planting	Days to Harvest or Harvest Dates
Sweet Potatoes	Centennial, Georgia Jet Beauregard, Verdaman, Puerto Rico	5/1 – 5/30	11-52-0 1 to 3 lbs. per 100 foot row	2 to 3 feet apart	4 to 6 feet	1 inch deeper than where roots stop on stem	none	8/15 – 9/25
Spinach	Long Standing Bloomsdale, Melody, Avon, Olympia Hybrid, Hybrid Tyee, Medania, Space Hybrid	8/20 – 3/31	11-52-0 3 to 5 lbs. per 100 foot row	2 to 3 inches apart	Double rows on each side of drip line 8 –10 inches apart with 3 feet between double rows	½ to ¾ inch	12-61-0 in irrigation system every 2 – 4 weeks	11/1 – 5/1
Tomatoes	Celebrity, Champion, Super Fantastic, Early Girl, Sun Leaper	3/1 – 4/15	11-52-0 10 – 12 lbs. per 100 foot row 12-61-0, 1 oz. per gallon when planting	1 foot apart	3 feet	2 inches deeper than container soil level or past first set of leaves	12-61-0 in irrigation system during fruit setting and development	5/1 – 6/30

Gardening Notes

**University of Nevada Cooperative Extension
1897 N. Moapa Valley Blvd., P. O. Box 126
Logandale, NV 89021-0126
(702) 397-2604 or 346-7215**

Copyright © 2009, University of Nevada Cooperative Extension

Mention of company or product names throughout this document does not signify endorsement and no discrimination is intended.

The University of Nevada Cooperative Extension is an outreach arm of the University that extends unbiased, research-based knowledge from the University of Nevada—and other land-grant universities—to local communities. Educational programs are developed based on local needs, often in partnership with other agencies and volunteers. Mention of company or product names throughout this document does not signify endorsement and no discrimination is intended. For more information about the University of Nevada Cooperative Extension, please visit the website at www.unce.unr.edu.

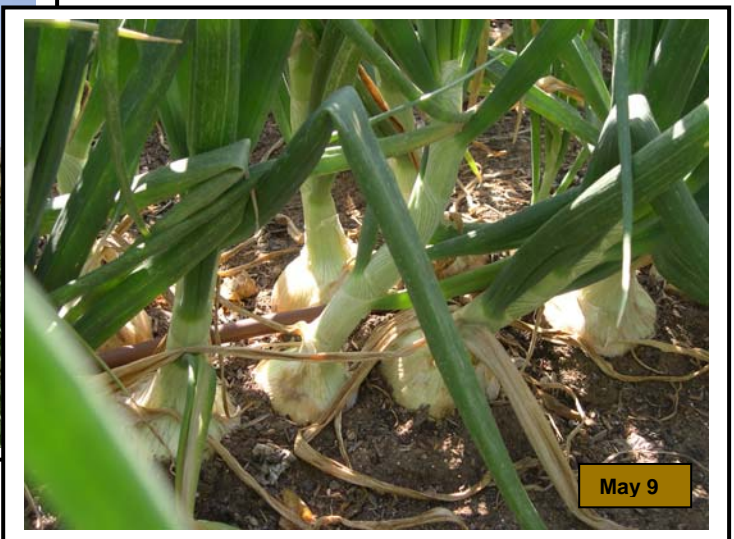
The University of Nevada, Reno is an equal opportunity/affirmative action employer and does not discriminate on the basis of race, color, religion, sex, age, creed, national origin, veteran status, physical or mental disability and sexual orientation in any program or activity it operates. The University of Nevada employs only United States citizens and aliens lawfully authorized to work in the United States.



Chard – June 19



Fruit trees to the northwest will shade the garden in late afternoon





March 31
East side of house -
tomatoes against
house get afternoon
shade.



Dec. 5



May 9



April 8



Vegetables and fruit trees as landscaping