Orchard Establishment

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Selecting A Site For Your Saskatoon Orchard

It is imperative to select a good site from the start. The use of a marginal site may lead to an orchard or plantation that is not economically viable because of increased costs associated with poor plant survival and replanting, decreased plant vigour and yields, greater susceptibility to weather, insect, disease, and nutritional problems, increased inputs, and loss of time and money. It is much easier to change location than to attempt to solve the limitations of a poor site. Remember that fruit plants are perennial and that initial mistakes can have long term consequences. Figures 4.1 to 4.6 illustrate some typical saskatoon orchards in Saskatchewan, and some typical problems.

The Prairie Climate

High quality fruit crops can be grown on the prairies provided that good management practices are followed.

The primary climatic limitations include a lack of rainfall, temperature extremes, strong winds, a short frost-free growing season (approximately from May 24 through September 7; this is about 100 days, depending on location), and sunshine in the winter, which can result in sunscald. Winter injury may be associated with extreme low temperatures, freeze-thaw cycles, dehydration, and improper hardening-off in the fall, depending on fall weather conditions. Cold temperatures, rain, and wind may reduce pollinator activity in the spring.

Despite these limitations, economically viable, commercial production of some fruit crops is possible. The Prairies have climatic advantages which include large amounts of sunshine necessary for the coloring and ripening of fruit, lower humidity levels which reduce the incidence of fungal infestation, and generally fewer insect pests.

Growers should make note of minimum and maximum temperatures, rainfall distribution and amount, and the prevailing direction and extent of wind for their chosen orchard location.

Topography

If possible, orchard sites should have a slight slope (1 to 3%) so as to provide for the drainage of water and cold air. Low-lying areas which form frost pockets and are prone to flooding and standing water must

Plate 4. Saskatoon Orchards

Figure 4.1: A typical two-year-old saskatoon orchard.

Figure 4.2: Typical saskatoon orchard with caragana shelterbelt.

Figure 4.3: Intercropping saskatoons with strawberries.

Figure 4.4: Giant sunflowers used as a windbreak.

Figure 4.5: Saskatoon orchard with standing water (Photo by H. Tulloch).

Figure 4.6: Saskatoon orchard on saline soil (Photo by H. Tulloch).

be avoided. There should be a break in any shelterbelt at the low end of the orchard to allow for proper air flow.

North, northeast, and east-facing slopes suffer fewer freeze-thaw cycles in the spring, stay cooler, and are moister; this helps delay the onset of growth, delays flowering, and results in less sunscald. South and southwest-facing slopes warm up earlier in the season, promoting earlier flowering, thus making the potential fruit crop vulnerable to late-spring frosts. Such slopes are also more vulnerable to sunscald in the winter.

Drainage

Most fruit crops require well-drained soils. If water stands around roots after rains, or if the water table is near the soil surface, problems with root rot will result. Drainage ditches may be required.

Soil

The saskatoon will grow in all types of soil, provided that the soil is well-drained. Clay soils may hold excessive water and lack drainage. Sandy soils don’t hold adequate amounts of water and require additional fertility. The best soil is a fertile, deep (at least 1 m above the water table), sandy loam or loam with 2 to 3% organic matter. Sandy loam and loam soils provide the best balance of drainage and retention of moisture. Heavy clay soils lacking in humus should be avoided, as should shallow soils and sites where the water table is high or erratic.

The saskatoon appears to be tolerant of a wide range of soil pH (5.0 to 8.0), although some observations suggest that low pH's may retard plant development. A pH range of 6 to 7 is best for maximizing the availability of plant nutrients.

Representative soil samples should be taken and analyzed for mineral nutrient content, pH, and organic matter. Past recommendations for fruit orchards on prairie soils generally indicated that minimum soil nutrient levels at 0 to15 cm depth be maintained at 28 to 56 kg N, 56 to 112 kg P, and 336 to 672 kg K per hectare. At a depth of 15 to 30 cm, minimum levels should be 39 to 84 kg N, 90 to 180 kg P, and 560 to 1120 kg K per hectare. Fertile loam soils may not require additional fertilizer. Ideally, soil salinity levels should be less than 1 mS/cm.

Note that many marginal soils can be improved considerably given some time and appropriate management techniques.

Availability Of Water

A source of water is required for irrigation, mixing pesticides, and washing of fruit prior to marketing.

For irrigation purposes, surface water is generally of better quality than well water, which can have a high salt content (the measure of salinity, or EC, should be less than 1 mS/cm). Ideally, the water supply should be situated relatively near the orchard, preferably at the same elevation or higher. Moving water upslope is more difficult and costly. The supply should be

sufficient to meet annual irrigation requirements.

Shelter

Protection from strong, drying winds is essential. Shelterbelts should be established to provide protection from the prevailing north and northwest winds in winter, and south and southwest winds in summer. Shelterbelts also help to trap snow and increase soil moisture reserves.

Cropping History

Previous practices may have left problems that could negatively affect fruit production. Such problems include residual levels of herbicide, compacted soil, high levels of salinity, disease and insect pest reservoirs, and weeds.

If it is suspected that herbicide residues are present in the soil, growing cucumbers during the period of site preparation will provide a fairly sensitive indication of the presence of herbicides.

Storage Facilities, Transport, Nearness To Markets

Fruits are highly perishable and will often spoil within a day or two of picking. Harvested fruit either must be sent to market as soon as possible, especially if refrigeration is uneconomical, or frozen or otherwise processed as quickly as possible. Spoilage can very quickly decrease a grower's profits.

Method Of Marketing

Growers must have a marketing plan in place prior to orchard establishment. The method of marketing dictates the method of harvest, orchard location, plant spacing and overall orchard design. Fruit destined to be processed or for the fresh frozen markets may be machine harvested. Fruit destined to be sold at the farmgate, or orchards designated to be U-pick or Pre-picked are more restricted in terms of possible locations (should be close to urban centres), must be accessible via a good all weather road, and should be simple to find.

Initial Preparation Of The Orchard Site

Prior to ordering and planting trees, an orchard plan should be drawn on paper to show tree locations, irrigation system, roads or paths, and a packing or storage shed. Proper layout allows for uniform plant growth, facilitates orchard operations (cultivation, intercropping, irrigation, spraying, harvesting, and so on), and avoids wastage of space.

It is strongly suggested that at least a full year be used for site preparation.

The site should be levelled and soil and water analyses done. Fine-textured soils such as silts and clays should be deep plowed, disced, and then subsequently rotovated; rotovation by itself only works the top 15-20 cm of soil, and may leave a hard layer beneath which can restrict water drainage and root growth. Where a hard layer restricts drainage, a deep chisel or

subsoiler may be required. On coarse or shallow soils, surface tillage may be acceptable. Ploughing in the fall allows frost to penetrate deeper into the soil, helping to break up large clods of soil. The following spring, the soil will be much easier to work.

Any amendments required should be made during this time and are best made during the fall. Heavy, clay soils with a pH greater than 7 may be amended with the addition of sulfur and peat in order to decrease the pH, otherwise iron chlorosis could be a chronic problem; acid fertilizers (21-0-0, or 16-20-0) may also be of benefit. Soil amendments using superior or hypnum peat may substantially improve growth (for any unit area of row length, add approximately 1/3 by volume peat). Well-composted manure may also be worked into the rows.

Prior to transplanting, the use of a non-residual herbicide such as glyphosate, will eliminate perennial weed infestations. Two years may be necessary for adequate control of perennial weeds. A green manure crop could be grown for 2 years prior to orchard establishment. It is important to eliminate all perennial weeds because young saskatoon plants do not compete well. Treflan may be used as a pre-plant treatment from 3 weeks to immediately prior to transplanting.

The entire orchard site could be sown with a grass cover such as sheep's fescue. Prior to transplanting, an application of Banvel and 2,4-D at recommended rates will destroy most broadleafed weeds. Subsequently, the fescue can be killed in 60 cm wide strips on 6 m centres using glyphosate plus a surfactant. The entire orchard site would then be mowed, and mulch lain on the 60 cm wide strips of killed fescue, prior to transplanting.

Design & Establishment Of Orchard Shelterbelts

Wind Damage

Protection from the prevailing winds is important. Strong or persistent winds can cause substantial water loss from soil evaporation, increased leaf transpiration, reduced photosynthetic activity, and desiccation of the plant, especially during the winter. Cold winds decrease the heat available for plant growth. Wind can cause physical or mechanical damage through abrasion and tearing, which may result in the breakage of branches, tearing of leaves, loss of shoots, buds, flowers and fruit, and damage to the fruit surface. Such damage acts as a natural form of pruning and results in reduced bush size and an atypical form. Additionally, leafing out and flowering can be negatively affected on the windward side of bushes; both can be delayed and the amount of bloom can be reduced. Wind can interfere with insect movement, therefore causing a lack of pollination. Exposure to wind may also reduce fruit size, and can cause the fruit to adhere more tightly to the pedicel (fruit stalk), therefore making the fruit more difficult to harvest. Wind can also cause soil erosion, unpleasant working conditions, and make chemical application inefficient and hazardous because of spray drift.

A shelterbelt, or windbreak, is

considered necessary for optimal growth and production of saskatoons. Windbreaks reduce surface wind speed, increase the air temperature within the orchard during the day, reduce soil moisture loss and evapotranspiration, help trap snow and maintain the snow cover (thus helping to increase potential soil moisture reserves), and decrease soil erosion. Windbreaks allow for better pollination and may serve to partially screen the orchard from airborne fungal spores. Windbreaks improve growth and yield, enhance early maturity, and result in better quality fruit.

Guidelines For The Establishment Of Shelterbelts

Protection from the wind can take the form of planted windbreaks, or the installation of a synthetic wind fence; a synthetic wind fence must be at least 3 m in height to have any significant effect. The exception is when fruit plants are small. During the first 2 or 3 years of orchard establishment, intercropping with barley, rye or a similar crop will provide acceptable wind protection.

Shelterbelts should be situated on the north, west and south sides of the orchard so as to reduce the effects of the prevailing winds in both summer and winter. Shelterbelts should extend 10-15 m beyond the area to be protected. The porosity and height of the shelterbelt determine the protective effect. A shelterbelt will provide protection upwind for a distance 2 to 5 times its height, and downwind for a distance up to 30 times its height. A 3 m high shelterbelt will reduce wind velocity for up to 15m upwind and 90 m downwind; a 9 m high shelterbelt reduces wind speed for 45 m upwind and 270 m downwind. Synthetic windbreaks should have a porosity of about 40 to 60%. Planted shelterbelts provide the best wind protection.

Shelterbelts should be planted 1 to 2 years earlier than fruit trees and there should be a distance of 10 to 15 meters from the shelterbelt to the first orchard row. Shelterbelt rows should be spaced at a distance 10 times that of the shelterbelt's height. Trees that are not too dense (about 50% permeable) are desirable for air circulation. Weeds must be controlled. Shelterbelts are best fertilized and irrigated in early years to increase their rate of growth. Natural shelterbelts can be single, double, or even multirowed, and can be utilized for fruit, firewood, or thatching material, depending on the species used. The distance between shelterbelt plants depends on the plant species rate of growth and soil fertility; the position of plants in double or multiple rows should be alternated.

Corn or sunflowers are useful for initial short-term protection. Fast growing deciduous trees such as caragana, lilac, laurel willow, sharp-leaf willow, and Siberian elm are good choices for shelterbelts. However, evergreens such as spruce or pine will provide the best long-term protection.

Row Orientation And Plant Spacing For Saskatoon Orchards

Plant primarily with air drainage in mind. North-south rows will maximize the

penetration of light into the plant canopy, whereas east-west rows will maximize air flow. Rows should begin about 10 to 15 m from the shelterbelt.

Between-row spacing must be adequate to allow passage of equipment for tillage, pest control and harvesting of the mature crop. In general, rows should be at least 1 to 2 m wider than the equipment available. Between-row spacings for U-Pick operations can be as narrow as 3.5 to 4 m. Over-the-row, self-propelled harvesters require a minimum 5 m spacing, while pull-type harvesters require about a 6 m spacing between rows.

Within-row spacing is limited primarily by the provision of sufficient space for growth, and airflow through the plant canopy, and secondarily by soil fertility and the availability of moisture. A suitable distance between fruit plants is required for proper development and maximum yield. A decreased within-row spacing will require increased management as crop develops. It is suggested that spacing between plants be 1 to 1.5 m, although some growers have been planting using a spacing of 30 to 60 cm between plants. A between-plant spacing of 1 m and a between-row spacing of 4.5 m requires about 2,400 plants per hectare; the exact number of plants varies with the dimensions of the area planted.

To estimate the number of plants per hectare, multiply the between-row spacing (in meters) by the between-plant spacing (in meters); divide 10,000 by this number. To estimate the number of plants per acre, repeat the above calculation using yards as the unit of measure, and divide 4047 by this number.

Wider between-row and within-row spacings provide for better orchard ventilation and therefore help reduce the risk of disease problems. Smaller within-row spacings increase early yields and returns, but will require pruning earlier. For the period 3 to 6 years following orchard establishment, a within-row spacing of 0.5 m yields over twice as much fruit as a within row spacing of 1 m.

If a U-pick operation is to be established, 90 - 120 m long rows are the maximum suggested length.

Transplanting Saskatoons

Survival, establishment, growth, and early yield of young saskatoon plants vary with site quality, local climate, site preparation, transplant quality, method of transplanting, post-transplanting care, and site maintenance. The following information is derived from published scientific literature on woody plant and small fruit crop management, in addition to the limited published material available for the saskatoon.

Plant Material

Healthy plants 20 to 60 cm tall should be used. The plants should be straight from rootstock to tip, free of damage, with the branches intact, and preferably still dormant. A well-developed root mass is essential. The roots should be fibrous, and not dry. Plants having tightly-wound roots

should not be purchased. Such plants will never develop a wide-spreading root system, will grow slowly, and may eventually decline in vigour and die. It is important to keep plants cool and moist (but not wet) upon purchase. Root and plant dehydration can restrict normal growth and activity for several seasons. Roots may be covered with damp sawdust or peat, or placed in polyethylene bags, and must not be allowed to dry out. Plants should be protected from excessive sun, wind, and/or frost before planting.

Hardening-off Transplants

Although it is best to obtain dormant plant material, most propagators supply non-dormant plants. Consequently, before transplanting newly-propagated plant material, hardening-off, or acclimatization to field conditions is necessary. Transplants must be hardened-off so that they can better withstand the move from the sheltered greenhouse or nursery environment to harsher field conditions, which may be warmer, colder, and/or drier. Hardening-off is a process of tempering whereby plants are gradually exposed to more sun and heat, and/or lower temperatures, to wind, and to moisture stress. This process of controlled stress reduces the rate of transpiration and photosynthesis, causes plant tissue to become more dense (therefore containing less water), and encourages food storage in plant tissues because growth is slowed. The initial stages may involve some wilting, but plants should recuperate at night (as long as the central stem and growing tips remain green and firm, the plants are not being harmed). Hardened-off plants are better able to cope with subsequent droughts and are more productive under dry conditions. Hardening-off should be initiated 2 weeks prior to transplanting. Hardening-off should not be overly excessive, otherwise plant growth will be affected for the rest of the growing season.

Timing Of Transplanting

A study currently underway at the University of Saskatchewan indicates that early-season planting dates result in increased transplant survival compared with planting dates later in the season. There is a greater risk of poor transplant survival if planting occurs after the end of June. The survival data indicate that July and August plantings should be avoided. Fall planting appears to have variable results. In general, it’s important to avoid transplanting just before or during a time of environmental stress, such as during hot, dry periods, or when there is a substantial risk of frost.

Planting in the spring while the plants are still dormant will decrease the danger of plants drying out because the soil is cool and moist; slow evaporation of water from the soil, and slow growth will allow for good initial establishment. Early planting also helps to increase root growth. In fruit crops such as apples, new roots form when soil temperatures reach 7^{o}C; existing roots will grow at even lower temperatures. The most active periods of root growth are in early-spring and late-summer. Consequently, transplanting may be done when soil temperatures reach 5^{o}C. The use of dormant plants allows for a full cycle of plant growth, and therefore maximal root and shoot

growth, which is not the case if non-dormant plants are used.

Fall transplanting will allow some root growth will occur. At this time of the year water loss from the plant is minimal, and dormancy is naturally imposed by winter. There is generally a lower risk of moisture stress at this time of the year, and the roots will grow at a significant rate until the soil temperature drops below 5°C. However, an excessively wet or dry fall, followed by a cold winter may result in a large percentage of loss. Excessively wet fall weather inhibits the development of adequate winter hardiness and may lead to root damage because of the depletion of soil oxygen. Excessively dry fall weather causes damage from plant desiccation.

Placement Of Plants In The Soil

Plants may be placed into furrows, trenches or holes in the soil using a variety of equipment. Planting holes must be large enough to easily accommodate the root mass. The use of an auger or similar implement can glaze the walls of a hole, thus inhibiting water drainage, root penetration, and the transfer of water. Trenches in heavy clay soil may be susceptible to poor water drainage. Plant roots should be disturbed as little as possible and should not be allowed to dry out. When transplanting, plants should be set a little deeper (5 to 7 cm) than they were in the propagation container. If planted too shallowly, frost heaving will push the plants out of the ground. Subsequently, once the rooting medium becomes exposed, the plants will dry out very quickly. The soil can then be firmed around the roots to remove pockets of air. However, growers must be careful not to transplant too deeply. Research on deep-planted maple and oak seedlings has indicated a decrease in survival and caliper growth (increase in stem diameter) and an increase in susceptibility to winter injury, compared to seedlings that were planted with the root collar at the soil surface. Deep-planting may also lead to girdling (strangulation) of the stem by roots. Girdling roots and soil compaction around stems decreases annual growth in caliper, and consequently decreases the flow of water, nutrients and growth regulators within the plant, leading to a decrease in vigour.

Fertilization should not be necessary at the time of transplanting, provided that soil nutrient levels have been adjusted appropriately prior to transplanting. It is widely held that a starter fertilizer high in phosphorus should be added to the soil prior to placing the plant, in the belief that this will stimulate root growth and promote rapid transplant establishment. However, studies have indicated that applications of high P fertilizers do not promote either root or shoot growth in woody plants except where substantial deficiencies exist. Additionally, concentrated fertilizer can burn roots and cause plant death. Excessive soil fertility may actually reduce root development and over-fertilization may cause a spurt of growth that the roots can't support. The addition of compost or well-composted manure may help to increase growth because the increase in organic matter content will improve soil aeration and moisture-holding capacity. Following placement, the plants need to be watered well, and consistently, but not overwatered. Mulching will help

reduce moisture loss. Remember that transplants require protection from wind and grazing animals.

Application Of Mulches

The orchard site must be well-prepared by pre-working the soil to a depth of 15 to 20 cm, prior to transplanting. Mulches can be applied immediately following transplanting. Black plastic (2 to 3 mil, UV resistant) or fabric mulches are preferred. Such mulches effectively control weeds, retain soil moisture, and warm the soil earlier in the growing season, thus enhancing growth. Organic mulches tend to keep the soil too cool in the spring, thus having a negative impact on growth, and are labour-intensive to manage. Black plastic or fabric mulches can be applied in conjunction with a trickle irrigation system and fertilization is then done via the irrigation system (fertigation). Plastic and fabric mulches must be applied mechanically; there is a variety of equipment available, some of which will integrate the procedures of transplanting, laying trickle and mulch. The transplants are placed in the ground first, and then pulled through a cross- or X-shaped slit in the plastic or fabric immediately after the mulch is laid.

Pruning Newly-Transplanted Saskatoons

Past practice has dictated that pruning at planting time will improve a transplant's chances of survival and enhance subsequent growth. It is usually thought that such a practice will reduce the transplant's requirements for water because of the reduction in actual and potential leaf area. However, the practice is labor-intensive and actually may have long-term negative effects on plant vigour and growth. Prior to transplanting, plants usually have a smaller root mass than shoot mass, that is, their root to shoot ratio is low. Additionally, the process of transplanting can destroy up to 90% of the effective root mass. Heavy pruning at planting time was thought to increase the root to shoot ratio. However, scientific research published in the last decade suggests that this is not what happens. Studies with apple, pear, peach, linden, and birch, where pruned transplants have been compared to unpruned transplants, have indicated that a minimalist approach to pruning newly-transplanted plants is the best. These studies all have indicated that topping or severe pruning at transplanting is not beneficial to survival, establishment and subsequent growth, and in fact may have substantial negative effects on subsequent root and shoot growth. The additional moisture stress resulting from leaving the shoot intact (that is, not-pruning) is more than compensated for by the additional availability of carbohydrates stored in the shoot, and the capacity to produce carbohydrates by the leaves, both of which are important to root and shoot growth. Additionally, severe pruning of young fruit trees delays the onset of bearing because of delayed growth and consequent lengthening of the period of juvenility.

For the first three years following orchard establishment, pruning should be primarily associated with the maintenance of plant health and the encouragement of vigour and growth. During this period,

pruning primarily involves the removal of weak, diseased, damaged and dead shoots. Low, spreading branches should be removed and the centers of shrubs thinned to keep them open and thus allow good air circulation.

Irrigation of Newly-Transplanted Saskatoons

New transplants should be monitored closely and irrigated every 1 to 2 days with small volumes of water, so as to ensure that the root plug does not dry out. It is very important to maintain even soil moisture levels. The root plug of young saskatoon transplants dehydrates at a similar rate to the soil near the top of the root plug, even if soil near the base of the plug is adequately moist. To prevent root damage from dehydration in newly-transplanted saskatoons, the moisture level of the soil near the top of the root plug must be monitored in order to determine if irrigation is necessary.

A Final Word

Although the above may not be the final word on transplanting saskatoons, growers should be aware that some alternative methods of transplanting are being heavily promoted in the absence of well-founded, scientifically-based information and studies. Growers are advised to question the validity of these alternative methods because of the potential for negative effects on orchard establishment and/or increased costs. In determining the merit of any approach, growers should consider the horticultural basis of the method, labour requirements, and the feasibility of the approach relative to increased profitability.
