oxadiazon-treated plots.

Weed pressure was not high in this experiment due to dry soil surface conditions for most of the season. All of the herbicide treatments provided excellent control of both grass and pigweed at the early and midseason evaluations (Table 3). By the end of harvest, grass control was excellent with metolachlor and oxadiazon and was unacceptable (<7.0) with oxyfluorfen and alachlor. Pigweed control was less with alachlor than with hand-weeding or application of oxadiazon; however, it was still acceptable and was comparable to that obtained with metolachlor and oxyfluorfen.

Due to the low weed pressure in this experiment, apparent injury to gypsophila plants sustained as a result of weeding and the growth habit of gypsophila, there was no difference in the numbers of marketable, cull, or total number of panicles harvested from the weedy check and hand-weeded check plots during the season (Table 4). Significantly more marketable panicles were harvested from plots treated with alachlor or oxadiazon than from the weedy checks. More cull panicles were obtained with oxyfluorfen than with hand-weeding or oxadiazon, while treatment with metolachlor, alachlor, or oxadiazon produced a greater total number of panicles than was obtained in the weedy check.

Panicle weights were influenced more by treatment than were numbers (Table 4). Hand-weeding and application of metolachlor, alachlor, or oxadiazon increased the weight of marketable panicles compared to the weedy check plots, whereas oxyfluorfen resulted in a greater production of cull panicles than hand-weeding or oxadiazon. No difference in total weight of panicles produced was observed among the herbicide treatments and the hand-weeded check.

Two applications of alachlor, oxadiazon, or oxyfluorfen were not injurious to gypsophila, and metolachlor was only slightly injurious. Oxadiazon and metolachlor provided the best overall weed control, while none of the herbicides reduced panicle yield. Results with oxadiazon in these experiments are comparable to most of those previously reported (1, 3). Contrary to research reported by Agamalian et al. (1), alachlor was not phytotoxic to gypsophila nor did it reduce yields; however, in their research, rates of alachlor were ≈2 to 4 times higher than used in my test, and their soil was finer-textured. Bing (2) reported satisfactory growth of gypsophila when treated with alachlor, thereby supporting the results of the present research. Based on plant vigor, weed control, and yield, 4.48 kg·ha^{-1} oxadiazon was the best herbicide treatment in the present study.

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Influence of Cultivar on Nectar Sugar Content in Several Species of Tree Fruits

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Abstract. **The nectars of several apple (*Malus domestica* Borkh.), apricot (*Prunus armeniaca* L.), crab apple (*M. baccata* L. and *M. floribunda* Seib.), peach (*Prunus persica* L.), pear (*Pyrus malus* L.), and sweet cherry (*Prunus avium* L.) cultivars were analyzed for sugar contents. 'Skaha' apricot was significantly higher in fructose, glucose, and sucrose than 'Wenatchee Moorpark' or 'Tilton'. 'Lambert' sweet cherry was significantly higher in these sugars than 'Van' or 'Stella'. Sugar levels were higher in 'Bartlett' and 'Spartlett' than 'Anjou'. 'McIntosh' and 'Red Delicious' nectars were higher in the individual sugars than 'Golden Delicious'. An appreciable range of values was found among the crab apples but the sugar content in some were comparable to those of apple.**

Concentrations of sugars in nectar vary from a high of 55% in apples to a low of 2% in pears (11). Both Percival (6) and Wykes (13) have characterized these nectars by the predominance of sucrose (S), glucose (G), and fructose (F). A nectar designated as SFG contains appreciable levels of all three sugars, whereas a sFG nectar would have high levels of fructose and glucose but low levels of sucrose. Apple nectar was classified as SFG, and pear nectar was sFG. No mention was made of cultivar influence on nectar sugars in these reports. Battaglini and Battaglini (1) analyzed the nectars of several apple and plum cultivars, but no cultivar effects were mentioned in the abstracted paper.

Nectars and their composition have been implicated in the level of bee activity. Wyke's (13) work showed an order of preference of sucrose : glucose : fructose when single sugar solutions were given to honeybees. However, the most preferred solution was an equal mixture of the three sugars. Zauralov (14) suggested nectar sucrose levels rather than nectar concentrations as more influential on bee activity. Nectar quantity did not alter appreciably the number of foraging bees in a study by Butler (3) but flowers with high sugar levels were visited more often than those with low levels. It is apparent that not only total sugar content but levels of individual sugars in the nectars of tree fruit blossoms influence bee activity. A study therefore was undertaken to determine whether nectars differed in sugar composition among cultivars within tree fruit species. Such information would be useful in the assessment of cultivars as potential pollinizers.

Blossoms from apricots, sweet cherries, apples, pears, peaches, and crab apples were individually collected from five trees of each cultivar of the tree fruits except for the crab apples, for which only one tree was available per selection. All cultivars within a species were located within the same row or adjacent rows in the orchard of the Summerland Research Station. Trees were mature (≥10 years), except the crab apples, which were

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Table 1. Sugar content in the nectar of newly opened flowers of several tree fruit cultivars.

Species	Cultivar	Sugar (mg/10 flowers)				
		Fructose	Glucose	Sucrose	Sorbitol	Total
Apricot	Skaha	21.87 a[z]	14.65 a	0.88 a	0.28 a	37.68 a
	Wenatchee	8.54 b	6.48 b	0.17 c	0.14 b	15.33 b
	Tilton	7.42 b	7.04 b	0.37 b	0.13 b	14.96 b
SE		0.79	0.53	0.04	0.02	1.36
Cherry	Lambert	1.57 a	1.57 a	10.02 a	0.06 a	13.23 a
	Van	0.88 b	0.78 b	8.27 b	0.01 b	9.94 b
	Stella	1.00 b	0.90 b	6.11 c	0.01 b	8.02 c
SE		0.06	0.06	0.29	0.00	0.37
Pear	Bartlett	1.82 a	2.04 a	0.18 b	0.11 b	4.14 a
	Spartlett	1.58 b	1.77 b	0.38 a	0.13 a	3.86 a
	Anjou	0.66 c	0.80 c	0.08 c	0.04 c	1.59 b
SE		0.07	0.08	0.01	0.00	0.16
Apple	McIntosh	1.19 a	1.25 a	3.67 a	0.07 a	6.19 a
	Red Delicious	1.10 a	1.10 a	2.37 b	0.04 a	4.16 b
	Golden Delicious	0.40 b	0.48 b	1.84 c	0.00 b	2.73 c
SE		0.06	0.05	0.10	0.01	0.21
Peach	Fairhaven	11.52 a	11.82 a	2.26 a	0.24 a	25.84 a
	Redhaven	10.74 a	10.74 a	1.62 b	0.14 b	23.26 a
SE		0.29	0.22	0.05	0.01	0.51

[z]Mean separation within each column for each species by Duncan's multiple range test, 5% level.

Table 2. Sugar content in the nectar of several potential crab apple pollenizers.

Selection	Sugar (mg/10 flowers)			
	Fructose	Glucose	Sucrose	Total
1-1	0.88 a[z]	1.06 a	1.72 ab	3.87 a
2-1	0.82 a	0.79 b	1.72 ab	2.97 ab
6-1	0.78 ab	0.78 b	1.57 abc	2.81 bc
2-4	0.40 c	0.53 c	1.54 abc	2.46 bcd
3-5	0.36 cd	0.30 cde	1.72 ab	2.38 bcde
1-2	0.34 cd	0.40 cde	1.57 abc	2.32 bcde
1-3	0.60 b	0.56 bc	1.11 bcde	2.28 bcde
1-5	0.34 cd	0.44 cd	1.30 abcd	2.08 bcdef
2-3	0.29 cd	0.31 cde	1.24 bcde	1.84 cdef
Manchurian	0.38 cd	0.31 cde	1.01 cde	1.70 def
1-4	0.21 cd	0.17 e	1.09 bcde	1.47 defg
5-5	0.29 cd	0.30 cde	0.80 def	1.39 efg
2-2	0.29 cd	0.31 cde	0.62 ef	1.22 fg
3-4	0.22 cd	0.18 de	0.72 def	1.12 fg
5-4	0.17 d	0.16 e	0.25 ef	0.59 g
SE	0.06	0.08	0.20	0.32

[z]Mean separation by Duncan's multiple range test, 5% level.

6-years-old. Ten blossoms per tree were collected at 1000 and 1400 HR during a consecutive 4-day period. Only 1400-HR collections were done for the crab apples because of the smaller trees and a limited number of blossoms. Only flowers that had just opened prior to each collection period were picked and immediately taken to the laboratory for nectar extraction. Insect visits to the trees were not prevented, because sampling results from the previous year showed no significant difference in nectar sugar content between a caged and open apricot tree.

The petals, anthers, and pistils were removed carefully with a sharp scalpel and the nectar washed into a 25-ml volumetric flask with a fine stream of 80% ethanol and then subjected to sugar analysis by gas chromatography. A 2-ml aliquot of each sample in a reaction vial was dried under vacuum at 60°C. Stearic acid (standard) in pyridine then was added along with Tri-syl Z (Pierce, Rockford, Ill.) as the derivitizing agent. The capped vials were heated at 60° to 70° for 20 min to complete derivitization. Separation of the derivatized sugars was accomplished on a 0.25 mm × 20 m fused silica capillary column coated with SE-30. Chromatographic conditions were: He carrier gas at 1 ml·min^{-1}, N_2 as make-up gas at 30 ml·min^{-1}, H_2 at 30 ml·min^{-1}, air at 200 ml·min^{-1}, initial temperature of 150°, final temperature of 250° and program rate of 6°/min.

Data from the sugar analyses were subjected to analyses of variance. For all tree fruits (except crab apples), time of day was a repeated measure with two levels and a split-plot analysis was used. For the crab apples, days of observation were used as replication but limitations of the chosen replication method are fully recognized.

No consistent effects of time interval or day of collection were evident across all nectars analyzed (data not shown). Nectar from 'Skaha' apricot was significantly higher in fructose, glucose, sucrose, and sorbitol than in 'Wenatchee Moorpark' or 'Tilton' (Table 1). All sugar values were comparable in the latter two cultivars, except that 'Tilton' had a higher sucrose content. 'Lambert' sweet cherry was significantly higher in all four sugars than either 'Van' or 'Stella', which had similar levels of all sugars except sucrose. Sugar levels were appreciably lower in 'Anjou' pear than in 'Bartlett' and 'Spartlett' and most of the other nectars analyzed, the exceptions being some crab apples. 'Bartlett' and 'Spartlett' had the same total level of sugars, but all four sugars were at different levels in the two cultivars. Both 'McIntosh' and 'Red Delicious' were higher in all sugars than 'Golden Delicious'. Sucrose was significantly higher in 'McIntosh', and its value resulted in a higher total sugar content compared to 'Red Delicious'. High levels of fructose and total sugar were found in the nectars of the 'Redhaven' and 'Fairhaven' peach. Differences were observed in sucrose and sorbitol concentrations between the latter two cultivars, but total sugar content was not different. An extensive range of values was found with the crab apples, 0.59 to 3.87 mg of sugar per 10 blossoms (Table 2). The rather low sugar value in crab apple 5-4 may be a consequence of a very confined nectary area.

Comparison of the results with those of other researchers is difficult because few cultivars are common among the studies. Mommers (5) showed high nectar volume and total nectar sugar in 'Yellow Transparent' apple. Sugar content in 'Golden Delicious' was ≈1.0 mg/blossom, a value substantially higher than the 0.27 mg reported here. Simidchiev (7–9) expressed nectar production and nectar sugar content on a 24-hr basis. Total sugar per blossom ranged from 0.6 to 8.0 mg in pears, 0.5 to

1.0 mg in peaches, and 0.4 to 1,0 mg in cherries. The value of 8.0 mg reported for 'Popska Krushka' pear is extraordinarily high, since pears are not considered good sources of nectar. Although sorbitol is a minor component in nectar, it is converted readily to other sugars by the nectaries (2). Extra-floral secretions, on the other hand, contain high levels of sorbitol (4). Sugar content in a nectar appears to be dependent on the rate of secretion of sugars into the nectar and on the uptake of these sugars from the secreted nectar by the nectaries (2). Timenskii (10) found a positive relationship between nectar sugar and fruit flesh sugar, but results in our studies do not confirm his observations. For example, 'McIntosh' invariably has a lower soluble solids in its juice than 'Golden Delicious' (usually 11–12% for 'McIntosh' and 13–15% for 'Golden Delicious'), yet, the sugar content in its nectar exceeded that of 'Golden Delicious'.

Appreciable differences did occur among cultivars within a species in our study. However, since time did not permit a bee count during blossom collection, it is not known whether the cultivar differences influenced bee activity. The implication of sucrose as an important sugar in bee foraging (13, 14) would render some of the cultivars in our study preferable to others. Future work in nectar studies will attempt to correlate cultivar and bee activity and also the influence of the genetic sources of the cultivar.

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Effect of a Hydrophilic Gel on Seed Germination of Three Tree Species

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Additional index words. legume, *Robinia pseudoacacia*, *Gleditsia triacanthos*, *Gymnocladus dioica*, moisture-holding compounds

Abstract. **Seeds of black locust (*Robinia pseudoacacia* L.), common honeylocust (*Gleditsia triacanthos* L.), and Kentucky coffeetree (*Gymnocladus dioica* L.) were coated with an adhesive plus hydrophilic gel, adhesive only, or neither (control), planted in sand in the greenhouse, and then irrigated at 3-, 6-, or 9-day intervals. Percent germination of black locust seeds irrigated at 3-day intervals was decreased significantly with exposure to hydrophilic gel. Gel-coated Kentucky coffeetree seeds irrigated at 6-day intervals also had a percent germination significantly lower than those treated with adhesive alone, but germination of untreated seeds was not different from adhesive- or gel-coated seeds. No other significant difference in germination percentage was observed. Seedling heights and dry weights were not affected by seed treatment; however, decreased moisture availability because of longer time periods between irrigations tended to delay emergence and reduced seedling vigor.**

Hydrophilic gels are compounds that, according to manufacturers, improve seed germination and seedling survival. These materials absorb many times their weight in moisture and release it as the environment becomes dry.

Hydrophilic gels can be used as a seed coating, incorporated into a plant growing medium, or as a fluid drilling medium. Studies examining effects of coating seeds with hydrophilic gels on germination and seedling growth have produced conflicting results. Coated seeds planted in strip mine soil had a higher initial germination than untreated seeds (4). No improvement was evident in emergence rate or total germination of Russian wildrye (*Elymus junceus* Fisch.) coated with five different hydrophilic coatings (2). Hydrophilic polymer seed coating enhanced germination of sweet corn (*Zea mays* L.) at 2.3 and 4.6 $g \cdot kg^{-1}$ seed but not at 9.1 $g \cdot kg^{-1}$ seed, whereas all levels of polymer coating had a negative effect on germination of cowpea (*Vigna unguiculata* L.) (1).

Germination of pepper (*Capsicum annuum* L.) coated with clay or sand decreased except when seeds were placed in a high O_2 environment, indicating that coatings may reduce O_2 movement into the seed (5, 6). When high concentrations of hydrophilic materials were used as seed coatings, the water held around seeds was increased, but aeration apparently was diminished (1). Reduced seedling vigor of pregerminated snapdragon (*Antirrhinum majus* L.) seeds stored in hydrophilic gels correlated with decreased O_2 diffusion rates through the material (3).

Other factors also may contribute to reduced germination rates in the presence of hydrophilic gels. According to Searle (7), a hydrophilic material absorbed water and seeds germinated, but the soil was too hard for root penetration, and seedling death resulted. In this situation, it would be advantageous for the seed to remain quiescent until adequate moisture was available to sustain growth and root penetration.

The purpose of the present study was to determine whether hydrophilic gel applied as a seed coating improves seed germination and seedling survival of three tree species.

Seeds of black locust (*Robinia pseudoacacia* L.), common honeylocust (*Gleditsia triacanthos* L.), and Kentucky coffeetree (*Gymnocladus dioica* L.) were coated with

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