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

Janet C. Henderson[1] and David L. Hensley

Department of Horticulture, Kansas State University, Manhattan, KS 66506

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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[1]Former Graduate Research Assistant. Present address: Dept. of Horticultural Sciences, Texas A&M Univ., College Station, Texas.

Table 1. Influence of hydrophilic gel seed coatings and 3-, 6-, and 9-day irrigation intervals on seedling emergence, average height (ca), and dry weight (g) of black locust 28 days after first emergence.

	Seedling emergence (%)						
	Irrigation interval			Height (cm)		Weight (g)	
Treatment	3-day	6-day	9-day	3-day	6-day	3-day	6-day
Control	99.2 a[z]	43.0 a	43.6 a	4.6 a	3.0 a	0.04 a	0.02 a
Adhesive only	91.3 ab	46.7 a	31.1 a	4.5 a	3.6 a	0.04 a	0.04 a
1% hydrogel	84.5 b	51.5 a	16.5 a	4.3 a	3.7 a	0.04 a	0.03 a
Excess hydrogel	83.2 b	44.4 a	4.4 a	4.3 a	3.5 a	0.05 a	0.04 a
Overall mean	89.6 A[y]	46.4 B	23.9 C	4.4A	3.4 B	0.04 A	0.03 B

[z]Mean separation within columns by Tukey's HSD, $P = 0.05$.
[y]Overall mean separation within a parameter by Tukey's HSD, $P = 0.05$.

Table 2. Influence of hydrophilic gel seed coatings and 3-, 6-, and 9-day irrigation intervals on seedling emergence, average height (cm), and dry weight (g) of common honeylocust 28 days after first emergence.

	Seedling emergence (%)			Height (cm)		Weight (g)	
Treatment	3-day	6-day	9-day	3-day	6-day	3-day	6-day
Control	64.4 [z]	44.1	5.7	10.7	9.3	0.14	0.13
Adhesive only	60.3	62.3	8.3	11.6	8.6	0.16	0.13
1% hydrogel	73.8	56.2	3.0	11.1	8.3	0.16	0.10
Excess hydrogel	60.3	60.6	2.4	10.4	8.4	0.16	0.10
Overall mean	64.7 A[y]	55.8 A	4.9 B	11.0 A	8.6 B	0.16 A	0.12 B

[z]There were no significant differences among treatments within each irrigation treatment in any measurement parameter (F test, 0.05).
[y]Overall mean separation within a parameter by Tukey's HSD, $P = 0.05$.

Table 3. Influence of hydrophilic gel seed coatings and 3-, 6-, and 9-day irrigation intevals on seedling emergence, average height (cm), and dry weight (g) of Kentucky coffeetree 28 days after first emergence.

	Seedling emergence (%)			Height (cm)			Weight (g)		
Treatment	3-day	6-day	9-day	3-day	6-day	9-day	3-day	6-day	9-day
Control	95.6 a[z]	89.1 ab	64.6 a	10.2 a	10.5 a	9.8 a	0.8 a	0.29 a	0.25 a
Adhesive only	93.4 a	91.3 a	94.9 a	10.6 a	10.8 a	10.8 a	0.51 a	0.33 a	0.33 a
Excess hydrogel	98.5 a	78.2 b	91.3 a	10.2 a	10.8 a	10.8 a	0.49 a	0.33 a	0.34 a
Overall mean	96.1 A[y]	86.2 A	83.6 A	10.3 A	10.7 A	10.5 A	0.49 A	0.32 B	0.31 B

[z]Mean separation within columns by Tukey's HSD, $P = 0.05$.
[y]Overall mean separation within parameters by Tukey's HSD, $P = 0.05$.

Table 4. Average percent emergence of seeds of three woody species exposed to 3-, 6-, or 9-day irrigation intervals.

	Percent emergence		
Irrigation interval	Black locust	Common honeylocust	Kentucky coffeetree
3-day	89.6 a[z]	64.7 a	96.1 a
6-day	46.4 b	55.8 a	86.2 a
9-day	23.9 c	4.9 b	83.6 a

[z]Mean separation in columns by Tukey's HSD, $P = 0.05$.

hydrophilic gel (a starch-graft copolymer of potassium polyacrylate and polyacrylamide) after pregermination requirements were met. Seeds were weighed and dipped in an adhesive [maltodextrin and water, 1:1 (w/w)] at rates of a) 1% by seed weight and b) the maximum amount retained by seeds when placed in excess gel–talc mixture. Other seeds were treated with adhesive only, and untreated controls were subjected to neither adhesive nor hydrophilic gel treatments. Seeds were planted in 10-cm plastic pots of washed sand and irrigated at 3-, 6-, and 9-day intervals. Each treatment contained 15 seeds and was replicated three times in a completely randomized design.

Seedling emergence was evaluated and recorded daily. Germination was considered complete when no further seedling emergence was apparent for 7 days. Seedling heights and dry weights were measured 28 days after planting.

Arcsin transformations (8) were performed on all germination data, and analysis of variance and mean separation procedures were conducted to evaluate differences among hydrophilic gel treatments within each species and irrigation interval.

Percent germination of black locust irrigated at 3-day intervals was greater in untreated seeds than in seeds treated with hydrophilic gel (Table 1). This trend also was apparent with 9-day irrigation intervals, although differences were not significant.

The tendency for decreased emergence of treated seeds may be attributed to a decrease in aeration around these seeds, as indicated by Sachs et al. (5, 6) with coated pepper seeds. Oxygen availability to the seed may have been reduced by the adhesive material and further inhibited by the addition of the gel material, particularly at the higher gel rate. Baxter and Waters (1) found that polymers had a beneficial effect on imbibition and germination of sweet corn at high water potentials, but this effect was reversed as water potentials increased.

Black locust seedling heights and dry weights were not significantly affected by any of the seed treatments (Table 1). Apparently, once the seed germinated, seed coating had no detrimental or advantageous effect.

Average emergence and growth of black locust seedlings were affected significantly by irrigation interval (Table 1). Seedling emergence was decreased as time between irrigations increased from 3 to 6 days and from 6 to 9 days. As expected, seedling heights and dry weights also were decreased by reduced watering. No seedlings in the 9-day irrigation treatment survived.

Germination of common honeylocust in response to seed treatment differed from that of black locust. Percent emergence was not affected by any seed treatment in any irrigation regime (Table 2). Seedling heights and dry weights also showed no differences.

As with black locust, decreased irrigation frequency delayed seedling emergence, although the delay was not significant until 9 days between irrigations (Table 2). Seedling heights and dry weights were decreased significantly with long intervals between water applications. No seedlings survived in the 9-day irrigation treatment.

Percent emergence of Kentucky coffeetree seed followed no consistent trends in any irrigation regime (Table 3). Gel-coated seeds at 6-day irrigation intervals had a percent germination significantly lower than that of seeds treated only with adhesive, but percent emergence of untreated seeds was not different than that of gel- or adhesive-treated seeds. As in other species, Kentucky coffeetree seedling heights and dry weights did not differ significantly among treatments within an irrigation interval (Table 3).

In contrast to other species, no differences in percent emergence of Kentucky coffeetree occurred among irrigation regimes. Seedling heights also did not differ among irrigation schedules; however, dry weights of plants irrigated at 3-day intervals were significantly greater than those at 6- or 9-day intervals.

Seed size appeared to have an effect on seedling survival at low moisture levels (Table 4). Black locust, a small-seeded species, was less tolerant to low moisture levels than common honeylocust, a species with larger seeds. Kentucky coffeetree, a species with very large seeds, survived all irrigation regimes tested. Therefore, large seeds may retain increased moisture levels that extends support for seedling growth and development for a limited time after germination.

These studies indicate that hydrophilic gels used as seed coatings do not improve consistently or significantly seed emergence or subsequent seedling vigor of the plants tested.

They may, in fact, inhibit or delay emergence by reducing aeration around the imbibing or germinating seed.

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Tomato Fruit Temperature Before Chilling Influences Ripening After Chilling

Mikal E. Saltveit, Jr., and Roberto M. Cabrera

Department of Vegetable Crops, University of California, Davis, CA 95616

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Abstract. **Tomato fruit (*Lycopersicon esculentum* Mill., cv. Castlemart) either harvested hot (e.g., 32°C) and chilled for 7 days at 7°, or harvested cool (e.g., 19°) and held in the laboratory at 37° for 7 hr before chilling at 2.5° for 4 days ripened slower (a symptom of chilling injury) than fruit that were either harvested cool (19°) or held at 12.5° for 7 hr before chilling.**

The storage life of many commodities is prolonged at low temperatures. Tomatoes, however, are chilling-sensitive and are injured at temperatures below 12.5°C (13). Tomato fruit are particularly susceptible to chilling injury at the mature-green stage, when they are normally harvested and shipped. Chilling injury of tomatoes usually is not visually apparent at the chilling temperature, but is expressed upon exposure to ripening temperatures of around 20°. Chilled tomatoes exhibit slow and abnormal ripening, increased disease susceptibility, and increased rates of respiration and ethylene production (13).

Treatments that reduce symptoms of chilling injury include conditioning near the chilling temperature, intermittent warming during chilling, low-pressure storage, increased atmospheric CO_2 levels, and pretreatments with Ca or ethylene (13). Chilling injury was reduced in fruit of bell pepper (12) and grapefruit (3, 6), and seedlings of tomato (8, 19) and ornamentals (15) by conditioning at a cool, but nonchilling temperature. Intermittent warming also can reduce chilling injury in citrus (4), cucumbers and sweet peppers (18), peaches and nectarines (2, 17), and potatoes (7). Susceptibility of tomato fruit to chilling varies with the cultivar, growing season, and time of harvest during the year (1, 9).

This paper reports experiments that show that chilling sensitivity of harvested tomato fruit changes during the day, that this change is related to fruit temperature at the time of harvest, and that similar changes in chilling sensitivity can be induced in the laboratory by holding harvested fruit at different temperatures before chilling.

Mature-green tomato fruit ('Castlemart') were hand-harvested at various times during the day from plants grown at the Vegetable Crops field station in Davis, Calif. Only uniform, healthy fruit with no external defects were retained. Fruit were washed in dilute commercial bleach (1:20 dilution of 5% sodium hypochlorite) and randomly divided into groups of 20 fruit each. Fruit were placed in paper cup trays so that each group could be handled as a unit.

Temperature treatments involved transferring trays of fruit to walk-in controlled-temperature rooms. After temperature treatments, trays were covered loosely with plastic wraps to reduce water loss, and the fruit ripened at 20°C. Tomatoes were scored periodically for

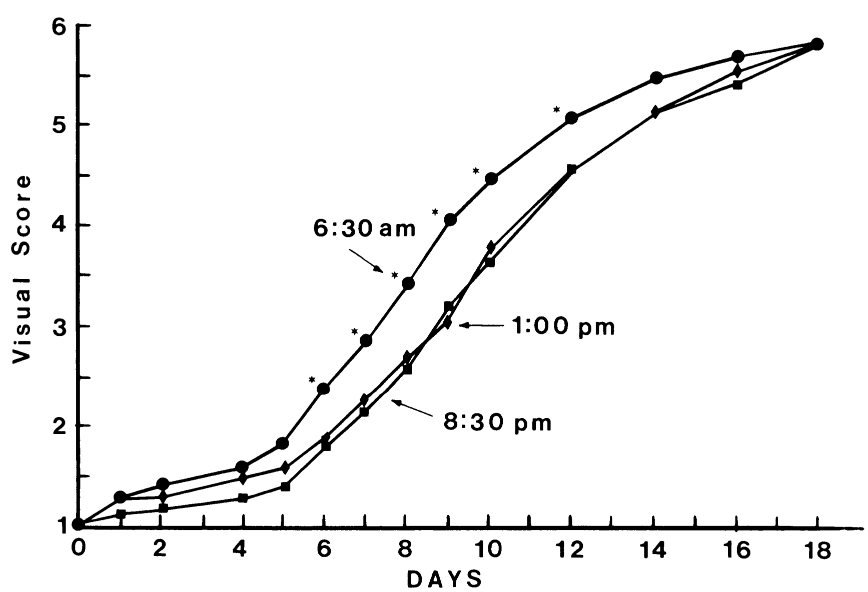

Fig. 1. Effect of chilling at 7°C for 7 days on the subsequent ripening at 20° of mature-green tomato fruit harvested during a sunny day at sunrise (6:30 AM) when cool (19°), at 1:00 PM when hot (32°), or at sunset (8:30 PM) when warm (29°). Ripeness scores of the sunrise harvest with asterisk are signficantly different at the 5% level from observations on the same day for the other harvest times. A subjective scale of ripeness was used where 1 equaled mature-green and 6 equaled red-ripe. The x-axis represents the days after transfer to 20°.

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