

cipally in retaining leaf serrations on the mature tree. From southwestern Missouri to New Mexico, a bushy tree or shrub form is var. *texana* Sarg. Some recent authors include a farther western var. *reticulata*, the netleaf hackberry, ranging from western Texas and possibly Washington state to southern California. (Rehder and Sargent called it *C. reticulata* Torr.) It has been recommended as a desirable native small tree species for southern Arizona landscape use. Steve Fazio, member of the Western region of the Society, and acting head of the Department of Horticulture at University of Arizona, sent me the views I show of desert hackberry in the Tucson area.

Some of the exotic species of hackberry have been cultivated at least to a limited extent in Georgia and California, and in arboreta elsewhere in the U.S. These include *C. simensis* Pers., now well naturalized at Davis, California, and *C. australis* L., the European hackberry, listed by Hortus Second as being grown in southern California. (Fazio does not know of any in southern Arizona plantings.) These probably are both more tender than the midwestern forms of *C. laevigata*.

Here in one of the Rochester parks, I've seen and liked *C. Bungeana* Bl., native to China and Korea. It would be my first choice of foreign hackberries to try in Zones 5 and 6 of the eastern states and Ontario. Wyman in his book, *Trees for American Gardens*, writes, "In general this species performs the best of those in the Arnold Arboretum . . . it is as yet unavailable from commercial sources." He also recommends another Asiatic species, *C. jessoensis* Koidz. from China and Japan. *C. jessoensis*, he says, is "possibly of value as a substitute for the American elm."

MODERATOR SHUGERT: Thank you very much. It certainly was well done. Our next speaker, speaking on *Crataegus* root stock studies at the Morden Experimental farm, a gentleman we are very proud and pleased to hear this afternoon, is W. A. Cumming who is the head of the Ornamental Section of the Canadian Department of Agriculture from Morden Manitoba.

CRATAEGUS ROOTSTOCK STUDIES

W. A. CUMMING

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In 1949 we introduced Toba hawthorn which was the result of a cross between *Crataegus oxyacantha* 'Paul's' Scarlet' and the native species *Crataegus succulenta*. This new cultivar gained recognition quickly in those areas where nurserymen were already propagating hawthorn cultivars and had a reasonably satisfactory rootstock available. On the Canadian prairies, from whence it was introduced, its performance was disappoint-

ing, largely because no satisfactory rootstock was available on which to propagate it. Seedlings of our two native hawthorn species, *C. chrysocarpa* and *C. succulenta*, which were the most readily available, are difficult to transplant successfully and provide poor anchorage, because of their deep, straight, tap root systems.

In the spring of 1955 we happened to have a surplus of seedlings of *C. arnoldiana*. Two hundred and thirty of these were lined out and budded in August of that year to 27 different species including *C. mordenensis* 'Toba'. The catch was only 60% but it was evident that seedlings of Arnold hawthorn were widely compatible. Two plants of each species on this stock were transplanted into permanent positions in the arboretum without a single loss to date. Previous experience had established that *C. arnoldiana* was hardy on the Canadian prairies and we proceeded to recommend it as a rootstock until such time as further tests could be made.

In the autumn of 1958 we collected seed from 23 different species growing at Morden. These seeds were cleaned immediately, air dried and placed in cool storage (40 degrees F.) until planted in late July 1959. Immediately before planting, portions of each seed lot were scarified in concentrated sulphuric acid (commercial) for 1 and 2 hours. Germination results for the nine species selected for rootstock studies plus those for our native *C. succulenta* are recorded in Table I following:

Table I Seed Germination Results

Species	No Treatment		H ₂ SO ₄ for one hour		H ₂ SO ₄ for two hours		% sdlg. dug based on No seeds planted	% survival transplanted seedlings
	Days	%	Days	%	Days	%		
<i>C. mollis</i>	291	28	291	28	291	31	23	95
<i>C. arnoldiana</i>	291	22	291	30	291	30	25	98
<i>C. sanguinea</i>	294	20	294	33	294	29	17	91
<i>C. rivularis</i>	297	16	297	32	297	39	24	95
<i>C. caesia</i>	297	0	297	15	297	12	7	82
	682	10	—	—	—	—	—	—
<i>C. wendlandi</i>	297	8	297	22	297	36	15	90
	679	2	—	—	—	—	—	—
<i>C. strigosa</i>	293	16	293	18	293	18	17	86
	679	12	679	2	—	—	—	—
<i>C. chrysocarpa</i>	297	2	297	24	297	27	16	97
	679	2	—	—	—	—	—	—
<i>C. punctata</i>	293	24	293	45	293	42	33	93
<i>C. succulenta</i>	294	0	294	8	294	16	6	79
	679	12	679	5	—	—	—	—

It is not my intention to discuss, in this paper, the many difficulties involved in germination of the seeds of the genus *Crataegus*. Although germination percentages in this particular year and presented in Table I are lower than usual, they serve to point out the procedure we have worked out for han-

dling hawthorn seeds under our climatic conditions. A short summary of our experimental results with the seed of *Crataegus* spp. appears on page 12 of our bulletin entitled "Propagation Studies in Fruits and Ornamentals at the Morden Experimental Farm" published in June, 1964. Our recommendations are as follows: "In the best treatment for *Crataegus*, seed is dried, stored at 40° F. over winter, scarified with acid for 30 minutes and sown in June. Seed sown in late summer benefits by a longer scarification treatment in acid, up to 2 hours."

The seedlings in this particular test were dug in the spring of 1962, at which time most of them were two years old. Notes were taken on their root formation and uniformity in size and nine species were selected for lining out for the actual budding tests. Seedlings of *C. succulenta* were eliminated because of their poor root system and their suckering habit, the others were eliminated either because of poor seed germination or unevenness in growth. Table II records the budding results.

Table II *Budding Results*

Seedling Rootstock	% of Surviving Sdls Budded in 1962	% Yield of Budded number budded)		Ave Height of Budded Plants (inches)		Ave diameter Budded Plants (sixteenths of an inch)
		Plants (based on 1963	1964	1963	1964	
<i>C. mollis</i>	96	88	88	42	73	13
<i>C. arnoldiana</i>	96	74	70	40	65	14
<i>C. sanguinea</i>	83	83	78	34	71	12
<i>C. rivularis</i>	88	93	86	34	61	12
<i>C. caesia</i>	89	81	56	34	71	14
<i>C. wendilandi</i>	79	67	67	35	66	13
<i>C. strigosa</i>	79	71	71	34	58	12
<i>C. chrysoarpa</i>	53	30	30	30	58	11
<i>C. punctata</i>	51	47	26	25	56	11

With the possible exception of *C. rivularis* these species can be rated in three groups:

The first group are decidedly promising and include *C. mollis*, *C. arnoldiana* and *C. sanguinea*. The latter is deeper rooted and requires careful handling at digging time.

The second group are only moderately good and include *C. caesia*, *C. wendilandi* and *C. strigosa*.

The third group are poor and include *C. chrysoarpa* and *C. punctata*.

C. rivularis has a definite dwarfing effect on all scion varieties tested. Varieties budded on it ripened up 10 days to 2 weeks earlier and the diameter of the scion variety is in all cases less than the diameter of the stock. Only time will provide us with the answer to the question of whether we have in this case an incompatibility which will result in a short life or whether we have a useful dwarfing stock.

I fully realize that this is only a meager beginning in the long process of selecting a suitable hardy rootstock. However, based on results of this test to date we are now including *C.*

mollis, the downy hawthorn, along with *C. arnoldiana*, the Arnold hawthorn, in our recommendations, as suitable hardy *Crataegus* rootstocks.

All of the material from this experiment will be replanted in the spring of 1965 and the remainder of this story will unfold with the passing years.

MODERATOR SHUGERT: Thank you very much, Mr. Cumming. Next speaker on our program will be speaking about nursery propagation of Carpathian Walnuts, Ben Davis II, Ozark Nurseries, Tahlequah, Oklahoma.

NURSERY PROPAGATION OF CARPATHIAN WALNUTS

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The first step in nursery propagation of Carpathian Walnuts is, thorough and adequate soil preparation. The site chosen for planting may have swags or low places that will need leveling. Either a dozer blade or a large float may be used to fill in the swags so that water will not stand in the field. After the site is properly leveled, it must be broken. At Ozark Nurseries we use a large offset disc, which cuts 9½ feet wide and 10 to 12 inches deep. The disc has the advantage of chopping up any trash present, while breaking the ground. After the ground has been broken, and the trash worked into the soil, some type of subsoiling should be done. This allows the ground to store up water during heavy rains and give it back to the plants during dry weather. The loosened soil also encourages better growth and makes digging operations easier when the trees are ready for sale. For nut trees, we use a large ripper which breaks up the soil to a depth of 36 inches. After this is done, it is necessary to run the offset disc again to level the soil and fill in the furrows left by the ripper. Then a disc harrow, with a spike toothed harrow pulled behind, is used to break up any clods and smooth and level the soil for planting.

Planting operations are begun in the fall by marking off rows 4½ feet apart with a V-shaped shoe that leaves a smooth furrows 2 to 3 inches deep. This shoe is mounted on a one-row tractor and is followed by a planting crew which drops the nuts, by hand, 5 to 6 inches apart. The nuts that we use are Native Black Walnut, or *Juglans nigra*. Immediately behind the crew dropping the nuts follows a one-row tractor with disc hillers. The disc hillers pull the soil in over the rows to cover the nuts. This keeps them moist until spring and prevents them from being heaved out of the ground during freezing and thawing. Once the nuts are covered they are left undisturbed throughout the winter.

The following spring, as soon as the weather warms up, the nuts are checked periodically by digging down into the hills to