Effects of Boron and Succinic Acid 2,2-Dimethyl Hydrazide (SADH) on Fruitfulness and Storage Behavior of 'Magness' Pears[1]

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Introduction of the 'Magness' pear in 1960 as a good quality, fire-blight resistant cultivar, increased interest in growing pears in areas where fire blight *(Erwinia amylovora)* is a severe problem. In 1970, a USDA report rated 'Magness' as highly resistant to this disease (4); however, further evaluation indicated that the trunk is susceptible, but that shoot growth is resistant (6). 'Magness' produces no pollen, but a number of varieties have been found to be effective pollinizers (7). Petals of 'Magness' flowers are small, and a considerable amount of foliage develops before full bloom; these two factors may contribute to the lack of bee activity in 'Magness' compared with other cultivars, as reported by Caron (2). Lack of fruitfulness has been the main problem with 'Magness' plantings, though the original testing at Beltsville, Maryland, gave no indication of this phenomenon.

These studies were undertaken to influence flowering and fruiting in a block of vigorous "Magness' trees, planted in 1962, at the University of Maryland Plant Research Farm near College Park. Pollinators were 'Moonglow,' 'Seckel,' and 'Stewart Bartlett' at a ratio of 1 pollinator to 3 'Magness' trees. Trees received ordinary care; no fertilizers were used. Two experiments were conducted involving 1) SADH sprays and, 2) boron, alone and in combination with other treatments.

SADH sprays of 1,200 and 2,400 ppm were applied from 1965 through 1971, when terminal growth was 3 to 6 inches long, to the same 5 single-tree replicates each year. A boron study was begun in 1969, using 6 single-tree replicates. In February, boron was applied to the soil at 2, 4 and 8 lbs per acre using Solubor as the source. Application was made with a sprinkling can on a 20 X 25 ft. plot assigned to each tree. Four sets of trees received the 2 lb soil application, 3 of which had other treatments superimposed thereon in 1969, 1970 and 1971 as follows: (1) scoring – one ring around the trunk with a pocket knife 1 to 2 weeks after full bloom; (2) 2,3,5 triiodobenzoic acid (TIBA) at 50 ppm applied 2 to 3 weeks after full bloom; (3) three sprays of boron at 245 ppm (Solubor, 1 lb/100 gallons), the first one at delayed dormant, the last before any blossoms were open. Another set of trees received 3 boron sprays only.

Yield and fruit size were recorded on both experiments from 1969 through 1971. Fruit samples from the SADH and certain boron treatments were picked on August 4 and 17, 1970, for storage studies; data from the two dates were used as replicates. The fruit was divided into two lots and placed in normal refrigerated storage at 30-32°F. On October 1, one lot was moved to a commercial controlled atmosphere (CA) apple storage at 30-31°F, where O_2 and CO_2 each ranged from 3 to 5%. This lot remained in CA until January 22, when it was returned to normal storage. In mid-February, all fruits were removed

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Table 1. Effect of 7 years (1965-1971) of single post-bloom SADH sprays on yield and fruit size of 'Magness' pears.

Treatment and concentration	Yield per tree[1] (lb)				Fruit size[1] (lb/fruit)		
	1969	1970	1971	Total	1969	1970	1971
Check	55	113	164	332	.311	.251	.235
1,200 ppm	117	162	232	511	.296	.226	.219
2,400 ppm	135	128	222	485	.289	.239	.216

1—No significant difference between treatments.

from the normal storage, part of which was examined immediately, the other part after 4 days at 65°F. Determinations included shear force (maximum peak in lbs per sq. in. with Lee-Kramer Shear Press), soluble solids, and total acidity (ml of .09 N NaOH required to bring 25 gm of pear tissue to pH 7.0).

Results and Discussion

SADH for 7 years resulted in a more compact growth habit in the 'Magness' tree, this commensurate with concentration. Although both concentrations of SADH increased the yield over the 3-year period, the differences were not significant (Table 1). Yields were unsatisfactory for the size and age of trees, as they could have supported a much heavier crop. Fruit size was 5 to 10% smaller on the SADH-sprayed trees, not a significant difference.

In the boron experiment, no treatment had a significant effect on yield (Table 2). Boron has increased pollen germination and fruit set in pears (1, 5) and other plants (3), but there was no evidence in this study that boron had a positive effect. Fruits were reduced in size by the TIBA sprays, but no other treatment had any consistent effect.

These results indicate that a lack of boron was not a contributing factor in unfruitfulness of 'Magness.' Demand for boron is high early in the season, particularly during the fruit-setting period. Should there have been a temporary shortage at this time, possibly due to low soil temperature inhibiting adequate transport from the soil, the 3 sprays applied should have met the demand even if boron in the soil did not.

When removed from storage, fruits which had been in CA about 4 months, had a much higher shear force value than fruit from normal storage (Table

Table 2. Yield and fruit size of 'Magness' pears as affected by boron sprays, and by soil applications with and without certain other treatments.

Treatments[1]	Yield per tree (lb)				Fruit size (lb/fruit)		
	1969	1970	1971	Total	1969	1970	1971
Check	56a[2]	118a	159a	333a	.313a	.250a	.236a
Soil boron, 2 lb/acre	108a	166a	218a	492a	.306a	.252a	.234a
" " , 4 lb/acre	91a	112a	172a	375a	.305a	.253a	.224a
" " , 8 lb/acre	86a	115a	163a	364a	.305a	.241ab	.232a
" " , 2 lb + scoring	108a	186a	182a	476a	.310a	.248a	.231a
" " , 2 lb + TIBA sprays	56a	87a	128a	271a	.243b	.212c	.185a
" " , 2 lb + boron sprays	45a	100a	135a	280a	.306a	.219bc	.233a
Boron sprays, 245 ppm	34a	77a	157a	268a	.301a	.232abc	.235a

1—All soil boron applied once, February, 1969. Other treatments performed yearly, 1969 through 1971, as follows: scoring—once, 1-2 weeks after bloom; TIBA—1 spray, 50 ppm, 2-3 weeks after bloom; boron sprays—3 each year between delayed dormant stage and first open blossom.
2—Mean separation within columns by Duncan's multiple range tests, 5% level.

Table 3. Effects of early-spring SADH foliage sprays on firmness, soluble solids, and acidity of 'Magness' pears in normal and controlled atmosphere (CA) storage, 1970.

SADH spray (ppm)	Type of storage	Shear force		Soluble Solids		Total acidity	
		Initial[1] (lb)	Ripe[2] (lb)	Initial (%)	Ripe (%)	Initial	Ripe
	Normal	192	156	15.9	15.9	2.44	1.78
Check	CA	521	93	14.4	16.6	2.28	1.94
	Normal	170	158	14.6	15.1	2.20	1.70
1,200	CA	642	145	14.2	14.4	1.25	1.58
	Normal	371	183	13.7	13.4	1.62	1.83
2,400	CA	690	154	15.5	15.5	1.60	1.83

1—At time of removal from storage.
2—After 4 days at 65°F.

3). However, after 4 days at 65°F, the CA-stored fruit was softer than fruit from normal storage. Even though CA storage did not increase shelf life, fruit from CA was decidedly superior in appearance, and exhibited less rot and skin blackening. Soluble solids in fruits from normal storage tended to be lower in the SADH treatments than in the check, both initially and when ripe. Total acidity was lower in the SADH-treated than in the check fruits in both types of storage immediately after withdrawal, but when ripe these difference had largely disappeared.

The effect of boron on shear force under CA or normal storage was inconsistent (Table 4). CA-stored fruit had a higher shear force than fruit from normal storage initially, but the reverse was true when ripe. This is consistent with data in Table 3. While large fluctuations existed among treatments, there was an indication that boron at the 8 lb rate caused softer fruit when ripe. Fruits from CA storage generally were higher in soluble solids than in fruits from normal storage, especially after ripening. No trends due to treatments were evident in total acidity measurements. As in the SADH experiment, CA-stored fruit had much less rot and black discoloration than fruit from normal storage. Some fruits from CA storage had a pink discoloration, but taste was not affected.

These tests indicate that 'Magness'

Table 4. Effect of boron on firmness, soluble solids, and acidity of 'Magness' pears in normal and CA storage, 1970.

Boron treatments[1] (lb/acre)	Type of storage	Shear force		Soluble solids		Total acidity	
		Initial[3] (lb)	Ripe[4] (lb)	Initial (%)	Ripe (%)	Initial	Ripe
	Normal	192	156	15.9	15.9	2.44	1.78
Check	CA	521	93	14.4	16.6	2.28	1.94
	Normal	446	178	14.9	14.9	1.56	1.10
2	CA	504	114	16.5	16.5	2.50	2.23
	Normal	485	159	16.7	15.5	2.64	2.28
2 + 3 sprays[2]	CA	682	151	15.5	16.4	1.93	1.90
	Normal	295	147	15.7	15.5	2.48	2.38
4	CA	686	110	16.5	16.4	3.08	2.25
	Normal	157	88	15.2	15.7	1.95	1.05
8	CA	500	81	17.0	16.3	2.20	2.10

1—Boron applied to soil February, 1969.
2—Boron applied at 245 ppm between delayed dormant stage and first blossom, 1969 and 1970.
3—At time of removal from storage.
4—After 4 days at 65°F.

pears can be stored up to 5 months in CA storage, that ripening is rapid after removal from CA storage, but that quality and appearance are greatly enhanced over fruits from normal storage. The fact that there was a 6 to 8 week delay before placing in CA makes the results even more striking.

The cause for lack of cropping of 'Magness' was not elucidated by this study, and there appears to be no available knowledge of how to increase it. Extra bee colonies during bloom have not been beneficial. There appears to be no relationship between fruiting and availability of pollen, or the cultivars providing the pollen. There are several small 'Magness' plantings in Maryland most of which have not been very fruitful. One of the highest producing blocks in the state, now 13 years old, has been pruned and fertilized annually with moderate amounts of nitrogen. Fireblight has not been a problem. These trees are less dense and open to more sunlight than most others in the state. Cropping has helped in the spreading of the branches; those which have been spread seem to bear more consistently than other upright ones. However, it is unlikely that this is the sole answer to fruitfulness in this block. It is possible that other factors such as nutrition, pollinating insects other than the honey bee, and geographical location may play a part.

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Potentialities for the Exploitation of Citrus Wealth in Uttar Pradesh Hills, India[4]

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The citrus industry is one of the most important enterprises in many developed countries of the world. Because of its varied adaptability, nutritive value, easy handling, delicious taste, fragrance, pleasing flavor and good keeping quality, citrus fruits are adapted nearly all over the globe. In acreage they rank third (2, 3, 8) among all fruits of the world with more than 8,000,000 hectares as compared with 10,600,000 ha of grapes and 5,400,000 ha of olives. India is the homeland of many citrus species of commercial and academic interest. It ranks second in acreage (7), with 105,396 ha as compared to 260,000 ha in the U.S.A.

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