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.

Literature Cited

1. Batjer, L. P. and A. H. Thompson. 1949. Effect of boric acid sprays applied during bloom upon the set of pear fruits. *Proc. Amer. Soc. Hort. Sci.* 53:141-142.
2. Caron, Dewey M. 1973. Honey bee activity on 'Magness' and pollinizer pear varieties. *Fruit Var. Jour.* 27:81-83.
3. Gauch, Hugh G. and W. M. Duggar, Jr. 1954. The physiological action of boron in higher plants: a review and interpretation. *Univ. of Md. Exp. Sta. Bul.* A-80.
4. Oitto, W. A., T. van der Zwet, and H. J. Brooks. 1970. Rating of pear cultivars for resistance to fire blight. *HortScience* 5:474-476.
5. Thompson, A. H. and L. P. Batjer. 1950. The effect of boron in the germinating medium on pollen germination and pollen tube growth for several deciduous tree fruits. *Proc. Amer. Soc. Hort. Sci.* 56:227-229.
6. van der Zwet, T., and W. A. Oitto. 1972. Further evaluation of the reaction of "resistant" pear cultivars to fire blight. *HortScience* 7:395-397.
7. van der Zwet, T., H. L. Keil, and W. A. Oitto. 1973. Pollination and fruit set of 'Magness' pear. *Fruit Var. Jour.* 27:77-80.

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

R. D. SINGH,[1] R. K. SRIVASTAVA[2] AND R. P. SRIVASTAVA[3]

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.

[1]Senior Horticulturist, Govt. Hill Fruit Research Station, Chaubattia (Almora), U.P., India.
[2]Chief Instructor, Govt. Fruit Preservation & Canning Institute, Lucknow, U.P., India.
[3]Chief Horticulturist, Govt. Hill Fruit Research Station, Chaubattia (Almora, U.P., India.
[4]The authors are grateful to Dr. S. S. Teaotia, Director, Horticulture and Fruit Utilization, U.P. and Dr. S. K. Bose, Officer-in-Charge, Govt. Hill Fruit Research Station, Chaubattia, for encouragement.

The hill districts of Uttar Pradesh (U.P.) are ideally suited for citrus cultivation. Many of the indigenous species have originated in these submountain areas (3, 5, 6). Commercial cultivation has existed since the aboriginal period.

Nearly all the commercial species and varieties are extensively cultivated in the hills of Uttar Pradesh, *viz.*, sour lime (*C. aurantifolia* Swingle); sweet lime (*C. limettioides* Tanaka); sour orange (*C. aurantium* L.), karna khatta (*C. karna* Raf); jambheri (*C. jambiri* Lushington); lemons (*C. limon* Burm. F.); mandarins (*C. reticulata* Blanco); sweet oranges, i.e., 'Malta' and 'Mosambi' (*C. sinensis* Osbeck); grapefruit (*C. paradisi* Macfd); pummelo (*C. grandis* Osbeck); kumquat (*C. japonica*); citron (*C. medica* L.); and minneola (*C. paradisi* x *C. reticulata*). Studies of the samples collected from different portions of the region revealed excellent quality standards for these fruits. In many cases, they were better in size, color, taste and flavor in comparison to fruits from the plains. Some of the important fruit characters of the varieties studied are presented in Table 1.

The fruits of these varieties were also analysed chemically (1) to assess their standards. The results are presented in the Table 2.

This table shows that the fruits of this region are fairly rich in chemical constituents (4) in spite of very little care given to their cultivation. Thus it would appear that fruits of superior quality can be produced if the plants were properly grown. The Directorate of Horticulture & Fruit Utilization has established several valley fruit research stations to improve commercial production of these fruits.

Table 1. Fruit characteristics of citrus cultivars grown in the U.P. Hills.

Cultivar	Size (cm) Length	Size (cm) Diameter	Weight per fruit (g)	Juices per fruit (ml)	No. of seeds per fruit
Sweet lime	5.00	5.40	145.60	37.02	3-4
Kagzi lime	4.60	4.70	183.80	21.05	0
Karna Khatta	8.80	8.10	290.00	51.03	18-22
Mathkakari	15.50	12.00	1062.00	Nil	19-22
Villafranka lemon	8.10	6.30	220.50	78.00	8-12
Hill lemon	10.30	8.20	553.00	62.40	8-12
Eureka lemon	7.00	5.20	197.63	35.87	30-33
Kinnow orange	6.50	7.16	200.00	45.00	4-6
Nagpur orange	5.98	8.06	205.00	50.78	4-5
Hill orange	5.40	6.90	160.00	50.00	8-27
Srinagar orange	5.40	5.50	145.00	45.00	5-25
Valencia late	7.80	7.90	199.60	54.28	8-12
Pineapple	6.40	6.00	168.00	41.11	8-10
Blood Red	6.90	6.90	152.00	48.00	0-4
Washington Naval	7.60	7.80	162.00	62.00	0-4
Common Malta	7.50	7.60	224.00	79.00	2-34
Mossambi	6.80	6.90	165.50	21.05	10-13
Saharanpur special grapefruit	9.60	11.40	218.70	37.60	27-30
Marsh seedless grapefruit	9.80	11.90	481.50	40.70	4-6
Pummelo	13.40	16.40	1725.00	20.48	80-85

Table 2. Chemical composition of citrus fruits grown in U.P. Hills.

Cultivar	Total Sol. Soils (%)	Acidity (%)	pH	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Ascorbic acid (mg/100 g)
Sweet lime	10.00	1.100	2.9	7.100	7.030	0.060	19.00
Kagzi lime	7.00	5.070	2.2	0.790	0.690	0.090	20.00
Karna Khatta	8.00	5.440	2.5	1.330	1.290	0.040	28.75
Mathkakri	9.00	8.460	2.2	1.350	0.980	0:350	30.00
Villifranka lemon	8.00	5.150	2.5	1.130	0.960	0.160	23.75
Hill lemon	7.00	3.970	2.8	—	—	—	18.75
Eureka lemon	10.00	5.000	2.2	1.000	0.670	0.310	22.50
Kinnow orange	15.00	1.070	3.1	5.320	4.240	0.790	18.50
Nagpur orange	10.00	0.730	2.8	8.250	4.920	3.160	25.25
Hill orange	11.00	0.632	2.8	8.594	3.380	4.952	40.00
Srinagar orange	10.80	0.600	2.8	8.250	3.350	4.655	25.12
Valencia late	10.00	1.030	2.9	3.600	3.350	0.240	46.25
Pineapple	9.00	0.730	3.0	5.630	2.500	2.910	60.00
Blood Red	9.00	1.490	3.0	5.190	2.930	2.150	40.00
Washington Navel	10.90	1.100	2.8	5.100	2.450	2.518	42.50
Malto common	11.50	0.896	2.8	8.019	3.882	3.930	71.18
Mossambi	12.00	0.370	3.0	7.520	7.350	0.160	47.50
Saharanpur special grapefruit	8.50	5.290	2.5	4.000	1.930	1.960	45.00
Marsh seedless grapefruit	10.00	2.130	3.1	4.650	4.260	0.370	55.00
Pummelo	12.00	1.100	3.0	6.360	1.820	4.250	62.50

Three flushes of growth occur in this area—February-March, June-July and August-September. The blooming period is mostly in March for nearly all the varieties in this area. Fruit ripening begins in November and continues to February. These are generally harvested when they begin to change color, although color is not a good criterion for maturity. Studies at the Govt. Horticultural Research Station, Pithoragarh, have indicated that maturity comes in 'Hill' orange and 'Common Malta' 160-180 days after fruit-set. The standards of maturity observed for 'Hill' were T.S.S. 10.19 - 10.7%, T.S.S./acid ratio 9.55 to 13.38, acidity 0.76 - 1.12% and sugars 7.453 - 7.835%; and for the 'Common Malta' T.S.S. 10.0 - 11.5%, T.S.S./acid ratio 8.984 - 11.16, acidity 0.896-1.28%, and sugars 7.00-8.019%. The juice content is also considerably high at this stage.

References

1. A.O.A.C. 1960. Methods of analysis, Washington, D. C.
2. Hume, H. H. 1957. Citrus fruits. The Macmillan Co., New York.
3. Hayes, W. B. 1960. Fruit growing in India. Kitabistan, Allahabad, U.P., India.
4. Kefford, J. F. and B. V. Chandler. 1970. The chemical constituents of citrus fruits. Academic Press, New York and London.
5. Motial, V. S. 1966. Classification of some citrus varieties of Uttar Pradesh. I. *Horticulturist;* 1 (4):160-169.
6. _____. 1967. Classification of some citrus varieties of Uttar Pradesh. II. *Hor. ticulturist;* II (1-4):11-22.
7. Singh, D. 1969. Citrus in India, Pakistan and Iraq. *Proc. First Inter. Citrus Sym. Vol. I*: 103-109.
8. Webber, H. J. and L. D. Batchelor. 1948. *The Citrus Industry. Vol. I.* University of California Press, Berkeley and Los Angeles