EVALUATING THE ROLE OF HONEYBEES IN FOOD PRODUCTION

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I. Value of Honey Bee Pollination in Crop Production

Most previous attempts to assign a monetary value to pollination by honey bees have consisted of compiling a list of crops known to require or benefit from bee (usually, honey bees) visitation. The values of these crops are then summed and presented as the value of crops pollinated by bees.

Crops included in these lists are those on which research, observations and/or practical experience have indicated the importance of honeybees. Research techniques for providing this information include growing plants under conditions which permit some of them to be visited by bees while some are isolated from bees. Thus, the presence or absence of bees on crops in greenhouses, screen cages, or isolated plots provide suitably replicated data which can be statistically analyzed and used to determine the need for bees (McGregor 1976, Free 1970, Borneck and Bricout 1984, Pesson and Louveaux 1984, Crane and Walker 1984). Other techniques involve placing paper or cloth net bags over individual flowers or groups of flowers and then removing the bags to hand pollinate some flowers or expose them to known numbers of bee visits (Deodikar 1975, McGregor et al. 1965).

The yield and quality of seed or fruit produced from the bee-pollinated plants or flowers is then compared with that from plants or flowers maintained in similar conditions but not visited by bees. Results vary with the crop tested and range from essentially no yield or only poor-quality fruit or seed where there has been no bee pollination too only slight changes in yield or quality. Results from such small-scale tests are rarely verified on large-scale experimental plantings because of the cost and difficulty in providing adequate replication of treatments. However, properly conducted small-scale tests can be used to make acceptable predictions of the role of bees in large-scale production.

Based on such data, tabulations and evaluations of crops pollinated by bees have appeared from time to time. Metcalf et al. (1962) valued crops in the United States which require pollination at $4.5 bilion in 1957. In 1971 Ware (1973) reported this value at $7.6 bilion. The acreage of certain crops (viz. sunflower and soybeans) has increased significantly and combined with higher prices, the value of crops pollinated by bees has increased dramatically to $11.8 billion. This most recent update (Levin, 1983) is based on the value of crops listed as of 1981 (Table 1). Crops and commodities included came from the 129 crops listed by McGregor (1980) as dependent upon or benefitting from insect pollination and on which statistical information was available (USDA, 1981). No attempt was made to separate the crops according to degree of dependency on insect pollination. Moreover, in addition to the actual value of the seed crop produced with the help of bees, the value of the resultant crops and commodities has also been included raising the total value to $19 billion. This is based on the argument that without seed, the subsequent crops could not be grown. For example, without alfalfa hay, beef or milk could not be produced as efficiently as they are now.

Atkins (pers. comm..) characterized this pyramid showing the dependency of one of the most important crop systems in California on honey bees – alfalfa seed and hay. In California a $25 million beekeeping industry directly supports a $40.8 million alfalfa seed industry. Alfalfa seed directly supports a $685 million hay industry (to say nothing of hay grown outside California from California-produced seed). California hay supports a $1.23 billion cattle and calf industry and $1.35 billion dairy products industry. On this basis, Atkins concluded that honey bee pollination is the vital key to $3.3 billion worth of agriculture food production in California alone.

A recent analysis of the role of pollinating honey bees in the development of the alfalfa seed production industry in the western United States was made by Olmstead and Wooten (1987). Their data show that concentrating honey bees in alfalfa seed fields resulted in dramatic increases in yields and restructuring of the whole alfalfa seed industry. A somewhat more conservative approach to similar calculations resulted in the values shown in Table 1. The total value of crops and commodities in the U.S. to which honey bees contribute through their pollinating activities reaches the impressive sum of almost $19 billion.

Table 1

Value of crops pollinated by bees, 1980 [a, d]

Commodities	Fruits and nuts	Value ($)	Seeds and fiber	Value ($)
Requiring or directly benefitting from bee pollination	Apples	757,027[a]	Alfalfa	114,652
	Apricots	33,705	Red clover	16,176
	Avocados	121,293	Ladino clover	3,941
	Bus berries	62,263	Crimson clover	1,433
	Cherries (Tart)	43,648	Lespedeza	2,628
	Cherries (Sweet)	91,812	Soybeans (1/10)[b]	1,382, 494
	Citrus		Sunflower	410,377
	Lemons	61,319	Cotton seed (1/10)[b]	57.693
	Tangerines	37,559	Cotton lint (1/10)[b]	407,831
	Tangelos	26,816	Lima beans	25,137
	Temples	25,020	Flax	59,054
	Carnberries	88,674	Vegetable seeds	60,000
	Eggplant	10,411	Total	2,541,416
	Nectarines	44,468		
	Peaches	368,004		
	Pears	174,876		
	Pomegranates	3,516		
	Prunes and plums	13,777		
	Strawberries	288,776		
	Cantelopes	161,133		
	Cucumbres-fresh	116,260		
	Cucumbres-processed	100,933		
	Honeydew	42,864		
	Watermelons	149,757		
	Almonds	473,340		
	Macadamia	24,174		
	Total	3,321,425		
Resulting from seed requiring bee pollination	Artichokes	27,473		
	Asparagus	82,118		
	Brocolli	55,286		
	Brussel sprouts	15,706		
	Cabbage	175,211		
	Carrots	161.432		
	Cauliflower	95,762		
	Onions	346,539		
	Alfalfa hay	4,981,394		
	Total	5,940,921		
Indirectly dependent on bee pollination	Cattle and calves (1/10)[c]	5,435, 974		
	Liquid milk production (1/10)[c]	1,688, 340 7,124,314		
Total Sum	$18,961,858,184			

[a] = Values represent thousands of dollars

[b] = Not all varieties benefit. Ten percent is a conservative estimate of pollination value

[c] = Sixty percent of all hay fed to cattle and dairy herds is alfalfa. A conservative 10% of total value is credited to pollinating activities that initiate the following chain of production: pollination → alfalfa seed → hay → cattle, meat and dairy.

[d] = FROM: Levin, M.D. 1983. Value of crops pollinated by honey bees. Bull. Entomol. Soc. Amer. 29 (11): 50-51

II. Value of Honey Bee Pollination to Non-Agricultural Plants

Many other plants besides agricultural crop plants require or benefit from pollination by foraging bees. These include plants of value for ornamental use, range plants, medicinal plants, and trees and shrubs that provide food and shelter for wildlife. Many of these plants also stabilize soil and prevent erosion. Home orchards and backyard gardens contain many food plants that require pollination, but the value of these are not included in the estimation of pollination value because appropriate data do not exist (Moffett and Barclay, 1984).

Moffett and Barclay (1984) estimated the value of honey bees to gardens and home orchards based on the number of these known to exist in the U.S. In 1983 approximately $14.5 billion of produce were harvested from the 35 million home vegetable gardens. Fifteen of the 23 most commonly grown vegetables benefited from insect pollination by either increased yields in the garden, or by an increase in the yields of seed grown for planting in gardens.

There were 16 million home orchards and 10 million families growing small fruits and berries for their own use. The pollination requirements of trees in home orchards are similar to those of the same cultivars grown in commercial orchards.

Most orchard trees, small fruits and berries need insect pollination to produce adequate yields. Although harderto determine than for vegetable gardens, the value of food produced by home orchards and plantings of small fruits and berries by the homeowner is several billion dollars.

II. Economics of Supplying Honey Bee Pollination

As important as the pollinating activities of honeybees are to agricultural production and to nonagricultural plants, only a small par of the beekeeping industry is directly involved in pollination for remuneration. Generally beekeepers derive most of their income from the sale of honey and beeswax. In a few cases specialists produce queens and packages of bees for sale to other beekeepers. In only a few states do some beekeepers derive income from renting colonies to pollinate crops. A great deal of pollination is supplied free, incidental to the production of honey, beeswax, queens and package bees (Levin 1986). No system has developed in the United States to reimburse beekeepers fairly for the pollinating services they supply. The industry has therefore turned to the national government for help in solving economic and technical problems that would interfere with the ability to supply adequate pollination. Over the years assistance has been available: an ongoing $3 million research program, the Pesticide Indemnification Act, the honey price support program, sporadic efforts at controlling imports and investigating honey quality and more recently, regulatory efforts directed at tracheal mites, *Varroa* mites, and Africanized bees. Invariably, the primary justification for such financial assistance has been the recognition that the pollination services of honey bees are of paramount importance to assure that American agriculture continues to maintain an abundant supply of high-quality food for the benefit of the American consumer.

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