

The Value of Herbicides in U.S. Crop Protection

Leonard P. Gianessi, Crop Protection Research Institute, CropLife Foundation, 1156 15th Street NW, #400, Washington, DC 20005, lgianessi@croplifefoundation.org

Widespread herbicide use is a relatively recent development in U.S. agriculture in comparison with insecticides and fungicides, which were routinely used in inorganic, naturally derived chemical formulations on U.S. fruit and vegetable crops beginning in the early 1900s. By contrast, widespread use of herbicides to kill weeds did not begin until the introduction of synthetic organic chemicals in the late 1940s. Currently, herbicides are routinely used on more than 90% of the area of most U.S. crops. The importance of herbicides to U.S. crop production can be understood through a historical perspective and examinations of the practices of organic growers.

In the early years of crop production in the United States, human labor was used to remove weeds from fields. As late as 1850, 65% of the population lived on farms and removing weeds was one of the main farm chores. The historical record reveals that herbicides replaced or reduced the use of hand weeding and cultivation for weed control with an associated reduction in cost and increase in yield. The adoption of herbicides was spurred by a desire to reduce weed control costs as labor became scarce and more expensive in the years following World War II.

Use of the short handled hoe was the primary weed control method for most vegetable crops in California from the early 1900s through the 1960s. Weeding of celery took 111 hours/hectare, carrot took 69 hours/hectare, strawberry required 69 hours/hectare. Numerous complaints were received from farm workers who stated that they suffered permanent back damage as a result of using the short handled hoe for extended periods of time. The California Industrial Safety Board issued a regulation that permanently banned the use of the short-handled hoe in 1975. Most growers switched to the use of herbicides which proved to be more economical than the use of workers wielding hoes. The cost of herbicides plus application was \$25/hectare in comparison to hand weeding costs of \$247/hectare for spinach, \$198/hectare for celery, \$309/hectare for onion, and \$988/hectare for strawberry. The use of herbicides is credited with reducing the use of labor in California onion fields by 297 hours/hectare, which was equivalent to two million hours per year.

For many crops, herbicides substituted for and reduced the practice of cultivation. For example, herbicides reduced the number of tillage trips in California almond orchards by 16 with grower savings of \$52/hectare.

For most crops, historical data indicate an increase in yields due to herbicide use. For two crops, corn and soybean, researchers have statistically determined the contribution of herbicides to improved yields. Herbicides accounted for 20% of the increase in corn yields 1964 through

1979 and 62% of the yield increase in soybean 1965 through 1979. Better weed control with herbicides is credited as an important factor in doubling rice yields in the 1960s.

For several crops, including carrot, cotton, and onion, dramatic improvements in yield did not occur following the adoption of herbicides. For these crops, an adequate amount of hand labor had been previously used to remove weeds and prevent yield loss prior to the introduction of herbicides.

Organic crop growers do not use herbicides to control weed populations. The problem of controlling weeds without herbicides has been cited numerous times as the single biggest obstacle to crop production that organic crop growers encounter. Organic rice growers report that weed management is the most difficult part of organic production, and it is the major reason that organic rice yields are 50% lower than conventional yields. Lower yields and higher costs for weed control labor are two of the major reasons that organic cotton must sell with high price premiums.

California organic crop growers rely extensively on hand weeding to control weed populations: almond (17h/ha), apple (50 h/ha), cotton (30 h/ha), cucumber (75 h/ha), grape (20 h/ha), lettuce (45 h/ha), onion (181 h/ha) and tomato (37 h/ha). The problem of farming without herbicides was recently highlighted in an exemption from a farm worker protection rule granted to California organic growers. The State of California banned the practice of using workers to pull weeds by hand in 2004. The California Occupational Safety and Health Standards Board determined that the practice of pulling weeds by hand was more destructive to workers backs than use of the short handled hoe, which had been banned in 1975. Organic crop interests sought and were granted an exemption from the ban on hand weeding, claiming they would incur tremendous yield and profit losses if they were required to use laborers with long handled hoes rather than hand weeders. Organic crop growers reported that workers with long-handled hoes would inadvertently damage or remove some of the vegetable plants while missing some of the weeds.

References

Adams, R. L. 1938. Seasonal Labor Requirements for California Crops. University of California Agricultural Experiment Station, Bulletin 623.

Asai, W., L. Hendricks, P. Verdegaal, K. Klonsky, C. Ingels, P. Livingston, and L. Tourte. 1992. Sample Costs to Produce Organic Almonds in the Northern San Joaquin Valley. University of California Cooperative Extension Service.

Ashton, F. M. 1960. The Major Problem in Vegetable Crop Production- Weed Control. Proceedings of the California Weed Science Society. 12: 72-74.

Bolgenhom, V. 2004. The Use and Importance of Handweeding in Organic Farming, letter to Jose H. Millan, Deputy Secretary, Enforcement, California Labor and Workforce Development Agency. Available at- <http://www.croplifefoundation.org>.

Earthbound Organic. 2006. Organic Farming 101: Controlling Weeds Without Chemical Herbicides. Available at <http://www.ebfarm.com/Organic/WeedControl.aspx>.

Gianessi, Leonard. 2007. The Value of Herbicides in U.S. Crop Production. *Weed Technology*, 21: 559-566.

Gianessi, L. and N. Reigner. 2005. Why California Organic Growers Want an Exemption from a Farm Worker Protection Rule. CropLife Foundation. Available at- <http://www.croplifefoundation.org>.

Jourdane, Maurice "Mo." *The Struggle for Health and Legal Protection of Farm Workers: El Cortito*. Houston, Texas: Arte Publico Press, 2004.

Klonsky, K., P. Livingston, R. Vargas, and B. Weir. 1995. Production Practices and Sample Costs for Organic Cotton – Northern San Joaquin Valley. U.S. Department of Agriculture, University of California Cooperative Extension.

Klonsky, K., L. Tourte, D. Chaney, P. Livingston, and R. Smith. 1994. Cultural Practices and Sample Costs for Organic Vegetable Production on the Central Coast of California. University of California, Giannini Foundation Information Series No. 94-2.

Klonsky, K., L. Tourte, and D. Chaney. 1993. Production Practices and Sample Costs for Organic Processing Tomatoes in the Sacramento Valley. University of California Cooperative Extension.

Klonsky, K., L. Tourte, and C. Ingels. 1992. Sample Costs to Produce Organic Wine Grapes in the North Coast. University of California Cooperative Extension.

Lange, A.H., and R.A. Brendler. 1965. Weed Control in Transplanted Celery. *California Agriculture*. 19 (2): 2-3.

Meith, H. C., and P. S. Parsons 1965. Nontillage and Strip Weed Control: Cut Almond Production Costs in Butte County Test. *California Agriculture*. 19(6): 2-4.

Mueller, K. E. and E. A. Oelke. 1965. Watergrass Control in Rice Fields with Propanil and Ordram. *California Agriculture*. 19(7): 10-12.

Nylund, R. E., D.C. Nelson, and D.H. Dinkel. 1958. Comparative Costs of Weeding Onions by Hand or with Monuron, CIPC, and CDAA. *Weeds*. 6:305-309.

- Peterson, G. E. 1967. The Discovery and Development of 2,4-D. *Agricultural History*. 41:243-253.
- Rood, Mary Ann. 2002. Long-Haul Organic. *Rice Journal*. 105:12-17.
- Schneider, Paul. June 20, 1993. The Cotton Brief. *New York Times*.
- Schroder, D., J.C. Headley, and R.M. Finley. 1984. The Contribution of Herbicides and Other Technologies to Corn Production in the Corn Belt Region, 1964 to 1979. *North Central Journal of Agricultural Economics*, 6(1): 95-104.
- Schroder, D., J.C. Headley, and R.M. Finley. 1981. The Contribution of Herbicides and Other Technologies to Soybean Production in the Corn Belt Region, 1965-1979. University of Missouri, *Agricultural Economics Paper* 1981-33.
- Smith, N. J. 1956. How to Kill 20 Million Weeds an Hour! *American Vegetable Grower*. May: 12-13.
- Smith, R. J., W.T. Flinchum, and D.E. Seaman. 1977. Weed Control in U.S. Rice Production. U.S. Department of Agriculture, *Agriculture Handbook* 497.
- Swezey, S. L., P. Vossen, J. Caprile, and W. Bentley. 2000. *Organic Apple Production Manual*, University of California Agriculture and Natural Resources, Publication 3403.
- Watwood, R. P. 1959. Weed Control in Carrots and Celery. *Proceedings 11th Annual Meeting California Weed Science Society*. 11:21-22.
- Yarrick, B. E. 1946. Notes on Non-Tillage. *The California Citrograph*. 31: 318-319.