Session D: Weed School
Moderated by: Joe DiTomaso, Weed Specialist, University of California, Davis
"Weed Impacts"

Economic Impacts of Weed Control in Agricultural and Non-Agricultural Systems

Karen Klonsky, Dept. of Agricultural and Resource Economics, University of California – Davis

A market economy can be viewed as the flow of goods and services between firms and households. Households supply land, labor and capital to firms through the factors market and receive payment in the form of rent, wages, interest and profits. Firms produce good and services and sell them in the goods market to households in exchange for revenue. Transactions in the goods and factors market determine the price of goods and factors based on the supply and demand from firms and households. Numerous influences continuously shift supply and demand changing prices faced by consumers and firms in the marketplace.

With respect to weed control in agricultural production, decisions at the farm level are made regarding how much of any one input to use and the most profitable combination of inputs based on the efficacy of the inputs and the prices of the inputs and the output being produced. In determining the amount of an individual input to use, the rational producer will to continue to add the input until the value of the production gained from the additional unit is equal to the cost of the additional unit. This criteria is consistent with the law of diminishing returns stating that when an input is added and all other inputs are held constant, the resulting production will first increase at an increasing rate, then increase at a decreasing rate and finally decrease.

As a result, the yield maximizing level of input is always higher than the profit maximizing level. This holds because the yield maximizing level occurs at the point where production changes from increasing at a decreasing rate to decreasing and the marginal value of an additional unit of output is zero. The profit maximizing level of input occurs at the point where the cost of an additional unit of input equals the marginal value of an additional unit of output. Since the cost of a unit of input is greater than zero, this equivalency holds when the output is still increasing and is therefore less than the yield maximum. What is most important to realize is that the optimum level of an input changes as absolute and relative prices change.

In practice, of course, agricultural producers choose among a range of possible inputs and use several inputs in combination. In choosing the most profitable combination of inputs, the most profitable combination of inputs for a given output level occurs when the rate of substitution between two inputs equals the rate of the cost of substitution. Again, this tradeoff will change as the relative prices of the inputs change. Therefore, the information needed for weed management decisions at the farm level includes the prices of inputs and outputs, the physical relationships between inputs and outputs, and a criteria for making a decision.

In the previous discussion the criteria used for decisionmaking was profit maximization. But in practice agricultural producers meet multiple objectives which may include risk reduction, cost minimization, meeting quality standards, or establishment of wildlife habitat to name a few. Also, no mention has been made of regulatory constraints that also impact decisions.

Weed Control Costs in Agriculture –Examples from the Sustainable Agriculture Farming Systems Project

The Sustainable Agriculture Farming Systems Project located at the University of California – Davis, is an interdisciplinary project comparing alternative farming systems including conventional, low input and organic rotations. The eleven - year experiment from 1989 to 2000 strove to develop the best farming practices for each of the farming systems. The conventional system used preplant and within season herbicides at rates consistent with practices of top farmers in Yolo County. The low input system used a low rate of preplant herbicide and no in season applications. The organic system followed organic regulations and did not use any herbicides. All of the tomato systems included tillage and hand hoeing for weed control. The organic and low input systems used winter cover crops that were in part weed control.

The processing tomato cost of production for the three systems excluding the cost of equipment ownership shows that the total cost for the conventional system averaged $724 per acre, $1,1016 for the low input system and $1,080 for organic (Figure 1). The higher costs for the low input and the organic systems relate to the use of transplants in these systems and direct seeding in the conventional, winter cover crops only in the low and organic systems, and a higher cost for hand weed control compared to conventional. The cost of weed control averaged $166 in the conventional system, $213 for low input and $234 for the organic system. The low input systems spent only $2 per acre on preplant herbicides and the organic system used no preplant herbicides compared to $26 for the conventional (Table 2). With respect to hand hoeing (referred to as custom in figure 2) the conventional system averaged $33 per acre compared to $75 for the low input and $85 for the organic system. Therefore, not only were the total weed costs different among systems but the input use within the weed control programs varied.

For corn the average cost of production was $289 per acre for the conventional system, $290 for the low input and $372 for the organic system (Figure 3). The cost of weed control averaged $41 for the conventional system compared to only $19 for the low input and $13 for the organic system. For corn the major differences in the costs were the use of cover crops in the low input and organic systems, manure in the organic system, and lower rates of herbicides and fertilizer in the low input system than the conventional system. The organic system used no synthetic fertilizers or herbicides. All three systems included tillage for weed control. The weed control costs for the conventional system were 60% for materials, 21% fuel, lube and repairs for equipment, and 19% labor (Figure 4). For the low input system the expenditure was spread evenly among the three input categories. For the organic system the costs were spread evenly between labor and equipment operating costs.

The weed control costs for corn were lower for the low input and organic systems than for the conventional systems while the opposite was true for processing tomatoes. For both crops the conventional system had higher fuel and herbicide use than the other systems. For corn weed control represented 14% of operating costs for the conventional system but only 6% and 4% for low input and organic, respectively. For tomatoes, weed control represented about 21% of total costs for each of the systems.

Figure 1.Tomato Operating Costs by Operation - SAFS
(average dollars per acre, 1989-2000)

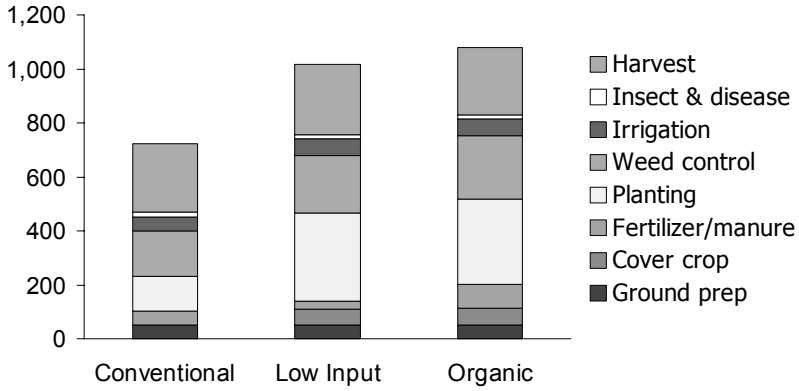


Figure 3. Corn Operating Costs by Operation - SAFS
(average dollars per acre, 1989-2000)

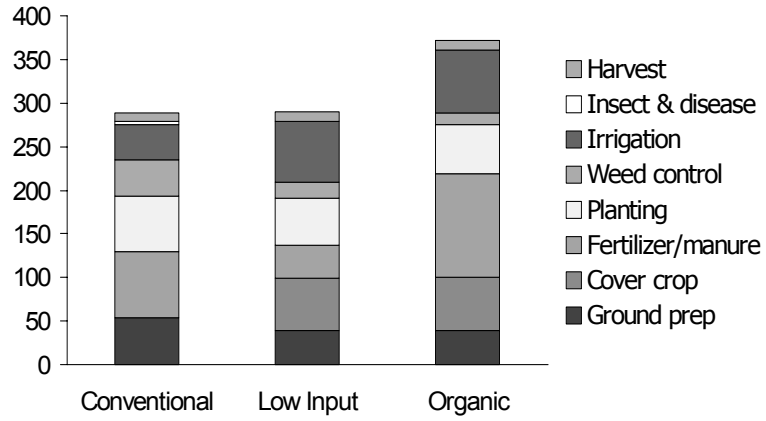
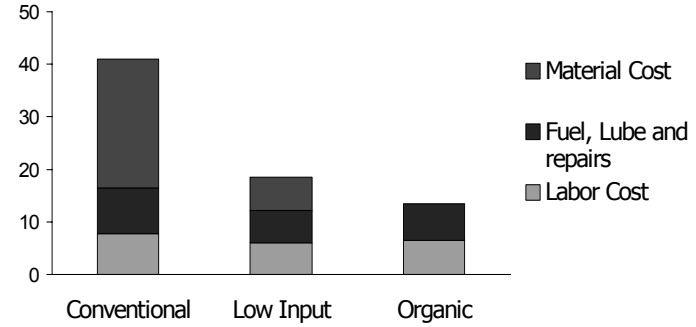


Figure 4. Weed Control Costs for Corn by Category– SAFS
(average dollars per acre, 1989-2000)



Weed Control Costs in Non – agricultural Systems – Example of Yellow Star Thistle Control in California

Weeds create costs to society that may not be fully reflected in the marketplace. These include aesthetics, rural viability, cultural diversity, habitat, flood control, fire control water quality, watersheds, food security, recreation, access to wilderness, and erosion. When market prices do not reflect externalities, government often employs taxes, subsidies and regulations to discourage negative externalities. It also steps in to control weeds when there is not the economic incentive to do so in the private sector.

Using yellow star thistle in California as an example, the groups negatively impacted include ranchers, landowners, homeowners, recreation enthusiasts, horse owners, farmers, wool growers, and honey producers. None of these groups have the resources to control star thistle statewide. While there are some examples of efforts by some of these groups to work together for weed control, the transaction costs are high. Private stakeholder organizations include the Nature Conservancy, the Audubon Society, Farmland Trust, and the CA Cattleman's Association. Public agencies involved include the Bureau of Land Management, US Forest Service, Bureau of Reclamation, US Fish and Wildlife Service, CA Department of Fish and Game, CalTrans, and park services at the national, state, county, and local levels. Many of these groups do work together, but again, the cost of coordination is high.

Control Scenarios include 1 do nothing, 2) intense, immediate suppression, 3) eradication in high priority areas and containment in others, and 4) statewide biological control program. Obviously, the cost of scenarios 2 and 3 will depend on the methods used for suppression and the definition of high priority areas. However, yellow star thistle is estimated to be spreading at a rate of 10% per year and 15 million acres in California are already infested. At that rate all 42 million acres of susceptible land will be infested in 10 years. The present value of the cost of intense suppression with Transline and biological control is estimated to be $2 billion over a 10 year period. The cost of high proporyt are eradication with containment elsewhere is estimated as $500 million, and the cost of a biological control program only at $8 million.

Policy Issues

The examples of cost of weed control in agricultural systems and in a non - agricultural system reveal relevant policy issues. With respect to both agricultural and non – agricultural systems the regulation of pesticides will always determine what is in the set of herbicide options available for control. Mil taxes on sales of pesticides impact the price and the demand for herbicides. Publicly funded incentive programs such as the Environmental Quality Incentives Program provide cost share arrangements to encourage the adoption of environmentally friendly practices for farmers and landowners. Pest management alliances funded by the Department of Pesticide Regulation provide information and research dollars related to alternatives to pesticides. The development of weed management teams to leverage spending and expertise for regional weed control can make public funding more efficient. There are opportunities for public private partnerships but funding must be made available to facilitate the initiation of these partnerships. Preemptive measures to keep exotic weeds from entering California is critical to reduce the economic impact of weeds in the future. Finally, the level of funding for weed management will always be made in the context of the total state budget and the benefits per dollar spent weighed against the potential benefits of other state programs.