

# Alfalfa Seed Production in the Western U.S. - A Commitment to Quality

Shannon C. Mueller<sup>1</sup>

## INTRODUCTION

California, Idaho, Washington, Oregon, and Nevada are the major seed-producing states in the U.S. There is some seed produced in Arizona, Wyoming, and Montana as well. Although fifty percent of the United States seed supply was once produced in California, in recent years, this figure has dropped to 30-40% as acreage has moved to the Northwestern seed producing states.

In general, seed yields in the U.S. have been on the increase since 1940 as a result of continuing research funded by state boards and commissions and release of varieties with improved disease and pest resistance. However, changing economics, increasing pest pressure, competition from other crops, unfavorable environmental conditions, and increasingly restrictive regulatory constraints make it difficult for growers to continue obtain economically optimum yields of high quality seed.

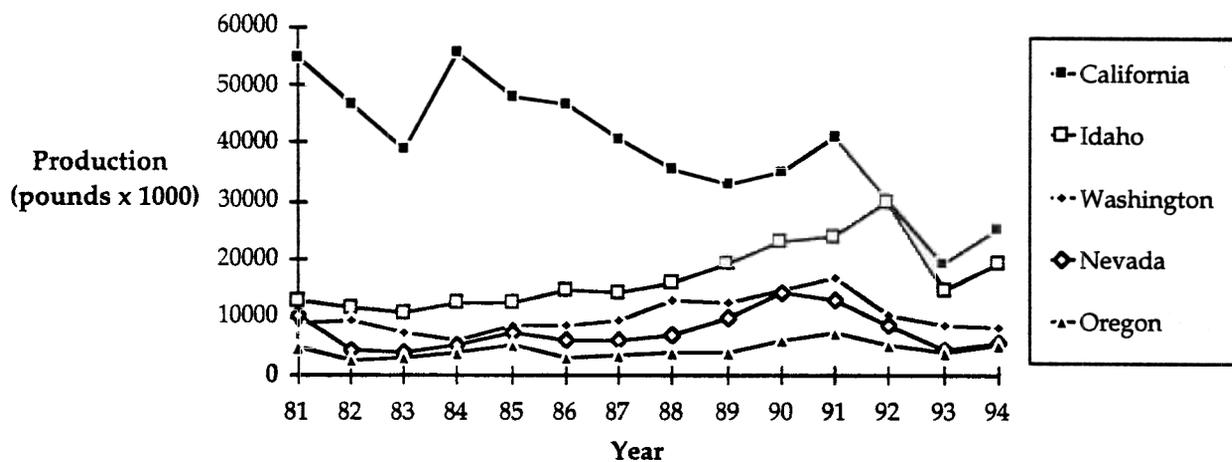


Figure 1. Alfalfa seed production history by state.

<sup>1</sup>Corresponding Author: Shannon Mueller, Agronomy Farm Advisor, University of CA Cooperative Extension, 1720 S. Maple Avenue, Fresno, CA 93702.

## PRODUCTION PRACTICES

Properly timing cultural practices is the key to a successful production system. In a typical system in California and parts of the Northwest, this would include:

- winter irrigation to provide 40-50% of the annual water requirement
- fertilization with required nutrients as determined by soil or tissue tests
- application of herbicides to control problematic weeds
- spring clipping in early April to initiate the seed crop
- insecticide application prior to initiation of bloom to eliminate harmful pests
- pollination beginning in late May-early June
- several crop irrigations timed to stress the plant enough to promote seed set without stressing to the point where yields are reduced
- hand weeding as necessary to control noxious weeds
- desiccation of the seed crop prior to harvest
- harvesting
- destruction of harvest residue including volunteer alfalfa plants resulting from the previous seed crop.

## IRRIGATION

An essential component of alfalfa seed production is timely scheduling of irrigations. In general, highest seed yields are obtained when irrigation practices prevent severe plant stress and promote slow, continuous growth through the entire production period without excessive stimulation of vegetative growth. New technologies, such as infrared thermometry, allow growers to measure plant water stress and make more informed irrigation decisions. When water is available, deep soil moisture applied in the winter and early spring can partially offset summer irrigation requirements providing a buffer to avoid detrimental effects of severe moisture stress.

Deciding when to terminate irrigation for the season is also critical. Enough water is required to mature the seed, but soil moisture must be depleted prior to desiccation or the plant will not dry down adequately to prepare for harvest. With excessive late season soil moisture, even repeat applications of desiccant aren't effective and direct combining becomes difficult with a large amount of seed lost in the process.

A factor making irrigation management even more difficult in California is recent legislation limiting the water available to agricultural water users. Water normally reserved for farmers will be diverted to rivers, estuaries, fish breeding grounds, and wildlife habitats. It will also increase the amount of water going to cities by allowing farmers to sell a share of their water. Decisions that growers were forced to make during the recent drought will be played out again in light of the legislated drought. With limited water supplies, growers must produce crops with the highest economic return. In our area, that means alfalfa seed acreage is often sacrificed in favor of cotton acres.

## INSECT CONTROL

As a result of the demand for disease and insect resistance in alfalfa grown for forage, seed producers do not have to worry about some pests, such as aphids and nematodes. However, since alfalfa grown for seed production is managed much differently than alfalfa grown for forage, there are several insects that must be controlled. The most important pests in alfalfa seed fields are lygus, stinkbug, mites, and chalcid.

There are few chemicals registered for alfalfa seed which effectively control insect pests. As a result of high registration costs, new materials are not being developed for use in seed production and in cases where the costs seem too high in relation to the potential for product sales, chemical companies are taking currently registered products off the market. Also, until recently, since the crop is used for food purposes as well as for planting seed, residue data was required for the establishment of tolerances before a product could be registered. California has joined some of the other Northwestern seed-producing states to separate alfalfa seed into two categories - seed grown for food and seed grown for non-food use. This separation should enable growers to obtain registration for some materials not available in states where that distinction is not made.

Compounding the problem of rare new product registrations, effective materials can be quickly rendered ineffective when insect populations develop resistance. For this reason, there is a great deal of attention being paid to resistance management. Resistance management is the use of methods that extend the number of generations that a given pest population can be controlled economically by a pesticide. This involves incorporating other pest control strategies such as the release of beneficial insects, and when using insecticides, rotating materials to maintain their effectiveness.

Bioassay techniques can be used to evaluate resistance mechanisms and predict resistance development, which gives growers the opportunity to adjust practices to retain product effectiveness. A successful bioassay technique exists to determine dose response regressions and LC<sub>50</sub> values for lygus. Small plastic ziplock bags are pretreated with solvent containing concentrations of insecticide. In the field, a small cork and alfalfa leaf are placed in each bag to keep the sides of the bag apart and to provide food. Adult lygus are collected by sweep net and five insects are placed in each bag. After eight hours, the lygus bugs are observed and mortality levels recorded. It appears from the bioassay tests that lygus populations are getting harder to kill with Capture<sup>®</sup>, currently the most effective bloom spray. In 1991, the first year Capture was available in California, LC<sub>50</sub> values averaged 110 ug/bag. Values from 1995 averaged 141.5 ug/bag at the beginning of the season before Capture had been used. Mid-season values increased to 292.5 ug/bag. In one field where three applications of Capture were made, the LC<sub>50</sub> value was reported at 955 ug/bag! These results have been confirmed by researchers in other states. Upward trends in LC<sub>50</sub> values have been observed at separate locations over the past several seasons. We recommend that growers keep good records of pest population levels, and pesticide use and performance data. They should also adopt rotation of insecticides as a routine part of their pest management program.

## WEED CONTROL

The control of weeds in alfalfa seed production is essential not only to prevent competition and encourage the growth of the alfalfa, but producers of certified seed must meet stringent requirements for purity of the seed, and are very careful to control noxious weeds. Most of the winter and summer annual and perennial weeds are effectively controlled by the use of herbicides registered for alfalfa. The few weeds that may escape are removed by hoeing crews that walk the fields prior to inspection for certification. Weeds harvested with the alfalfa seed crop are removed during the conditioning process where modern seed cleaning equipment separates and removes weed seeds from alfalfa seed. A significant quantity of alfalfa seed can be lost during the conditioning process, therefore, control of weeds in the field is a more efficient and less expensive practice.

## POLLINATION

Seed yields can be significantly affected by the activity of the pollinators. Irrigation, pesticide applications, and the weather can all negatively impact pollinator activity. Honey bees, leafcutter bees, and alkali bees are used to pollinate alfalfa for seed production in the United States. Honey bees are used almost exclusively to pollinate alfalfa for seed production throughout California. They are inexpensive and readily available, but they are not the most enthusiastic pollinators of alfalfa. When a bee lands on an alfalfa flower, the stigma springs up from within the keel petal and smacks the bee in the head. Honey bees quickly learn to avoid this trigger mechanism by approaching the flower from the side. The bee can still obtain nectar, but the flower does not trip, pollen does not get transferred and the grower doesn't make seed.

Because of their inefficiency, it typically requires a long pollination season to set seed with honey bees. Consequently, there has been a lot of research conducted in California to improve the attractiveness of alfalfa to the honey bee. Researchers have concentrated on improving the floral aroma, pollen attractiveness, the quantity of nectar, and the ease of tripping of the floret. It is believed that these factors alone or in combination can have a significant impact on seed production. If companies developing varieties for forage production are willing to incorporate selection for these traits into their breeding programs, it would not impact forage production potential, but it would greatly benefit seed production potential.

There are also concerns within the seed industry about the future of pollination using honey bees because of the recent arrival of Africanized honey bees in California. Researchers are approaching improvements in pollination through improvements in honey bee characteristics. In typical honey bee colonies, only a small proportion of the population actively collects pollen. Strains of honey bees have been selected for the quantity of pollen they store. Workers from strains of bees selected for high pollen stores show a high tendency to collect pollen and might therefore be better pollinators. Queens from these selections to improve pollen hoarding can be sold to beekeepers to

improve their colonies. Techniques are also being developed to improve the success when beekeepers requeen hives in order to reduce the impact of the Africanized Honey Bee on commercial pollination.

In addition to attempting to improve the efficiency of honey bees in commercial pollination, researchers have started to look at leafcutter bees for commercial seed production in California. Leafcutter bees are used extensively in the Northwestern states and Canada with great success. Leafcutter bees are more efficient pollinators of alfalfa compared to honey bees since every female in the population gathers pollen and nectar, unlike honey bees where only a small percentage of the population gathers pollen.

Growers in California and elsewhere have evaluated a number of different shelter designs. They range from very simple stationary structures constructed of plywood to more sophisticated, mobile designs that can be moved from field to field. Leafcutter bees nest in holes formed in either wood, styrofoam, or paper nesting material. Under the climatic conditions typical of the pollination season in California, growers need to provide shade for the nesting material and ventilation to reduce the build up of temperatures inside of the shelters during the summer. Furthermore, the leafcutter bee is extremely susceptible to pesticides. Although most pesticide applications are made at night to protect the pollinators, because these bees cut leaf material and use it to line their nests, their exposure to pesticides is much greater than that of a honey bee. The length of the pollination season, irrigation constraints, bloom cycles, and repeated pesticide applications require that growers move bees frequently from field to field.

Yield data indicated that leafcutter bees did an excellent job of pollination in the central San Joaquin Valley of California. On the average, growers saw an increase of 225 - 600 lbs./acre as a direct result of using leafcutter bees. Although in the Northwest leafcutter bees are used alone quite successfully, most of the alfalfa seed growers in this area are using them in combination with honey bees. Leafcutter bees compliment honey bees in pollination by working under different environmental conditions, setting green spots in the field where honey bees prefer not to work, or working different parts of the plant.

## SUMMARY

Growing alfalfa for seed production may be a challenging and gratifying task, but no one is willing to pursue it unless it is a profitable undertaking. Profitable production requires that all cultural practices be geared to insure the uniform and vigorous growth of the alfalfa. It must be managed to encourage abundant flower production, insure good pollination, protection of the seed from insect damage, and mature the crop to enhance effective desiccation for efficient harvesting of a high quality product to become available to forage producers.