

## PAST TRENDS AND THE FUTURE OF VEGETABLE WEED CONTROL

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Fifty years ago when this conference began, the vegetable growers' weed control programs were limited to the "hoe", weed oils, and the limited use of dinitro-selective and potassium nitrate. Although these early developed herbicides were limited to crops such as carrots, celery, onions, garlic and peas, the growers were becoming educated in the tremendous benefits of using selective herbicides.

California vegetable growers had become an economic force in the production of asparagus, tomatoes, spinach, lettuce, and cole crops, while relying only on mechanical weed control. In that post World War II era, available labor was limited, which ultimately led to the U.S.- Mexican Bracero program, allowing for the importation of labor for agriculture. Even with this available labor source, weeding costs were oftentimes a major limitation in the production of these crops. Weeding costs in 1955 were reported to cost one hundred dollars per acre for asparagus, and spinach costs were as much as eighty dollars per acre. Even with these types of costs, entire fields were abandoned near harvest because of excessive weeds making the crop unharvestable.

Growers' best judgment was used to "outsmart" weeds by trying to plant crops at periods of low weed germination, selecting "clean" fields, and using transplants that would help gain some time over germinating weeds. In the early 1950's, transplants were limited to "bare root" type plants, mainly limited to tomato, celery, and cauliflower.

What appears to be the first soil-applied selective herbicide for vegetable was IPC (propham). Like so many of the early herbicides developed during this period, its performance was inconsistent due mainly to the lack of required rainfall or just inadequate information. California growers were limited to furrow irrigation, and the early preemergent herbicides would not work when applied to the soil surface.

A major contribution to developing application techniques for preemergence herbicides was Stauffer Chemical Company, specifically Dr. Joe Antognini. He was instrumental in developing the "ROTOTILLER" as an essential tool for preplant incorporation of herbicides. This technique led to greater grower usage of soil-applied selective herbicides in vegetable weed control.

The 1960's saw a greater use of selective herbicides with more herbicides becoming available and a major political decision not to renew the U.S.-Mexican Bracero program. I attribute this immediate loss of reliable labor force for hand weeding a major factor in coastal vegetable growers' adoption of selective herbicides.

## Historical Crop - Herbicide Development

The early development of lettuce herbicides included Vegedex and IPC. These two herbicides effectively controlled purslane and stinging nettle, two of the most important weeds in the Salinas Valley. It was not uncommon to see seedling lettuce fields disced under when either of these weeds was so dense as to prohibit economical thinning of the stand. In the mid 1960's, the development of Balan provided a more consistent herbicide for the control of summer weeds. Throughout the late 1960's, Balan and combinations of Balan, Vegedex and IPC became the standard lettuce weed control program. The development of Kerb in the mid 1970's was considered a major breakthrough for lettuce weed management. This product did not require preplant incorporation and it provided excellent control of crucifer and nightshade type weeds. During this period, the increased use of sprinklers had become most common for the germination irrigation, which led to the rapid use of Kerb as the major herbicide for lettuce. As we moved into the 1980's, we started to see cancellations of such herbicides as IPC and Vegedex, leaving only Balan, Kerb and Prefar as soil-applied herbicides for lettuce.

Early herbicide development in cole crops such as broccoli and cauliflower were limited to Treflan, Dacthal, and Vegedex. These herbicides required soil incorporation under furrow irrigation. A major development in herbicide adoption to furrow irrigation was the introduction of TOK. This herbicide was extremely effective with surface applications using furrow irrigation. The primary difference was that TOK's mode of action was primarily at the short tip of germinating weeds, compared to root uptake by Treflan, Vegedex and Dacthal. TOK subsequently became the major herbicide used for these crops due to the above and also its effectiveness on cheeseweed and purslane.

The subsequent loss of TOK and Vegedex due to herbicide cancellation left a large deficiency in weed management systems for these crops. Dacthal became the major herbicide used. Subsequent cultural practices such as the utilization of transplants for cauliflower and modified fertilizer applications in broccoli resulted in excellent weed management practices.

The umbellifere crops - celery, carrots, and parsley were severely impacted by the cancellation of selective weed oils. The loss of weed oil in carrots greatly limited where they could be planted as nutsedge-infested, coarse-textured soils were a prime growing site for carrots. Without effective nutsedge control, carrot acreage declined dramatically in Monterey County. This left Treflan as a preplant treatment and Lorox as a post-emergent herbicide, which are effective on most grasses and broadleaves.

The cultural shift in direct-seeded celery to transplanting was a salvation for weed control. The crop has been maintained with excellent weed control systems using Treflan preplant and Caporal or Lorox post-emergent.

Weed management in parsley was extremely limited until the recent registration of prometryne as a preemergent herbicide for this crop.

Asparagus is one of the major vegetable crops that has had effective weed control materials for the past 50 years. This perennial vegetable was able to tolerate soil persistent herbicides, which resulted in effective weed control. Although several of the original herbicides have been lost, the crop currently has six soil-applied herbicides and three post-emergent herbicides which provide excellent weed management systems when used effectively. Herbicide persistence following asparagus is of concern and labels should be followed to reduce herbicide injury to rotational crops.

Onions were one of the first annual crops that received early weed control inputs, enabling growers to use high density plantings for optimum yields. Although dinitro-selective, potassium nitrate, TOK, and Tenoran are no longer registered for onions, other herbicides have been good replacements. Currently the major preemergence herbicide in use is Dacthal. Two post emergent herbicides, Buctril and Goal, provide excellent broadleaf control whereas Prowl is used in established onions for late germinating weeds. Three systemic grass herbicides, Fusilade, Poast and Prism are registered for onions.

Garlic was formerly a major crop grown in the coast counties. Due to several factors, much of the acreage has shifted to the interior valleys of California. Weed control methods include Prowl or Dacthal as a preemergent application, followed by Buctril and Goal. Two systemic grass herbicides are currently registered.

Another important perennial vegetable crop to the central coast area are artichokes. This winter harvested vegetable crop received early herbicide registrations in the 1960's with Karmex and Princep. Applied as a directed spray, they allowed for weed-free conditions during the harvest period. Princep is no longer registered, but additional herbicides now registered include Kerb, Devrinol, Goal, and Poast. Using these herbicides in winter growing periods, and tillage practices during late spring and summer, provide effective weed control systems.

The advent of value-added packaging of salad type crops has had a significant impact on spinach production. This crop, formerly grown mainly for processing, is now a major fresh-market commodity. Planted as a high density crop, requirements for hand weeding are extremely costly. Several preemergent herbicides have come and gone for this crop due to economical considerations. Two marginally effective herbicides remain. Those are Ro Neet, applied preplant/preemergence and Spin Aid, a post-emergent herbicide. Hand weeding costs may run between \$200-\$300 per acre. Growers often seek "weed free" soils in which they can produce economical crops with lower weeding costs.

## What are the Future Weed Control Trends?

If one were to use a single word to describe the future of vegetable herbicides, it would be "less". Since many of the currently registered vegetable herbicides are 30 to 35 years old, one can readily visualize their economical and regulatory fate is extremely limited on today's market. So, if one has a pessimistic outlook on future existence, one must ask, "are there going to be replacements?" The days of traditional herbicide development moving from agronomic crops (soybeans, corn) to vegetable crop development are most unlikely, especially if the trend continues toward developing Transgenic varieties resistant to herbicides. The question that one must ask is "are vegetables scheduled for future herbicide tolerance using this same concept?" I believe one can definitely say "yes!" What is the time frame?... maybe anyone's guess! The cost of research and development for this technology by Agro-Chemical-Seed Company partnerships is intense. These costs must be paid for in future profits, which can come only from extensive usage. Unless this process becomes extremely inexpensive, vegetable usage appears to be limited to large acreage crops such as tomatoes and lettuce.

Research in these crops is under development at this time and, if successful, may pave the way for other vegetables. In addition to the cost factor, public concerns over Transgenic vegetables may become a political issue that would restrict the development process.

The benefits of 40 years of selective herbicide usage in the Salinas Valley have demonstrated the feasibility of reducing the "weed seed bank" to the extent that some crops are planted without the use of herbicides, thus growing in a weed-free environment. If growers maintain a vigilant position in preventing weed seeds from infesting their fields, they need be less reliant on selective herbicides. The challenge will be to incorporate diligence in the integration of good cultural practices with the remaining selective herbicides.

I am optimistic for the future because the California vegetable farmer is a very resourceful entity. I have no doubt that his innovativeness will provide the means to develop and adopt weed control systems for the 21st century.