PREVENTING THE OFF-SITE MOVEMENT OF PESTICIDES IN ALFALFA

By Dan Putnam[1]

ABSTRACT

Off-site movement of pesticides into groundwater or surface water has been detected. The movement of organophosphate insecticides into surface water, and the movement of winter-dormant herbicide sprays into groundwater are the primary concerns for alfalfa. A number of measures are suggested that may be useful to help mitigate these problems, but must be integrated with specific limitations and considerations on each farm. There is no single solution for all cases. A key aspect of controlling offsite movement of pesticides is irrigation management. Growers should be aware of public concerns about this issue and take steps to mitigate pesticide movement, before regulatory steps are taken.
Keywords: pest management, Chlorpyrophos, insecticide, herbicides.

INTRODUCTION

Alfalfa is a crop with a relatively low intensity of pesticide spray use compared with many crop species. The genetic diversity in modern *Medicago sativa* varieties, with multiple insect and disease resistance, helps avoid sprays. Additionally, the rich diversity of beneficial insects in alfalfa is an important check on insect pest populations. Vigorous alfalfa stands are naturally resistant to weed infestation.

However, there are several pests for which effective non-chemical control has proved elusive. The most important of these are Alfalfa Weevil, a dependable pest each spring in most alfalfa fields in California. Additionally, a complex of aphid species populations and summer and fall worm species are the most common causes of insecticide sprays in California (see UC IPM website). Herbicides are commonly used during stand establishment, dormant periods, or during specific infestations.

EMERGING WATER QUALITY PROBLEMS

There have been several environmental issues associated with insecticide and herbicide sprays used in alfalfa that have arisen in the past few years. Organophosphate insecticides such as chlorpyriphos (Lorsban or Lock-on) and diazonon have been detected in spikes in the San Joaquin delta in levels of sufficient to be toxic to test aquatic organisms, though at levels are below drinking water standards. These levels are in violation of toxicity objectives of the Central Valley Regional Water Quality Control Board. Under the Federal Clean Water Act, the San Joaquin River and associated delta/estuary have been listed as an impaired waterway due to these detections.

These insecticides are used widely around homes, but in agriculture have been associated primarily with orchard crops and alfalfa. Spring weevil and aphid sprays in the spring are the most common periods of time of detection. There are several stages by which

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regulators (State Water Quality Control Boards and Department of Pesticide Regulation) will seek to address this issue, beginning with voluntary steps by the industry (current phase) and ending with full regulation or removal of pesticides. It should be pointed out that the standards being considered by Water Quality Control Boards are very small (parts per trillion). That is, a few drops of a pesticide escaping in many acres during an irrigation event may be enough to be detected using these techniques and standards.

A separate issue has arisen as winter-dormant herbicides used in alfalfa have been detected in a small number of wells in the northern San Joaquin Valley. This should be considered along with surface water pollution issues, since practices influence both.

Members of the UC Alfalfa Workgroup and the California Alfalfa and Forage Association have been discussing methods to address these issues over the past several years. Although there are remaining technical questions about the nature, mechanism, intensity, and scope of the problems, there is a general consensus that in principle it is desirable to prevent entirely the movement of pesticides off of alfalfa production fields. This article discusses several proposed mitigation measures that may help in addressing these environmental problems.

From an alfalfa grower's perspective, there appear to be a confusing array of regulations related to crop production. The wide range of economic constraints that growers face, and the wide range of production practices common with alfalfa are important when considering means to prevent off-sight movement of pesticides.

NO 'ONE SIZE FITS ALL' SOLUTION FOR ALFALFA

There are several mechanisms by which pesticides can move off of production fields and into streams, estuaries, and into groundwater. First, accidents or oversprays from equipment can occur during application. Secondly, pesticides can move in solution during rain events or during later irrigations. Thirdly, pesticides may be associated with soil or plant particles that are eroded off of fields. It is not entirely clear how pesticides move from alfalfa fields, but there is ample evidence that it does occur.

Alfalfa is produced in a wide variety of ways throughout the state. There are a wide range of irrigation practices from region to region and from farm to farm. Soil type and infrastructure differ greatly. Thus, there is likely no 'one size fits all' series of 'best management practices' that will work in all cases. A series of ideas for addressing this issue have been developed, to be integrated carefully for each situation. There are economic and practical constraints, and environmental implications for each of these methods.

MITIGATION MEASURES

The following mitigation measures arose through discussions with UC Cooperative Extension farm Advisors, PCAs and growers, as techniques that may be of use to mitigate the off-site movement of pesticides. These should not be considered complete or necessarily 'best management practices', since some practices may be best for some circumstances and not as appropriate for other circumstances. Some are not

economically viable. Considerably more research and experience is required to understand the value of many of these ideas. Typically, an integration of many techniques will likely be most appropriate. These are not listed in any particular order of importance. These are meant to be a starting point for further development, not a finalized listing.

Improved Management of Spray Technology. Education and Outreach efforts towards Applicators to reduce offsite movement may help to reduce accidental offsite movement of pesticides. These may include controlling droplet size, stopping spray near windrow ends, sprayer maintenance, mixing wagon calibration, dry lock etc. This will only effective if oversprays are a key aspect of offsite movement.

Modifications of Labels. Suggestions have been made to change pesticide labels so that spray numbers per year are reduced, irrigation is restricted, or applications are restricted when conditions for higher runoff occurs. This would have the advantage of being communicated widely and uniformly. However, label restrictions would have little relevant in situations where water movement is already restricted, as with sprinklers and some flood systems and may be overly restrictive in those cases.

Use of Polymers (PAM) to reduced Sediment Movement. Polyacrylimides (PAMS) aggregate soil particles, and allowing them to precipitate from the soil solution. Although further experimental data is required, PAMS may prevent movement of pesticides if they are associated with soil particles. PAMS have the disadvantage of high cost, and may be impractical due to the frequent irrigations of alfalfa. They would not be effective in preventing solubilized pesticides from moving off site.

Catch basins and re-circulation of tailwater. Catch basins, with recirculation systems to the same or neighboring fields are common improvements of flood irrigation systems. In addition to preventing off-site movement of pesticides, they can save water. Costs may be high in some cases. However, unlined catch basins can contribute to downward movement of pesticides towards groundwater, as has been shown with some studies, so must be designed carefully.

Activated Charcoal or other Filter ditches. Suggestions have been made to construct ditches or areas filled with activated charcoal, peat, or other filtering agents at locations where water leaves a ranch. These could be replaced periodically. This would act to filter pesticides before the soil solution reaches surface water. This idea requires further research, and would have the difficulty of increased maintenance and costs.

Shift from Organophosphates to other Pesticides. Studies comparing alternative pesticides, such as pyrethroid insecticides (Warrier, Baythroid) have shown a great reduction in runoff when compared with chlorpyriphos . However, other pesticides may have environmental problems as well. Pyrethroids can be hard on beneficial insects, leading to aphid outbreaks, and are considered highly toxic to fish in solution.

Non-Sprayed Buffer Zones between Alfalfa and Waterways. Maintenance of non-sprayed areas between alfalfa and waterways or tail end areas, may result in reduction in offsite movement. However, this would only be effective if water or suspended sediment did not carry the compound a greater distance than the buffer zone. Additionally, insect damage would presumably occur in the non-sprayed zone.

Use of Filter Strips. Filter strips of grasses and legumes have been used in the Midwestern regions to mitigate offsite pesticide movement, with some effectiveness in row crops. However, alfalfa itself is a good filter, similar to grasses. Grasses may serve this function in alfalfa as well, but their effectiveness remains to be shown. Filter strips would reduce the quality and value of the hay, depending upon size of strips.

Overseeding into Alfalfa. The use of berseem clover, oats, ryegrass, or red clover overseeded into alfalfa may negate the need for an insecticide if yields are maintained. However, weevil damage is not reduced in Sacramento Valley studies. Overseeding may significantly change the quality and value of alfalfa, especially with oats or grasses. This is a technique most appropriate for older stands of alfalfa, not vigorous young stands.

Restricting Pesticide Use in Thin or in Newly Cut Alfalfa Stands. There is some evidence that open canopies may lead to offsite movement of chlorpyrophos than vigorous closed canopies, possibly due to greater pesticide attenuation in foliage. However, this is not yet fully confirmed, and whether it would be fully effective is unclear.

More Vigorous Implementation of IPM techniques. While IPM techniques have been developed decades ago, greater monitoring, and implementation of IPM techniques might lead to lower overall less pesticide use. Techniques such as more careful parasite accounting, and revision of thresholds may aid in better spray decisions. However, it is not certain the degree to which these techniques are not already widely used by growers.

Improved Irrigation management. A range of methods, from improved tailwater management, to improved monitoring of soil water, improved irrigation timing techniques, and better application technologies, such as improved flood designs and sprinkler systems may prevent irrigation runoff, and offsite movement of pesticides. Irrigation management is so central to the offsite movement of soluble components in irrigation water, that it is difficult to overemphasize this as a central theme for prevention of offsite movement of pesticides. Limitations occur in situations where offsite irrigation drainage is very important for salt leaching.

SUMMARY

There are a wide range of possible on-farm solutions to prevention of the off-site movement of pesticides. There are likely few solutions that are universal to all farms in all regions. It is important to consider economic and practical constraints, efficacy of pest control, and both ground and water quality as well as agronomic constraints when considering these methods. Improvements in irrigation management (monitoring, time, and system infrastructure) are likely key unifying aspects of this problem.