Cooperative Extension • Monterey County

Crop Notes

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In This Issue:

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WEED MANAGEMENT IN LETTUCE

Steve Fennimore and Richard Smith, Extension Vegetable Weed Specialist and Farm Advisor, University of California Cooperative Extension

We have been informed by the Kerb registrant Dow AgroSciences that the USEPA has ordered that Kerb can only be used in head lettuce. This obviously leaves a huge hole in the weed management program for leaf lettuce. Therefore the purpose of this letter is to remind growers of the weed management options that might be used to mitigate this loss with cultural practices and the use of alternative herbicides such as bensulide (Prefar).

Weed management in lettuce is divided into several time intervals: 1) before lettuce planting: weed management in fallow ground and rotational crops, pre-plant irrigation and weed removal, 2) after seeding: preemergence herbicides, 3) during crop growth: cultivation and hand weeding. Rotational crops with effective weed control programs such as celery (prometryn/Caparol, linuron/Lorox), broccoli (DCPA/Dacthal, oxyfluorfen/GoalTender), strawberry (fumigants) can help clean up or hold down weed populations in a field so that weed management in the subsequent lettuce crop will be less of a struggle. During fallow periods weed removal with tillage, glyphosate (Roundup, others), paraquat (Gramoxone) and oxyfluorfen (90 to 120 day plantback) all can be used to kill weeds on fallow beds. Prior to planting, preplant irrigation to stimulate weed emergence is an effective way to kill weeds in fallow beds so that fewer weeds infest lettuce during the production interval. The process begins with sufficient sprinkler irrigation to stimulate weed emergence, say 1.5 to 2 acre inches, then after 7 days or more weeds that emerge are killed with shallow tillage or with herbicides such as glyphosate or paraquat. If weeds are removed with tillage, it is important not to till deeper than 2 inches to avoid bringing up weed seed from deeper in the soil. Time permitting, repeat the process of preplant irrigation and weed removal again for better results. Skillfully implemented, preplant irrigation will result in a shallow layer of soil that is partially depleted of viable weed seeds. Results will vary as weeds are very sensitive to the seasons and weather, so the process of preplant irrigation and weed removal involves skill and a bit of luck. Our research has found that preplant irrigation can reduce weed populations by 15 to as much as 50%, so when combined with an herbicide, this can provide very good results.

Herbicides applied prior to planting are benefin (Balan) and metam sodium (Vapam, Soil Prep, Sectagon others). Benefin must be incorporated after application, but plan rotational cropping sequences as onion and spinach may not be planted for 10 months following benefin. The loss of pronamide leaves only one preemergence herbicide, bensulide (Prefar 4E). Bensulide is labeled on head and leaf lettuce at 5 and 6 qts/A. Compared to pronamide, bensulide provides control of grass weeds, goosefoot, lambs quarters, pigweed and purslane, but does not control mallow, nightshades, and shepherds-purse (Table 1). Some ideas for getting the most out of bensulide are treating the entire bed top or applying by chemigation through sprinklers (see Prefar label). After crop emergence two postemergence grass herbicides are available Clethodim (Select) and sethoxydim (Poast). Both herbicides are effective only on grass weeds and sethoxydim does not

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control annual bluegrass, but Clethodim does (Table 1). After crop emergence the only options for controlling broadleaf weeds are cultivation and handweeding. For cultivation and handweeding, lettuce growers are well aware of the options. However, we conducted trials with the vision guided cultivators (EcoDan and Robocrop) and this technology provides growers with a tool to facilitate cultivating closer to the seedline; closer cultivation removes a greater percentage of the weeds and improves the efficiency of subsequent hand weeding operations. We are currently experimenting with in-row cultivators that cultivate around the plants and will report the results of that work in a separate document. We have been searching for new herbicides for seeded lettuce for over 10 years without success. Germinating lettuce is very sensitive to most herbicides, which is why there are so few herbicides for this crop. Transplanted lettuce is much more tolerant to herbicides, and there are some products that may soon be registered, but only for transplanted lettuce. If you have questions about this please contact us.

Summary. Cultural weed management practices such as rotation with crops that leave fields relatively clean of weeds, preplant irrigation and weed removal combined with the remaining herbicides should allow leaf lettuce growers to manage weeds, although hand weeding costs may be higher. The most likely new weed management tools on the horizon for lettuce would be new herbicides for transplanted lettuce and in-row cultivators.

Table 1. Weed susceptibility chart for lettuce herbicides. Kerb is included for comparison as it can no longer be used in leaf lettuce. Note: C=control, P=partial control, N=no control. See full chart at

Weeds	Balan	Prefar	Metam sodium	Kerb	Select Max /Poast
Barnyardgrass	C	C	C	P	C
Bluegrass, annual	C	C	C	C	Cleth. = C Seth. = N
Canarygrass	P	C	C	C	C
Chickweed	C	P	C	C	N
Goosefoot	C	C	C	C	N
Groundsel	N	N	C	N	N
Lambs quarters	C	C	C	C	N
Mallow	N	N	P	P	N
Nettle, burning	P	C	C	C	N
Nightshade, hairy	N	N	P	C	N
Pigweed	C	C	C	P	N
Purslane	C	C	C	C	N
Shepherds-purse	N	N	C	C	N
Sowthistle	N	N	C	N	N

SPOTTED WING DROSOPHILA, NEW PEST IN CALIFORNIA CROPS

Mark Bolda, University of California Cooperative Extension - Santa Cruz County

The recent infestation of local crops by the spotted wing drosophila, Drosophila suzukii, is serious. Vinegar flies normally are associated with rotting and over-ripe fruit and have not been thought of as being anything beyond a nuisance. However, the spotted wing drosophila is different from other vinegar flies in that lays eggs into fruit which are yet to be harvested. The larvae then feed within the fruit and exit to pupate. The feeding of the larvae, while damaging in itself, also exposes the fruit to fungal and bacterial infection.

To growers, a pest such as the spotted wing drosophila presents several challenges. The first is

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We have been informed by the Kerb registrant Dow AgroSciences that the USEPA has ordered that Kerb can only be used in head lettuce. This obviously leaves a huge hole in the weed management program for leaf lettuce.

This situation leaves a serious gap for controlling cool season weeds.

Effective control will be achieved by a combination of careful cultural practices, cultivation and use of available chemical options.

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that three of the four stages of fly development, namely the egg, larva and pupa are generally inaccessible to conventional pest management methods. Secondly, the very high numbers of flies frequently found in production fields and the apparently high breeding potential of the individual female make it very difficult to reduce a population quickly to economically acceptable levels once it is established.

While apparently new to Santa Cruz County and other areas of California, the situation of the spotted wing drosophila is not unique. Serious infestations of fruit flies (not vinegar flies) in Hawai'i, California and Florida have been successfully brought under control by multi-faceted management programs, which can guide us in our approach to managing the spotted wing drosophila.

A successful management program for spotted wing drosophila will quite likely consist of three essential parts:

1. Use of attractant bait sprays, although this has not yet been fully tested for control of spotted wing drosophila. Attractant based sprays, such as the GF 120, utilizing environmentally safe toxicants used in low volumes across the production field and border areas can be useful in reducing fly populations while minimizing effects on predators, parasitoids and honeybees. However, since the efficacy of any bait and toxicant decreases over time, these materials need to be re-applied, perhaps at weekly or bi-weekly intervals to be effective.

2. Field sanitation. Infested fruit which remains in the field allows eggs and larvae to fully develop and serve as a source of more flies. All infested, ripe fruit should be removed from the field and destroyed, either by burial or disposal in a closed container.

3. Looking at other successful programs of fruit or vinegar fly management, it is clear that using management practices over a wide area was essential. It is important for every grower within a fly infested area to participate, since a single, unmanaged field will serve as a source of infestation to surrounding fields.

Spotted wing drosophila on raspberry, picture courtesy of Ed Show

Spotted wing drosophila on raspberry, picture courtesy of Ed Show

FARMING CLOSER TO THE EDGE

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This year we observed that vegetable producers on the Central Coast, confronted with economic and regulatory challenges, are rethinking their fertilization practices. Specifically the spike in fertilizer prices in 2008 caused growers to consider reducing rates of nitrogen (N), phosphorus (P) and potassium (K) fertilizers to minimize costs. In addition, proposed changes to the conditional agricultural discharge waiver proposed by the Regional Water Quality Control Board may increase restrictions on the amount of nitrate and phosphate that can be discharged into surface and ground waters.

As a result of economic and environmental concerns, growers are interested in strategies to reduce nitrogen and phosphorus fertilizer rates without reducing yield or quality of their crops. This can be accomplished by reducing the buffer that is built into fertilizer programs. However, to do so successfully it is important to take advantage of monitoring tools and current knowledge of soil/plant nutrient dynamics, as well as the impacts of irrigation management on nitrate levels in the root zone. In this article we will discuss each of these aspects of nutrient management.

Cool season vegetables grow in predicable fashions. For instance, the total amount of nitrogen taken up by the crop is shown in Table 1 and the uptake pattern of nitrogen follows a predictable pattern (Figure 1). These values are useful for guiding fertilizer programs and adjusting the timing and rates of application. This important because applying high rates of nitrogen fertilizer too early in the growth cycle places the applied N at risk of nitrate leaching before it can be utilized by the crop.

Soil/Plant Monitoring Tools

The first tool for managing soil N, P and K are soil tests. It is sufficient to monitor P and K annually with standard soil tests. In the vegetable production areas of the central coast, soil pH values are generally above 6.2 and the Olsen bicarbonate extractions test is the appropriate test for evaluating soil P status. Table 2 shows adequacy values for P. Soil P is less available when soils are cold during winter and early spring and at planting applications of low rates of P such as 20-30 lbs/A of P2O5 may improve growth of lettuce. These low rates are equal to the amount of P that is removed by a lettuce crop and do not add to soil loading of P. As soils warm later in spring through summer, adequacy values serve as a good guideline to determine if applications of P are required in these later plantings. Potassium application can also be guided by soil tests. Potassium does not pose a water quality risk, and soil adequacy values in Table 1 can be used to guide fertilization programs. Large amounts of K are removed with the crop at harvest and applications to replace removal in most cases are warranted and economically justifiable.

The nitrate quick test is a useful test for monitoring levels of residual nitrate that exist in the soil, available for crop growth. It is particularly useful for 2nd crops because residual levels of soil nitrate tend to build up during the first crop. Soil levels of 20 ppm nitrate-N in the top foot of soil are equivalent to 80 pounds of N/A. In commercial field scale studies we have observed that this test is particularly useful at the first nitrogen application at thinning. Crop N uptake is slow until the middle of the season (Fig. 1), so high soil residual nitrate at thinning indicates that sidedressing can safely be delayed. However, soil nitrate level can change both as a result of crop uptake and leaching by irrigation, so a soil nitrate test is valid for only a couple of irrigation cycles. The test can be repeated prior to each scheduled sidedress-

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To economize on fertilizer applications it is important to take advantage of monitoring tools and current knowledge of soil/plant nutrient dynamics, as well as the impacts of irrigation manangement on nitrate levels in the root zone.

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ing. In situations in which only one sidedressing is done, applying only half the normal sidedress amount in fields with significant residual soil nitrate is a reasonable practice that reduces N loading while safeguarding against N deficiency later in the season.   Lack of uniformity of soil nitrate in production fields can be caused by differences in soil type and water application and drainage. In such fields N deficient areas occur in streaks or at the bottom end of the fields. Obtaining a representative soil sample can help detect weak areas and avoid jeopardizing yields.

Impacts of Irrigation Management

Because the nitrate form of nitrogen readily moves with water in the soil, irrigation management strongly affects nitrate levels in the soil profile. In recent studies we have observed a close connection between retention of nitrate in the rootzone and the amount of water applied per irrigation. During the germination of lettuce, once the soil is nearly saturated, additional irrigation events of more than ½ to ¾ of an inch of applied water, depending on soil type, can leach significant amounts of nitrate-N below depths of 18 inches. Another critical period where leaching of nitrate often occurs is after the first post-thinning nitrogen application. Since the crop is still small at this stage (<10 % canopy cover at 30 days after planting) most of the moisture that was applied for germination still remains in the soil profile, and applying much more than ½ to ¾ inches of water will over saturate the soil and cause nitrate to leach below the root zone. As a lettuce crop matures to full canopy cover during the 3 to 4 week interval before harvest, greater amounts of water are removed by the crop between irrigations; consequently, as much as ¾ to 1 inch of water can be applied without significantly leaching of nitrate beyond the root zone, again depending on the soil type.

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The key to minimizing nitrate leaching in lettuce and other cool season vegetables without reducing yield is to apply an amount of water with each irrigation about equal to the amount of water that the crop removed since the last irrigation without letting the crop deplete the soil moisture to the point that would stress the plants and reduce growth. Water use of the crop will depend greatly on the weather and the size of the plants. Between Castroville and King City, average evapotranspiration rates can vary from 0.12 – 0.24 inches/day, respectively, for a leafy green crop with full canopy cover during the summer. A crop with 50% canopy cover would use about half the amount of water per day in Castroville as in King City.

Another rule of thumb for irrigating leafy green vegetables is that they will become stressed and grow slower at soil moisture tensions beyond 30 cbars.   For sandy loam to clay loam textured soils in the Salinas valley that were recently irrigated to field capacity, a depletion of 0.2 to 0.4 inches of water per foot of soil depth would bring the soil to about a 30 cbar tension.   At full canopy cover, approximately 2 weeks before harvest, the rooting depth of head and romaine lettuce is typically near 2 feet, which means that between 0.4 to 0.8 inches of moisture can be extracted by the crop before it would become stressed for moisture on these soil types.   Hence if the average water extraction of the crop was 0.2 inches per day, an irrigation interval of 2 to 4 days would be required to minimize moisture stress. Such short intervals between irrigations are not possible due to practical considerations such as conflicts with field operations or increased disease pressure that would result from frequent irrigations.   However, using the shortest practical irrigation interval and minimizing the volume of individual irrigations will minimize crop water stress and limit nitrate leaching.

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Table 1. Nutrient content of Salinas Valley crops at harvest (lbs/acre).

Crop	Nitrogen	Phosphorus	Potassium
Lettuce	90 - 140[1]	11 - 15	150 - 180
Broccoli	180 - 220	25 - 30	160 - 240
Cauliflower	180 -220	25 - 30	160 - 240
Celery	180 - 240	40 - 45	350 - 450
Spinach - clip	20-40	2-4	25-55
Spinach - freezer	70-80	5-6	90-100

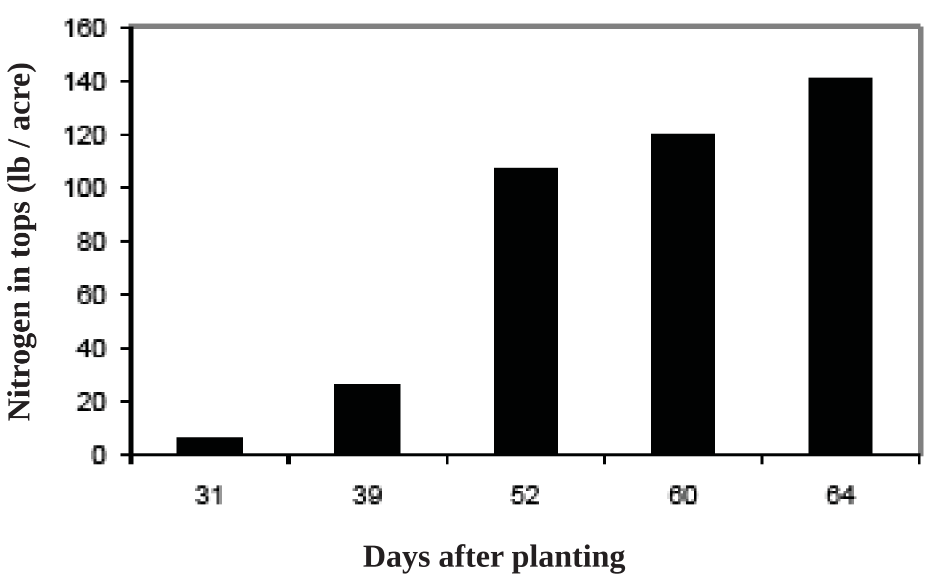
1 – higher nitrogen uptake occurs on 5-6 seedlines on 80 inch beds

Table 2. Soil adequacy levels of phosphorus and potassium for Salinas Valley cool season crops

	Phosphorus[2] ppm		Potassium[3] ppm	
Crop Response[1]	Celery & Lettuce	Other cool season vegetables	Celery	Other cool season vegetables
Response unlikely	>60	>35	>200	>150
May respond	40-60[4]	25-35	150 - 200	100-150
Response likely	<40	<25	<150	<100

[1] crop response is the likelihood of a yield increase with phosphorus or potassium fertilization
[2] Olsen bicarbonate extractable P (soils with pH values > 6.2)
[3] ammonium acetate extractable K
[4] in cool soils during winter and early spring;

Figure 1. Nitrogen uptake by lettuce over the growing season.



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