

Strategies for Improved Weed Management on Small - Scale Diverse Farms

Good weed management is critical for the financial success of small-scale diverse organic farms. Time spent hand weeding vegetable crops has a direct negative impact on the profitability of the farm. In most cases labor costs associated with post-plant weed management can be easily avoided or minimized by following a set of production practices that can effectively diminish weed pressure over time. Organic farmers have a limited number of tools and strategies for dealing effectively with weeds and good management often involves utilizing a range of techniques. The following is a set of practices that can greatly assist growers in managing weeds effectively.

Avoid weed seed set

Probably the most important cultural practice utilized by growers to minimize weed pressure is to never let a weed set seed in the production system. This can be very challenging for small-scale producers in highly diverse cropping systems - especially growers with limited access to effective tractor mounted implements for tillage, bed forming, planting and follow up cultivation. Allowing escaped weeds to set viable seeds within your production system adds significantly to the weed seed bank and these weed seeds will be in direct competition with your crops once conditions are right for germination. For this reason it is critical to get off to a good start initially with your production system and reduce the seed bank as much as possible prior to planting out your crops. It is quite common for a few "escaped" weeds that have grown along side your crop to continue to mature and set seeds after the crop has been harvested prior to mow-down and tillage. In diverse systems this is particularly problematic since crops of various maturation windows are often sown in blocks making it difficult to get in and till two lines of a quick maturing crop that is directly adjacent to a crop with a longer maturation rate. For this reason it is essential to plan production blocks that are as uniformly matched, in terms of maturation, as possible. It is also important to utilize set row configurations that match your implement selection to allow for mowing and tilling of specific crop rows within a production block if different maturation times within a production block are unavoidable. Tools that facilitate knock-down of specific rows within a block, in an attempt to minimize weed seed set post harvest, include the flail mower, the under-cutter and either a bed recycling disc or a rototiller. All of these tools need to be very closely matched to your bed configuration to minimize damage to adjacent crops and to effectively destroy escaped weeds.

Cover Cropping and Smother Cropping

A much overlooked production practice that can very effectively limit weed seed production is the timely and careful preparation of cover crop seed beds and the use

of fast growing allelopathic cover crops planted at higher than normal seeding rates. Examples of highly competitive cover crops include cereal rye, mustard and sudan grass. Sudan grass is not cold tolerant and requires high temperatures for good growth so it may not be suitable for cooler climates. These dense stands of highly competitive cover crops (often referred to as “smother crops”) can very effectively out compete weeds for light, water and nutrients. Timing in terms of soil preparation, soil temperature and soil moisture is critical. Good timing is challenging for small growers who are dealing with high demands on time due to irrigation, harvest and sales pressures but good weed management will save time overall. It is important to point out that a less than optimal stand of winter cover crop can allow for significant weed growth and subsequent seed development. These weed seeds can persist in the seed bank for years and can add significantly to weed management costs over time.

Crop rotation

Crop rotation can be a very effective tool for minimizing weed pressure on small-scale farms. There are numerous examples of effective crop rotations and the concepts involved in the design of a good rotation are fairly straightforward. If you are familiar with the weed issues in specific areas of your farm you can simply avoid planting crops that are “weed challenged” in areas that have higher weed pressure. In other words don’t plant carrots on the same block that the “escaped” amaranth set seed in last season. Instead, plant corn and potatoes in that block or plant a highly competitive “smother” crop.

Fallow

Fallow periods are absolutely critical for the eradication of problem perennial weeds in organic systems. The best example is either summer or winter fallow for the control of Bermuda grass and/or Johnson grass. Both of these perennial grasses have very shallow rhizomes that can be very easily controlled through desiccation from exposure to summer sun or from exposure to freezing temperatures. For proper desiccation or freezing, the rhizomes must be separated from the soil and brought to the surface. This is very easily accomplished with the use of an under-cutter to first under cut and lift the rhizomes. After the initial separation of the rhizome from the deeper roots, the rhizome clumps can be brought to the surface and separated from the soil by repeated passes with a spring tooth cultivator. Spring tooth cultivators do an excellent job of bringing plant residue to the surface. The springs literally “lift” the residue to the surface – especially when in clumps. Discing and/or rototilling are strongly discouraged in the management of these problem weeds because cutting and burying will simply assist in the continued propagation and spread of the rhizomes. Though difficult to eradicate entirely, morning glory, oxalis and nutsedge plants can be effectively reduced in vigor over time through fallow periods in conjunction with tillage and/or undercutting to continually reduce the photosynthetic capability of the plant thus draining the plant’s rooting structure

of its carbohydrate reserve needed for continued propagation and growth. Eradication of these weeds can take many years of persistent fallow management coupled with the intensive use of smother crops.

Irrigation frequency and duration

How a grower irrigates his or her crops can have an impact on weed growth and development. Frequent shallow overhead irrigations will most often result in higher weed seed germination. Generally speaking weed seeds germinate more readily when surface soil is kept closer to field capacity. Reduction in the frequency of irrigations and watering less often and deeper can lead to a reduction in weed seed germination. Good uniformity of application, for the same reason, is critical for good weed management.

Pre-irrigation

The efficacy of pre-irrigation as a weed seed bank reduction tool, in organic farming systems, has been very clearly demonstrated in numerous field trials. A drawback to pre-irrigation is that it creates additional costs related to water use, labor and land out of production. In heavier soils pre-irrigation is sometimes impractical due to the potentially slow dry down time. Another challenge with pre-irrigation is that it can be difficult to apply enough water during the pre-irrigation to effectively germinate the majority of the weed seeds that are in a favorable location for germination within the seedbed. Often weed seeds will germinate more readily in soil moisture conditions at or near field capacity. If a grower can form beds and apply adequate irrigation water for good seed bank germination then there are two commonly used methods for weed destruction once the weeds emerge. The first method is flaming and the second method is very shallow cultivation, preferably with an under cutter followed by a crust breaker. It is critical to destroy the weeds when they are very newly emerged and they need to desiccate adequately for good kill prior to planting of the cash crop. Reduced soil disturbance is critical when attempting to mechanically destroy newly emerged weed seed since the more the soil is disturbed the higher the risk of bringing new weed seed up from lower in the soil into a position favorable for germination. Pre-irrigation is most often utilized in the springtime heading into summer production or in late summer heading into fall production. The challenge with this timing is that soil temperatures are also changing during these times and it is not uncommon for spring soil temperatures to remain low enough during pre-irrigation that the summer annual weeds aren't stimulated to germinate and similarly in the late summer the soil temperatures are still too high to germinate the fall annual weeds.

Drip irrigation

The use of drip irrigation can be a tremendous aid in minimizing weed pressure due to the fact that the surface wetting from the drip emitters is limited to a very small percentage of the overall soil surface. Where there is no surface wetting there is very little opportunity for weed seed germination and growth. Utilization of drip is particularly effective in areas with limited summer rainfall. Drip irrigation can also be utilized for pre-irrigation but there is significant labor costs associated with the laying out and retrieval of the drip lines. In gardens with marginal water resources pre-irrigation with drip is a very effective method of weed management. Soil compaction is minimized when drip is utilized for pre-irrigation. It is also easier to get a more thorough weed flush since the grower can easily maintain field capacity for optimization of weed seed germination within the area to be planted without sacrificing the ability get back into the field for the planting of the crops.

Planting to Moisture

This often overlooked planting technique is a very effective method for minimizing weed competition when planting large seeded crops like corn, beans and squash, especially in our California Mediterranean climate. A sequence for planting to moisture would look something like this:

- 1) Form beds
- 2) Pre-irrigate
- 3) Wait for weed flush and re-work beds with rolling cultivator
- 4) Knock dry soil off bed tops and precision plant large seeds into residual moisture
- 5) Lay drip line in seed line after crop emergence
- 6) Wait as long as possible for crops to establish prior to first irrigation
- 7) Cover drip line with soil using a rolling cultivator prior to first irrigation and before crop is too tall to cultivate

Large seeded crops that have been planted to moisture respond favorably to the optimal soil moisture conditions and they can get their roots into the soil to tap the deeper moisture needed for good growth without the risk of soil born pathogens impacting their growth. Surface crusting from irrigation is eliminated as well. When the moisture is right the crops respond favorably and the weeds don't have enough moisture to germinate leaving the production block effectively weed free.

Flame weeding

Though not commonly practiced on large-scale organic farms, flame weeding can be an effective and cost effective tool for managing weeds on small diverse farms. With the use of a backpack flamer a small grower can very easily diminish weed pressure in carrot and garlic crops. Both of these crops emerge slowly and almost always the weeds emerge before the crop emerges. With a backpack flamer a grower can knock out the weeds that germinated just prior to emergence of the crop. When done correctly flaming is fast, efficient and inexpensive relative to the cost of hand weeding. Flame weeding provides just enough heat uniformly across the bed top to very quickly expand the moisture in the cell walls of the just emerged dicot weeds. This rapid expansion of the cell wall kills the dicot seedling. Because the growing point of grasses is below the soil surface flame weeding is not considered effective for control of grass weeds.

Transplanting

The use of transplants in a farming system has huge benefits in terms of weed management. Direct seeding of small seeded crops can be extremely challenging when weed pressure is high due to the high rate of competition and the difficulty and precision required for removal of the competing weeds. The use of transplants give the grower a jump on the weeds and will often be the difference between success and failure.

Blind Cultivation

Blind cultivation is a term that refers to the use of shallow soil disturbance (cultivation) just prior to or right after the emergence of large seeded crops or cover crops. This disturbance is often adequate to kill newly germinated weeds while leaving the larger seeded crops relatively undisturbed. The larger seeded crops can more readily recover from the disturbance because they are planted deeper and/or have stronger stems and roots. Tine weeders are typically used for this method of weed control. Timing in terms of the growth stage of the crop and the weeds is critical - often coming down to hours - and soil conditions must be perfect as well with minimal crusting or cloudiness. Some soils are simply not conducive to this practice.

Stale seed beds

A stale seed bed is a seed bed that is prepared well in advance of the intended planting date. While on hold for planting the bed is either rained on or irrigated to germinate weeds and then the bed is lightly tilled to kill the weeds just prior to planting. The term "stale seed bed" is most often used in reference to east coast vegetable production.

