

MAUROLOU FARM

APPROPRIATE AGRICULTURE

FNE 93-8

530 Long Highway
PO Box 919
Little Compton, RI 02837

Historic Flint Corn • German Milling Rye
Specialty Crops

Paul B. Pieri
(401) 635-2613

FLAME WEEDING

Flame weeding is an agricultural practice that uses heat to control weeds. The objective is not to incinerate the weeds, but merely heat the plants sufficiently to kill them. Raising the temperature of the plant tissue to 160 degrees F. for one second causes cell walls to burst and plant proteins to coagulate, thus killing the weed.

In the spring of 1993, I received a grant from the Northeast region Sustainable Agriculture Research & Education Program (SARE). The purpose of the grant was to build a push cart flame weeding tool for trial use in field grown cut flower production. While I am encouraged about the possibilities for flame weeding, it is important for individual growers to evaluate how a flamer might meet his/her particular needs. Climate, crops, and most importantly, management skills and objectives of the operation must be compatible with the advantages and disadvantages of flaming.

In my operation, I prefer to avoid the use of plastics and not use herbicides. My fields average 3% slopes and are quite stony. This limits the effectiveness of mechanical cultivation, especially on delicate crops. It was for these reasons I became interested in flame weed control.

STALE SEEDBED

In a few cases flaming can be used on growing crops. Its most common use, however, is before planting or transplanting a crop. Using a flamer (or an herbicide) to kill weeds in a seedbed without disturbing the soil is known as the stale seedbed technique. The following details for stale seedbed technique have been adapted from the Cooperative Extension 1993 New England Vegetable Guide.

The basic concept supporting this technique is that most of the weeds that have the potential to germinate are positioned in the upper 2" of the soil. These weed seeds will usually germinate within two weeks after the soil has been prepared if adequate soil moisture and temperature (at least 50 degrees F. to a depth of 2")

are present. By not disturbing the soil after the seedbed has been prepared, few new weed seeds will be brought close to the soil surface. Later cultivations which may be performed must be kept extremely shallow (3/4" to 1" maximum) so as not to reposition any additional weed seeds. In essence, the stale seedbed technique follows this process; prepare the seedbed, wait and encourage any potential weed seeds to germinate, flame or apply herbicide, then plant.

Except for cool early spring conditions, when weeds are slow to germinate, this method can give acceptable weed control by following these steps:

1. Prepare the soil as if you are about to seed or transplant. A fine seedbed will germinate 100% more weeds than a coarse seedbed. A compacted seedbed will give an additional 50% increase. The soil should have adequate moisture, irrigate with 1/4 " of water if needed.
2. Wait as long as possible before taking any action, at least 10 days. The weeds will germinate and emerge. Allow weed seedlings to about the 3rd leaf stage, no younger than the 1st true leaf nor older than the 5th. On sandy, loamy or high organic matter soils, the soil should not crust and modern seeders should work satisfactorily. On heavy clay soils, crusting could make this technique unusable.
3. Flame the weeds just before transplanting. If the crop is to be direct seeded, flaming may be done just before planting, or after planting but before emergence. CAUTION: If the crop has already been seeded, be careful that the flaming process does not injure the seed or unemerged crop seedlings.

While there is obviously a risk, I have had no problems to date in flaming over spring sown larkspur planted 1/4" deep or summer sown sunflowers planted 1" deep.

My experience has been that a flamer can easily control annual broadleaf weeds in the 1 to 5 leaf stage; not so easily young grasses; and with difficulty (meaning use of more heat and slower ground speed) older annual broadleaves and grasses. Finally, one flaming cannot control established perennials such as quackgrass, bindweed, or nutsedge. Many plants with strong root systems will regrow even when all top growth has been destroyed. This may provide some

interesting opportunities for flaming on perennial crops, although I have only worked with annual flowers to date.

For anyone interested in flame weeding but unsure where to begin, I suggest purchasing a hand held propane vapor torch in the 200,000 to 500,000 BTU range. These are available for around \$80.00 through several farm supply catalogs or from some local welding supply stores or propane dealers. Connect this torch to a 20 lb. propane tank (such as those used on gas barbecue grills) and try it out. This simple hand torch will enable experimentation and offer insight into what flaming can and cannot do for a particular operation.

A hand torch is adequate for small plantings, perhaps up to 1000' of row. If you decide to flame on a larger scale, you should contact and work with a local propane supplier. Their trained service people can put together any equipment and components you might need. It would be a far safer system than if assembled by an inexperienced person. Two sources of flame weeding equipment are listed at the end of this report.

PROTOTYPE FLAME WEEDING CART

The flamer I built provided a good introduction to flaming with valuable experience in the field. The following is a brief description of the cart design and the changes I would recommend based on two seasons of experience.

First, I contracted a neighboring farmer skilled in metal fabrication to build a push cart frame similar in design and size to the common 2 wheel garden carts. Two 40 lb. propane tanks (vapor withdrawal) were secured in the cart. Below the cart, four vapor propane torches (two 200,000 BTU and two 50,000 BTU) were mounted. At the rear of the cart, within reach of the operator, a shut off valve, a pressure regulator, and a pressure gauge were installed. This valve, regulator, and gauge with connecting hoses and pipes were all assembled and checked by a local propane dealer, then installed as a single unit on the cart.

In the field, the cart was used to flame a 10" strip, directly over the row and 5" on either side. The ground between rows was cultivated with standard tractor mounted cultivators. Although the cart rolled easily on firm ground, it was quite difficult to push across the soft seedbeds. In the future, I would mount a small motor to drive the cart; or mount the flaming unit on a tractor. An alternative would be to make the cart as light as possible. The two tanks on the prototype, fully

loaded, weighed over 150 lbs. Smaller tanks would be sufficient for plantings under 1/2 acre.

The 50,000 BTU torches, although hot enough for plant tissue destruction, had to be mounted so close to the soil that the torches occasionally struck rocks or dirt on uneven ground. 200,000 BTU torches (or hotter) had flame lengths long enough to avoid this problem.

The single most important change I would recommend is to switch from a vapor system to a liquid propane system. The propane fuel is the same for either system. It is the tanks and torches that differ.

Vapor flamers use propane gas taken from the top of the tank. Liquid flamers use liquid propane taken from the bottom of the tank which later vaporizes at the torch. The same tank could supply both if equipped with both types of withdrawal valves. **CAUTION: DO NOT TIP A VAPOR WITHDRAWAL TANK UPSIDE DOWN TO OBTAIN LIQUID PROPANE.** The vapor delivery valve and the excess pressure relief valve on the tank are not designed for this use. A serious accident could occur. Always follow the instructions that come with specific equipment. Do not deviate from the intended use of this equipment.

Initially, I chose to use vapor torches in building the flamer because vapor torches are 1/2 the cost of liquid torches for the same BTUs. Also, vapor withdrawal tanks (such as those used on a gas barbecue grill) are less expensive, weigh less, and are available in a greater variety of sizes than are liquid withdrawal tanks (such as those used on industrial forklifts). The potential difficulty with a vapor system is that as you draw vapor from the tank, the tank cools. As the tank cools, the pressure available for the torches drops. The cooling speed and pressure drop are related to the size of the tank, the outside air temperature, the amount of propane in the tank, and the speed at which the propane is being drawn. A liquid system does not have this potential problem. For a handheld or back pack torch, vapor is acceptable. I do not know of any liquid tanks light enough to easily carry around the field. A multiple row or wide bed flamer mounted on a tractor should use liquid torches. A cart flamer similar to my prototype could go either way, vapor being used for small plantings (under 1/2 acre).

Fuel cost for flaming 10' strips, 30' on center, with torches totaling 500,000 BTUs was about \$15.00 (40 lbs. propane) per acre. This equals about 14,000 square feet of flamed ground. Fuel costs may be highly variable. I was not operating the torches at full capacity. With an estimated output of 300,000 BTU/hour covering 10", ground speed was about 2 to 2 and 1/2 mph.

Keys to the successful use of flame weeding are:

1. Properly match equipment size to the size of your operation.
2. Encourage as many weeds as possible to germinate before flaming.
3. Manage field operations in a timely manner in order to prepare a final seedbed more than two weeks before target planting date (even longer during cool spring conditions).

Two seasons of trial and error were encouraging. With experience gained, the second season was more successful than the first. By the second season, flaming was successfully used on vigorous summer planted crops. One flaming with two tractor cultivations between the rows provided adequate weed control. Weed control was not adequate on slower growing crops and spring sown crops. One unforeseen significant problem was the potential for erosion due to the longer period of time with unprotected soil. In conclusion, I recommend flame weeding as an alternative weed control method that may have a place in the operations of a grower willing to experiment and innovate.

Outreach

1. August 1993 - Columbia, Maryland; Slide presentation, Cut Flower Workshop, University of Maryland Cooperative Extension
2. October 1993 - Kingston, Rhode Island; Slide presentation and flamer demonstration, RI Sustainable Agriculture Field Day, University of Rhode Island Cooperative Extension
3. November 1993 - Kansas City, Kansas; Slide presentation and written report for conference proceedings, Association of Specialty Cut Flower Growers National Conference
4. January 1994 - Barrington, Rhode Island; Slide presentation and flamer demonstration, NOFA - RI Annual Meeting
5. August 1994 - Copy of final report (minus outreach page and cooperators' comments) forwarded to ATTRA, Fayetteville, Arkansas. ATTRA is a federal agency that distributes information on alternative and appropriate agricultural practices.



COOPERATIVE EXTENSION

College of Resource Development, University of Rhode Island

Eastern District Office
Florence M. Gray Center, York Street, Newport, RI 02840
Telephone: 401-847-0287 423-1730 847-0296
Fax: 401-847-0287

February 4, 1994

Paul Pieri
P.O. Box 919
Little Compton, RI 02837

Dear Paul,

On behalf of the Rhode Island Sustainable Agriculture Committee, I want to acknowledge your presentation to us of the push-cart flame weeder that you built with the help of a S.A.R.F. farmer's grant. I also want to thank you for selecting our organization to be custodian of this device. Please be sure we will make its availability known to the farming community. In addition, we have some ideas of our own for projects that would make use of the weeder. Please accept our congratulations for your ingenuity and our thanks for your generosity.

Best regards,

Will Reynolds
Coordinator
R.I. Sustainable Agriculture
Committee

Wishing Stone Farm
Skip Paul
25 Shaw Road
Little Compton, R.I. 02837

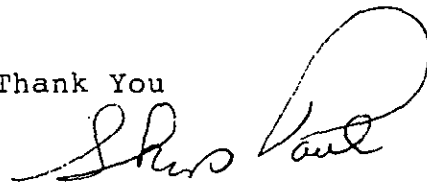
To whom it may concern:

We run a small truck farm and retail stand in Little Compton, R.I.. Our farm is one of the largest certified organic farms in R.I. and we have long been in supporters of sustainable practices. I was particularly interested in Paul Pieri's project when he described it to me. Flame weeding has been a strong interest of mine for some time now. We have attempted it in a make shift way with a hand held unit. Needless to say, our efforts met with some success but more often failures. However, through it all we were excited by the possibilities that could present themselves with the right materials and execution.

Paul Peiri's flame weeder was a necessary step in the evolution of this technology. Though we did not have an opportunity to experiment with his apparatus, I did see it demonstrated several times and was impressed with its design and utility. We look forward to assisting Paul and others in developing this new technology.

With all the uproar over ground water contamination, it is heartening to see grants being awarded to projects like Paul Pieri's flame weeder. The farmer needs alternatives to look forward to if we expect him to give up his dependance on herbicides and pesticides.

Thank You

A handwritten signature in cursive script that reads "Skip Paul". The signature is written in dark ink and is positioned above the typed name.

Skip Paul
Wishing Stone Farm

Frances D. Chaplin
Adamsville Flower Farm
30 Main St. P.O. 51
Adamsville, R.I. 02801

January 15, 1994

S.A.R.E.

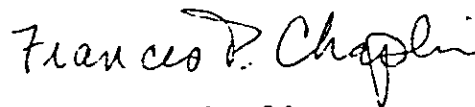
I am a cut flower grower and sell to the Boston Flower Exchange and to local farmstands. I grow organically and weed control is labor intensive but an absolute necessity. Most of my growing area is raised beds which minimizes weeds, but the flame weeder seemed like an excellent alternative to hoeing and handweeding.

Paul Pieri brought his flame weeder to my house on the back of his small pick-up truck. Transporting and removing the weeder was not a problem. We fired the weeder up in the driveway so I could practice before moving into the field. I rolled the weeder over some weeds and grasses along the edge of the drive with ease. (The grasses grew back, the annual weeds did not). In the field we found the width of the wheels was not narrow enough for my paths and the clearance of the flame shooters was not high enough. We figured the only way the weeder would work in my situation would be to have a long hose with the flame on the end so I could walk along and spot weed, or I would have to rework the beds.

Appropriate clothing is necessary with the flame weeder. A long skirt and sneakers is dangerous as the day was windy. Grass or hay mulch is another problem. I was also a bit leery of the propane tanks perched on top of and so close to the flames.

I saw Paul's slide show on two different conference occasions and his experiments and experiences were well documented. The pros and cons of this alternative method of weeding were presented very clearly. I feel the flame weeder has enormous potential in the cut flower aspect of farming. I wish to thank S.A.R.E. for this grant and the opportunity to promote education about alternative methods of farming.

Sincerely,



Frances D. Chaplin

A REVIEW OF WEED CONTROLL VIA FLAME TORCH FOR SPECIALTY CUT FLOWERS

The concept of using propane flame for weed control has great potential value, but has some practical limitations. Overall, I was personally quite impressed with Paul's experiment of controlling weeds on specialty cut flowers. The following is some impressions I had about the experiment:

ADANTAGES:

- 1) Effective weed control for flowers which prefer warm dry soil temperatures.
- 2) Alternative to both mechanical and chemical weed control for sterl seed bed method and pre-emergance period.

DISADANTAGES:

- 1) The experimental unit actually tested was difficult to move around the field, and wasn't very accurate after plants had emerged.

POSSIBILITIES:

- 1) A tractor mounted unit over a shaped raised bed, with torches that would articulate around stiff and erect type of flower (like a sunflower).

COMMENTS:

I feel Paul deserves alot of credit for attempting to find an alternative for weed control on flowers. Unfortunately, I am not sure that his experimental unit has practical commercial application. I believe that with some modifications, it might be possible to produce a unit that would have some practical use.

A.W. Closson Gardens
West Main Road
Little Compton RI. 02837

Thad Closson