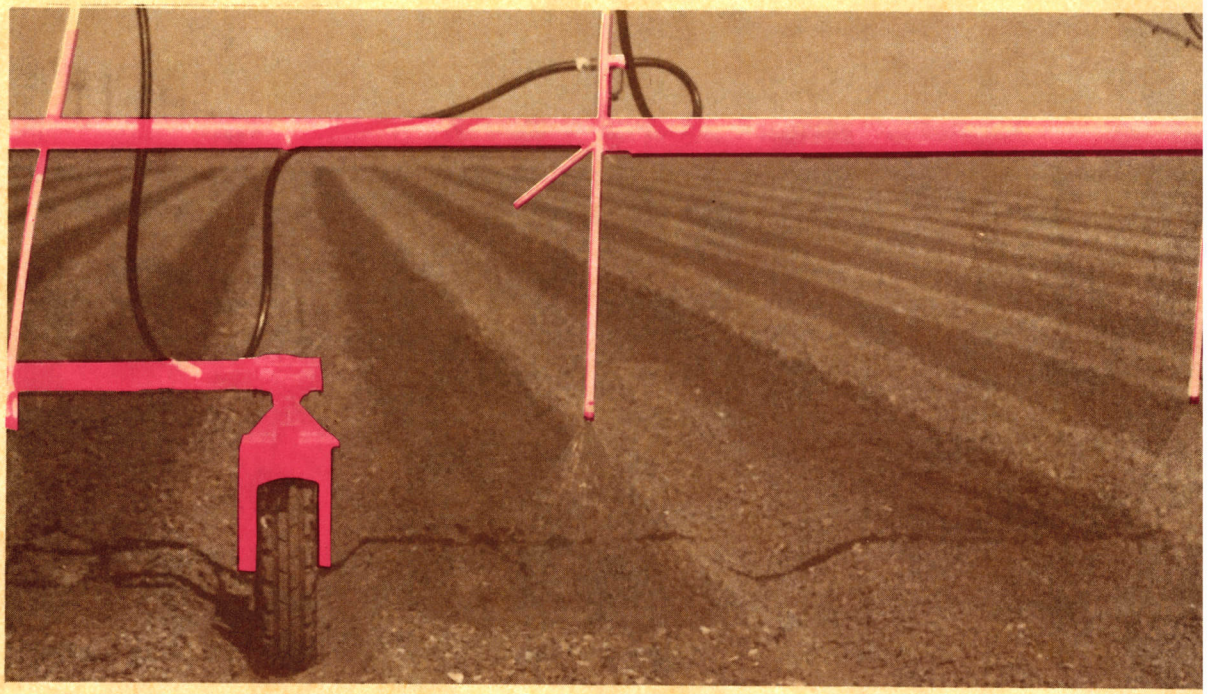
RUNCINA VOL. 41

THE USE OF

METHAM

METAM® SECTAGON 42® SOIL PREP® VAPAM®



FOR WEED CONTROL

A PROGRESS REPORT

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

FRESNO COUNTY

This is a report of work in progress only. The chemicals and uses contained in this publication are experimental data and should not be considered as recommendations for use.

Until the products and their uses given in this report appear on a registered pesticide label or other legal, supplementary direction for use, it is illegal to use the chemicals as described.

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Recommendations are based on the best information currently available, and treatments based on them should not leave residues exceeding the tolerance established for any particular chemical. Confine chemicals to the area being treated. THE GROWER IS LEGALLY RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

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ACKNOWLEDGEMENTS

We acknowledge the efforts and the innovative applied research trials conducted by numerous University of California Cooperative Extension workers and cooperating growers in developing different application methods for the effective use of metham for weed control.

This progress report does not contain recommendations for the use of metham. It is but a summary of different application methods that have been developed for the use of metham to control weeds.

We wish to express our appreciation to Juan Barrera, of Harris Farms, for his collaboration and the use of equipment in conducting trials in Fresno County. The cooperation of Don May, Farm Advisor in Fresno County, Richard Schetter, Principal Superintendent of Agriculture, and other members of the West Side Field Station have been indispensable.

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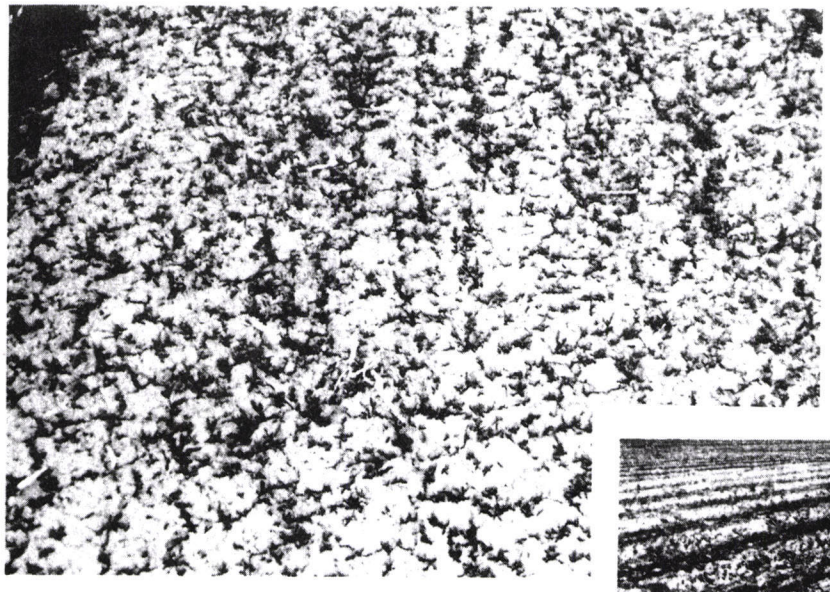
THE USE OF METHAM FOR WEED CONTROL

A Progress Report

Bill B. Fischer and Kurt Hembree*

Thousands of acres of productive agricultural land in California's Central San Joaquin Valley have become infested with black nightshade and hairy nightshade in recent years and their control has required farmers to consider using metham. Other species of weeds in the nightshade (Solonaceae) family that are becoming more widespread include: lanceleaved groundcherry, tolguacha, jimsonweed, Indian tobacco, and buffalobur. Several species of weeds in the sunflower (Compositae) family that are also becoming more prevalent: horseweed, flaxleaf fleabane, sunflower and cocklebur.





Tomato fields in the San Joaquin Valley treated with preplant incorporated napropamide (Devrinol) are heavily infested with black and hairy nightshade.

*Farm Advisor and Research Assistant, respectively, UC Cooperative Extension, Fresno County, .

Among the numerous reasons advanced to explain these shifts in the weed population, the more significant ones are:

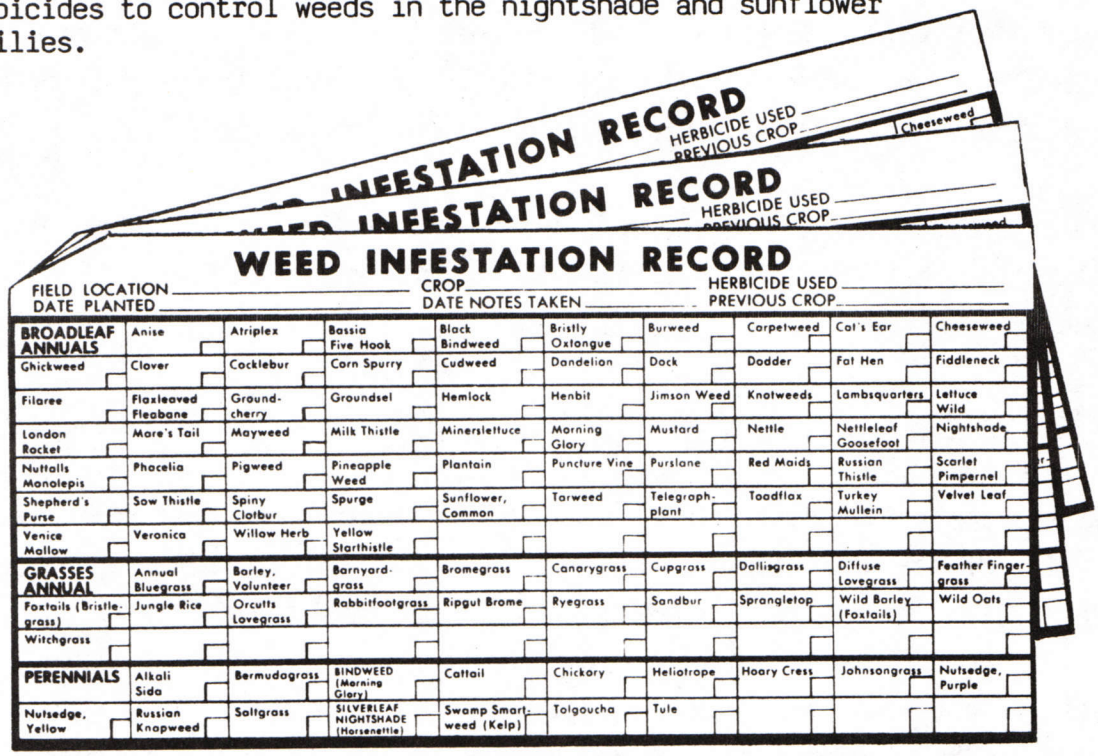
- Weeds are becoming tolerant to several selective herbicides widely used in the crops grown in the area.
- More acreage in the valley is being devoted to such crops such as tomatoes, peppers, and eggplant, which are in the same family (nightshade) as the weeds.
- Mechanical harvesting, especially of tomatoes infested with nightshades, groundcherries, tolguacha, and jimsonweed, greatly enhance distribution of their abundantly produced seeds.
- The reduced number of cultivations due to the use of selective herbicides may benefit growth and seed production of the tolerant weed species.

CONTROL MEASURES

In a well-planned vegetation management system, weeds in the nightshade and sunflower families tolerant to several widely used herbicides can be controlled, their population can be reduced, and their wider distribution minimized . To accomplish this successfully:

- Properly identify all weeds and record their distribution on the farm (Weed Infestation Record Cards are available for this purpose).
- Select cropping sequences in which selective herbicides can be used to effectively control the tolerant weed species.
- Select crops and planting patterns (i.e. single instead of double rows per bed) that will facilitate repeated close cultivation to minimize costly hand hoeing.
- Rogue fields that are sparsely infested to prevent the production of seeds and their subsequent distribution in the field.
- Remove rogued weeds that are in fruit, even though they may appear immature.
- Clean mechanical harvesters when moving them from infested fields.
- If possible, avoid using irrigation tail water from infested fields to irrigate clean fields.

When making field assignments or when selecting cropping sequences, consider the potential weed infestation and inquire about the availability and effectiveness of selective herbicides to control weeds in the nightshade and sunflower families.



WEED INFESTATION RECORD

FIELD LOCATION _____ CROP _____ HERBICIDE USED _____
DATE PLANTED _____ DATE NOTES TAKEN _____ PREVIOUS CROP _____

BROADLEAF ANNUALS	Anise	Atriplex	Bassia Five Hook	Black Bindweed	Bristly Oxtongue	Burweed	Carpetweed	Cat's Ear	Cheeseweed
Chickweed	Clover	Cocklebur	Corn Spurry	Cudweed	Dandelion	Dock	Dodder	Fat Hen	Fiddleneck
Filaree	Flaxleaved Fleabane	Ground-cherry	Groundsel	Hemlock	Henbit	Jimson Weed	Knotweeds	Lambsquarters	Lettuce Wild
London Rocket	Mare's Tail	Mayweed	Milk Thistle	Minerslettuce	Morning Glory	Mustard	Nettle	Nettleleaf Goosefoot	Nightshade
Nuttalls Monolepis	Phacelia	Pigweed	Pineapple Weed	Plantain	Puncture Vine	Purslane	Red Maids	Russian Thistle	Scarlet Pimpernel
Shepherd's Purse	Sow Thistle	Spiny Clotbur	Spurge	Sunflower, Common	Tarweed	Telegraph-plant	Toadflax	Turkey Mullein	Velvet Leaf
Venice Mallow	Veronica	Willow Herb	Yellow Starthistle						
GRASSES ANNUAL	Annual Bluegrass	Barley, Volunteer	Barnyard-grass	Bromegrass	Canarygrass	Cupgrass	Dallisgrass	Diffuse Lovegrass	Feather Finger-grass
Foxtails (Bristle-grass)	Jungle Rice	Orcutts Lovegrass	Rabbitfootgrass	Ripgut Brome	Ryegrass	Sandbur	Sprangletop	Wild Barley (Foxtails)	Wild Oats
Witchgrass									
PERENNIALS	Alkali Sida	Bermudagrass	BINDWEED (Morning Glory)	Cattail	Chickory	Heliotrope	Hoary Cress	Johnsongrass	Nutsedge, Purple
Nutsedge, Yellow	Russian Knapweed	Saltgrass	SILVERLEAF NIGHTSHADE (Horsenettle)	Swamp Smart-weed (Kelp)	Tolgoucha	Tule			

Cards such as these (available free) can be used to keep records of weed infestations on the farm.

THE USE OF METHAM

In recent years, many trials were conducted in California to evaluate the effectiveness of metham in controlling nightshades and other weeds. Metham as a soil fumigant was discovered more than 35 years ago and has been used to control numerous fungus diseases, nematodes, and weeds.

Since 1977, when metham was first applied through center pivot irrigation systems, investigators have observed its effectiveness in controlling annual and perennial weeds. S. C. Phatak, at the Second National Symposium on Chemigation in 1982, reported good control of yellow nutsedge (Cyperus esculantus) with 100 gallons of Vapam applied with 0.5 inch of water per acre. Following discovery of the effectiveness of applying pesticides through irrigation water, many papers were published reporting the use of metham to control diseases and weeds. More recently, in 1986, Teasdale and Taylorson reported that metham and methyl isothiocyanate controlled dormant and nondormant large crabgrass (Digitaria sanguinalis) seeds.

In California, A. H. Lange, UC Extension Weed Scientist Retired, spearheaded studies evaluating metham applied through low-volume drip irrigation systems, subsurface blading, and as a drench to control weeds in the nightshade family. More metham was applied in 1988 for weed control than ever before. Results obtained by growers varied from very effective to failure.

The purpose of this progress report is to outline the methods of metham application that effectively controlled weeds in numerous Central California crops.

WHAT IS METHAM?

A little understanding of the chemical properties, the mode of action, and behavior of metham in the soil may explain how to use it safely and effectively. Metham is synthesized from monomethylamine and carbon disulfide in the presence of concentrated sodium hydroxide. In its solid state, it is unstable, but when stored in a 32.7 percent water solution it is stable. The acute oral LD in mice is 285 mg/kg. Metham can be irritating to the skin and mucous membranes.

For agricultural use, metham is formulated as a 4.0 lb/gal sodium N-methyldithiocarbamate dihydrate and has been available under the following trade names: Metam , Sectagon 42 , Soil-Prep , Vapam, and V.P.M.

Metham is nonvolatile. However, as soon as it contacts soil, it starts to decompose into methyl isothiocyanate, a volatile, highly toxic fumigant. This is a chemical rather than biological process. In soils, decomposition of metham to methyl isothiocyanate occurs within 1 to 5 hours. In moist loam soil, it is usually complete within 1 hour. In sandy soil, decomposition may take 5 hours. Increasing organic matter and clay content of the soil increases the rate of breakdown.

Unless it is covered immediately with soil or moved into the soil with water, methyl isothiocyanate can be lost very rapidly through vaporization . It is the primary toxic agent that controls fungi, nematodes, plant roots, and weed seeds ready to germinate.

Methyl isothiocyanate is degraded in the soil to nontoxic compounds within a few days. Its speed of disappearance depends on the rate applied, the temperature, and the soil's moisture content.

Briefly, metham is a water-soluble liquid that converts to a highly toxic, volatile, gaseous fumigant. Properly applied, it will kill many disease organisms, nematodes, weeds, and germinating weed seeds.

EFFECTIVE WEED CONTROL WITH METHAM

Effective weed control with metham was obtained when applied at a rate of 50 to 75 gallons per acre. Rates lower than 50 gallons per acre provided marginal to poor weed control. The higher rates provide control of a broader spectrum of weeds.



With proper use of metham, effective weed control can be obtained as pictured above.

Metham applied on the surface of the soil and moved into the soil with flood or sprinkler irrigation did not provide acceptable weed control. With this method of application it leached too rapidly out of the soil zone where most weed seeds germinate. In many states metham is being used most extensively by injection into center-pivot irrigation systems. In California, it has been used successfully through:

solid set sprinklers

linear, movable sprinklers

drip irrigation

soil drench

spray blades

Application through solid set-sprinklers has been used successfully. However, to minimize costs, metham is most often applied in bands 6 to 12 inches wide on preshaped beds. When injected into solid-set or linear sprinklers, or when applied in drip irrigation or as a drench, at least 1/8 to 1/4 acre-inch of water must be applied to wet the soil to sufficient depth where weed seeds germinate.

Table I can help in calculating the amount of metham needed for the area to be treated.

TABLE I
GALLONS OF METHAM REQUIRED TO TREAT ONE INCH BAND OF SOIL ON THE BED SPACING INDICATED

RATE IN Gal/A	30" BED	40" BED	60" BED	66" BED	80" BED
25	0.8	0.63	0.4	0.37	0.31
50	1.6	1.25	0.83	0.75	0.6
75	2.6	1.9	1.3	1.1	0.95
100	3.2	2.5	1.7	1.5	1.2

To determine the total amount of metham needed per acre, multiply the values given under the proper bed spacing by the width of the band to be treated.

Example: Tomato bed:.....66-inch spacing
Band to be treated:.....8 inches
Rate of metham to be used:..75 gallons per acre

From the Table: 75 gal. per acre on 66-inch beds = 1.1 gal./inch to be treated
8 X 1.1 = 8.8 gal. metham needed to treat one acre of tomatoes

To calculate the amount of water required for drench, drip, or linear, movable sprinkler application, Table II may be helpful.

TABLE II
WATER REQUIREMENT FOR METHAM APPLICATION THROUGH DRENCH, LINEAR SPRINKLERS AND DRIP EMITTERS

	GALLONS OF WATER NEEDED ON THE FOLLOWING BED TO TREAT 1 INCH BAND				
WATER A/INCH	30"	40"	60"	66"	80"
1/8	113	85	55	50	43
1/4	226	170	113	103	85
1/2	452	340	226	206	170

To determine the amount of water required to obtain the desired depth of wetting for one acre, multiply the values given under the proper bed spacing by the width of the band to be treated in inches.

Example: Pepper bed spacing:...40 inches
Band to be treated:...12 inches
Water to be applied:..1/8 acre-inch

From the Table: 1/8 acre-inch on a 40-inch bed = 85 gal./inch band width
85 x 12 = 1,020 gal. water needed to treat one acre of peppers

METHAM APPLICATION FOR DISEASE AND NEMATODE CONTROL

To control diseases and nematodes, different metham application techniques are required. The nematodes and fungi occur in the soil deeper than 0 to 3 inches where weed seeds germinate. However, modifying the application to obtain distribution to a greater depth in the soil profile can be accomplished to obtain disease and nematode, as well as weed control.

APPLICATION METHODS

Regardless of the method of application, certain conditions must be met to insure metham's effectiveness in controlling weeds. They are:

. Prepare the field for planting before fumigation.

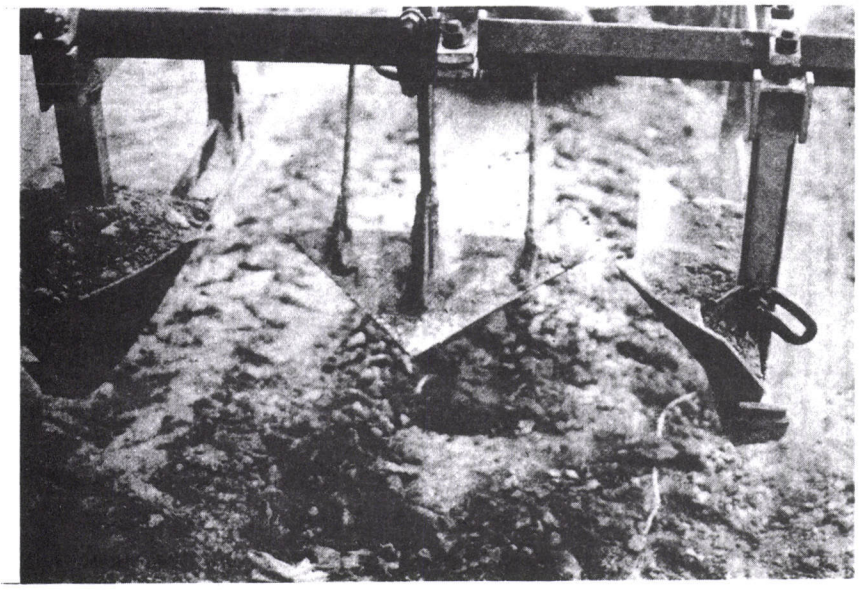
. Prepare a good seedbed, free of clods.

- Moisten the soil at least a week before fumigation to insure that weed seeds have imbibed water. Avoid excessive moisture.
- Soil temperature for good fumigation should be between 50°F and 90°F (10°-32°C).
- Apply starter or preplant fertilizers before fumigation.
- Plant as soon as the required waiting period indicated on the label is met.
- During planting and subsequent cultivation, do not move untreated soil to the treated band.

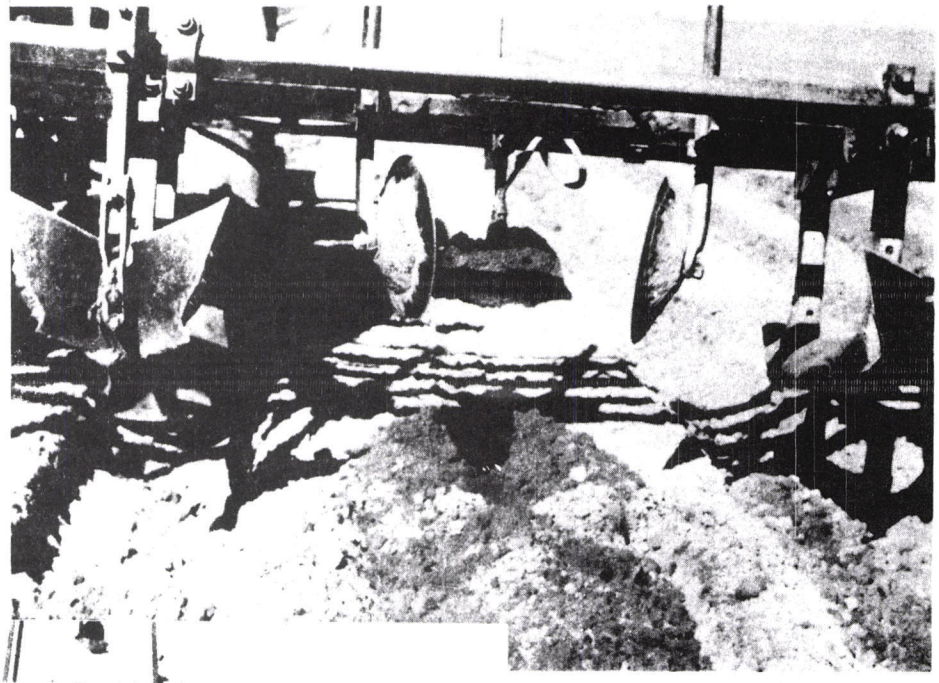
Failures and poor weed control resulted in fields that were cloddy or where excess moisture prevented a good seal. Poor weed control was also observed when weed seeds were not ready to germinate, or in blade injection, when a good seal or cap was not maintained. Application through sprinklers and drip lines resulted in poor control when additional water was applied without metham to flush the system and the fumigant was leached from the surface 1 to 2 inches.

BLADE INJECTION

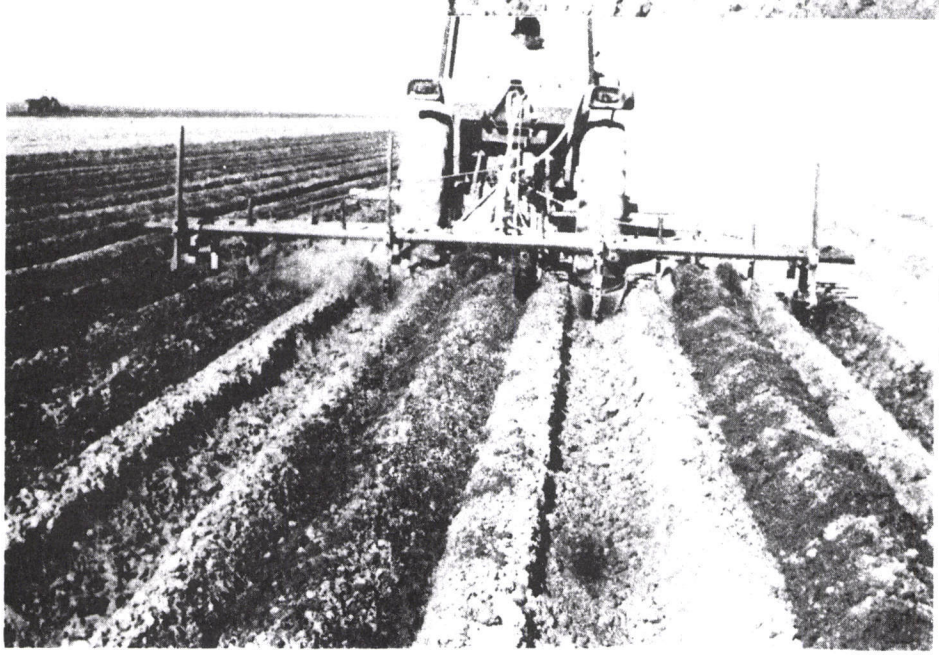
The most widely used method of metham application in the San Joaquin Valley is with spray blades in 4- to 12-inch bands on preshaped beds. The fumigant is applied 2 to 3 inches deep in concentrated form or diluted with water. A cap (layer of soil), 2 to 3 inches deep, is formed over the treated band to minimize loss of methyl isothiocyanate.



Front view of one type of injection blade.



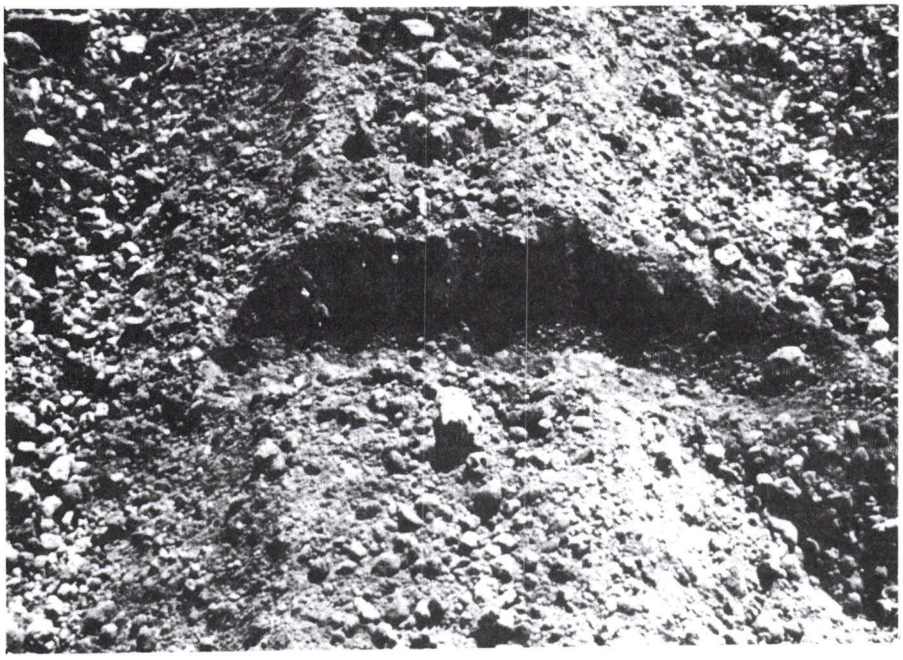
Rear view of injection blade arranged to apply metham in 8-inch band on 60-inch tomato beds on Panoche clay loam soil.



Rear view of injection blades applying metham in three 60-inch tomato beds.

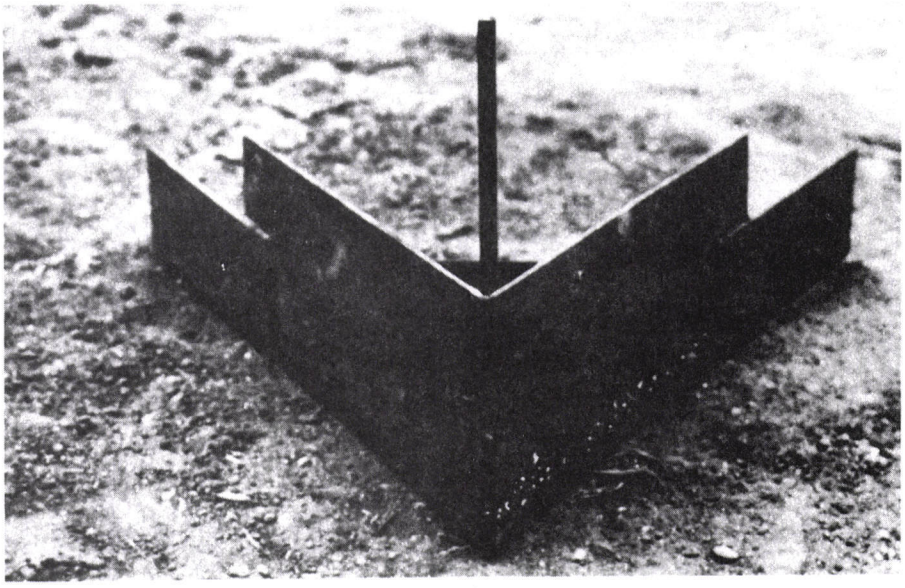
During or before planting, the cap is removed with a crowder and the crop seed is placed in the fumigated strip. The soil used to form the cap is not fumigated; therefore, it should be crowded off the treated band, but, in the process, the treated band should not be contaminated with nonfumigated soil. By following these procedures, effective control can be obtained.

Note: During blade injection, the spray should be turned on only after the blades are in the soil and turned off before lifting it out of the soil when turning at the end of the rows.



Bed profile showing the depth of the injection of metham and the cap on a tomato bed.

A simple crowder used to remove the cap of soil following the application of metham with a blade injector.

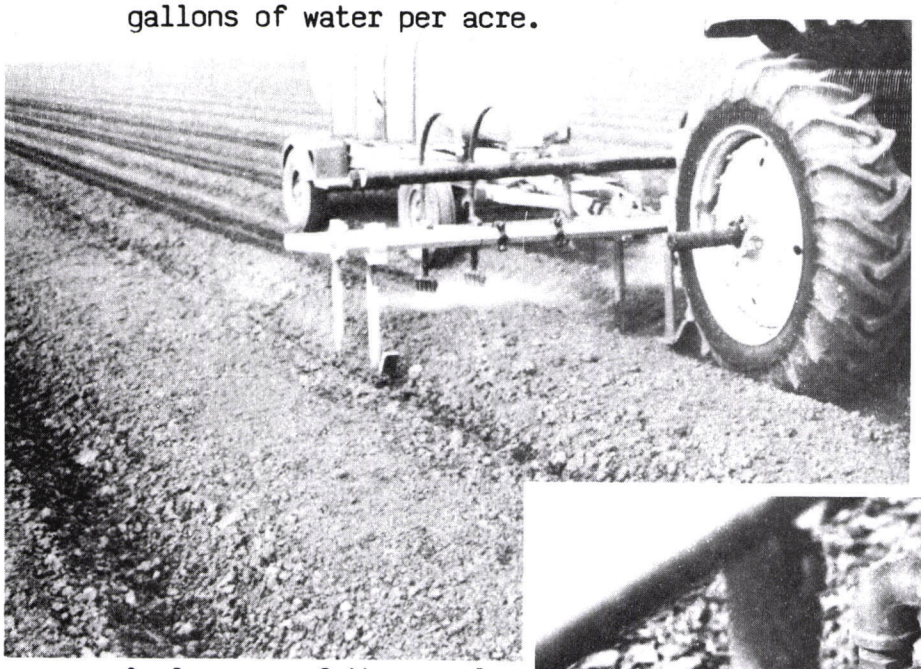




Effective nightshade control was obtained with blade injection of 75 gallons of metham per treated acre as shown on the left.

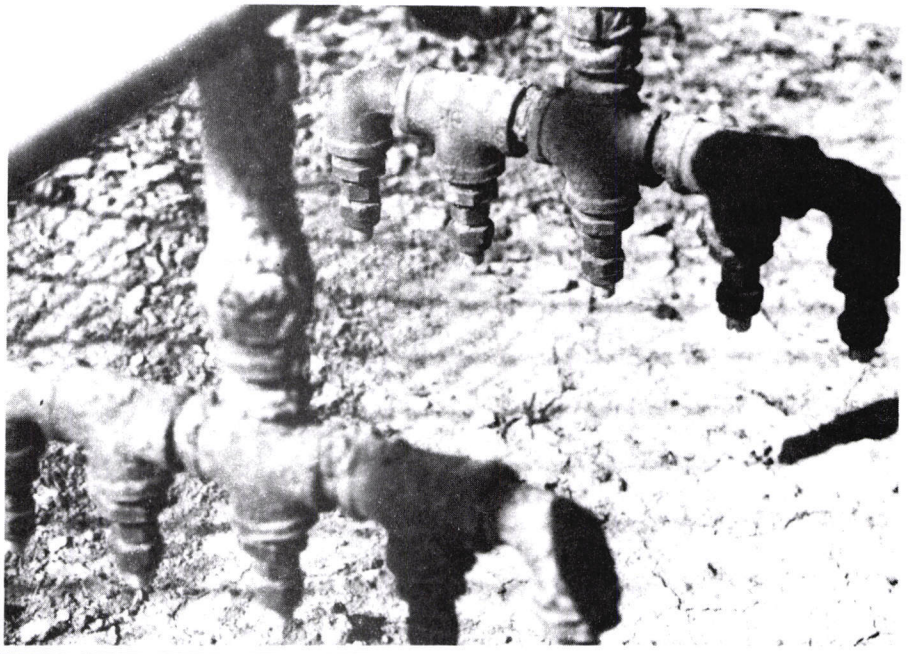
DRENCHING

Although used effectively, drenching is not favored because it requires large quantities of water. As an example, to apply metham in an 8-inch band of soil on tomato beds spaced 66 inches apart with 1/8 acre-inch of water requires 400 gallons of water per acre.



Application of metham on the surface of the soil as a drench in 1/8 to 1/4 acre inch of water per treated acre requires a large quantity of water.

A close-up of the nozzle arrangement in the application of metham in two 8-inch bands on 66-inch tomato beds.



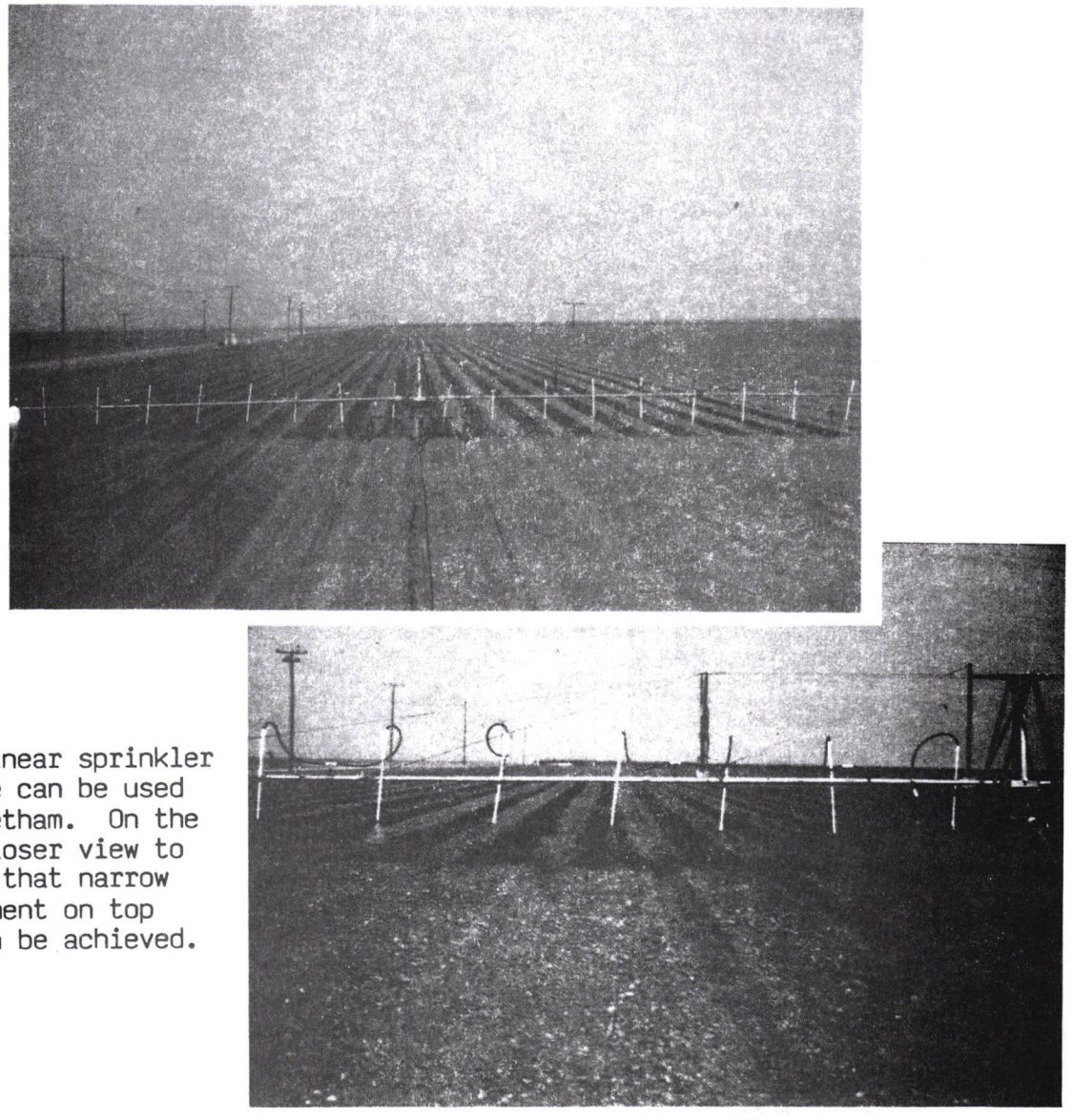


Effective weed control can be obtained with metham applied as a drench on well prepared seed beds free of clods.

In drenching, metham is diluted in the required amount of water and sprayed onto the soil through several (four to six) flat-fan nozzles mounted in clusters. The soil conditions required for effective fumigation are the same as that described for spray-blade application; no capping, however, is required and effective control can be obtained.

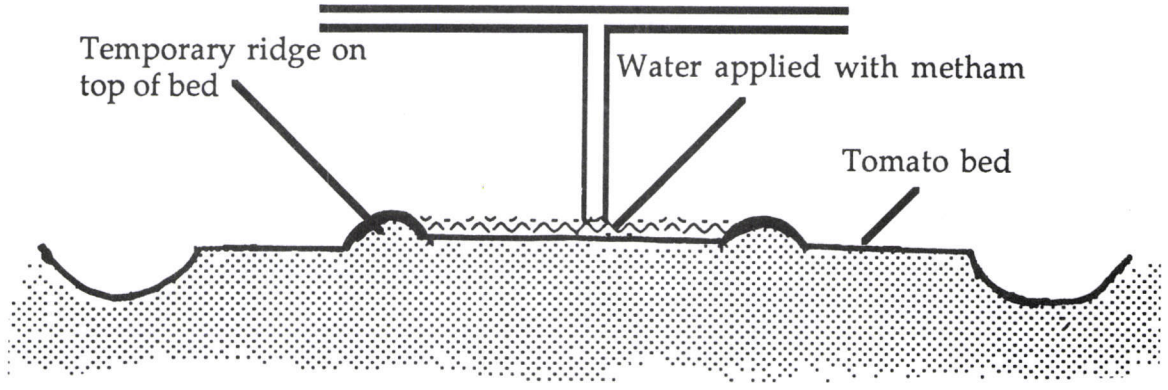
LINEAR SPRINKLERS

Metham can be applied in narrow bands with portable linear sprinklers. The method is similar to those described in drenching. The fumigant must be metered into the system during the entire period of irrigation. The spray nozzles are mounted close to the surface of the soil on low-hanging booms and the width can be manipulated by the height of nozzle in relation to the soil surface.

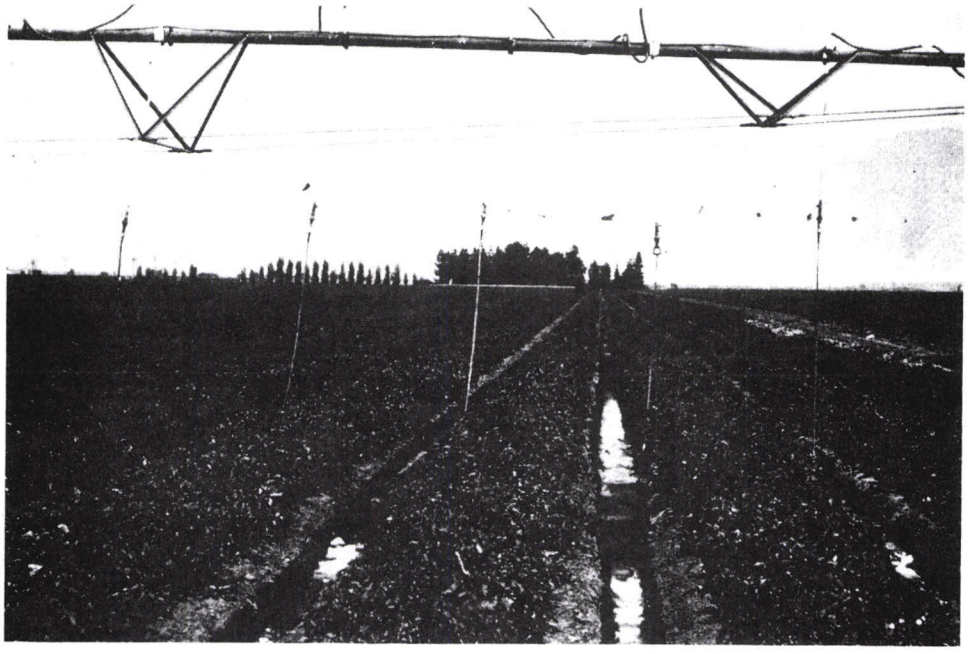


Portable linear sprinkler shown above can be used to apply metham. On the right, a closer view to illustrate that narrow band treatment on top of beds can be achieved.

Another method that has been used successfully is constructing ridges on top of preshaped beds, and the water with the metham is applied in the area between the ridges, resembling shallow furrows. Later, the emitters are moved in the furrow to irrigate the crop through the season.



The sketch above illustrates the application of metham as a drench prior to planting. The photograph below illustrates furrow irrigation with the same system.



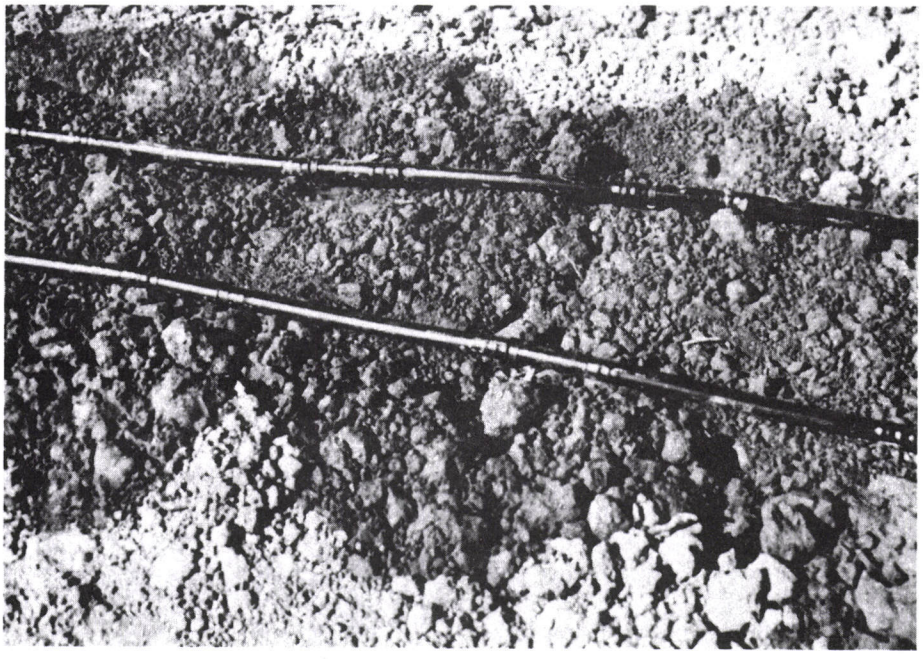
SOLID-SET SPRINKLERS

Solid-set sprinklers were used to effectively control weeds with 30 gallons of metham per acre. However, volunteer onions and some species of weeds survived. The fumigant must be metered into the system during the entire

period of irrigation. This method should not be used during windy conditions and workers should not be present in adjacent fields during application. Following application, the lines should be rinsed but not with an excessive amount of water that would leach the fumigant from the surface of the soil. Movable sprinklers that would expose workers to the fumigant soon after its application should not be used for applying metham.

APPLICATION THROUGH LOW VOLUME EMITTERS

Application of metham through low-volume emitters (drip irrigation) resulted in erratic control. To obtain uniform wetting of the soil and even distribution of the fumigant, either two lines per bed or close spacing of the emitters was required; both are expensive.



Using low-volume emitters requires close spacing of the emitters or two lines per bed to obtain sufficient wetting and good distribution of the fumigant.

The area wetted by individual emitters is influenced by the texture of the soil; hence, the quantity of water and the duration of irrigation need to be determined before treatment. The fumigant must be applied throughout the water application cycle. As in the other methods described, the importance of proper land and seedbed preparation cannot be overemphasized.

CONCLUSION

Growers of vegetables in the San Joaquin Valley are rapidly learning how to use metham to control weeds in the nightshade family and other weeds that are tolerant to widely used herbicides and that have spread at an alarming rate.

Metham can be applied by various means as described in this progress report. It is worth emphasizing that to insure effective weed control:

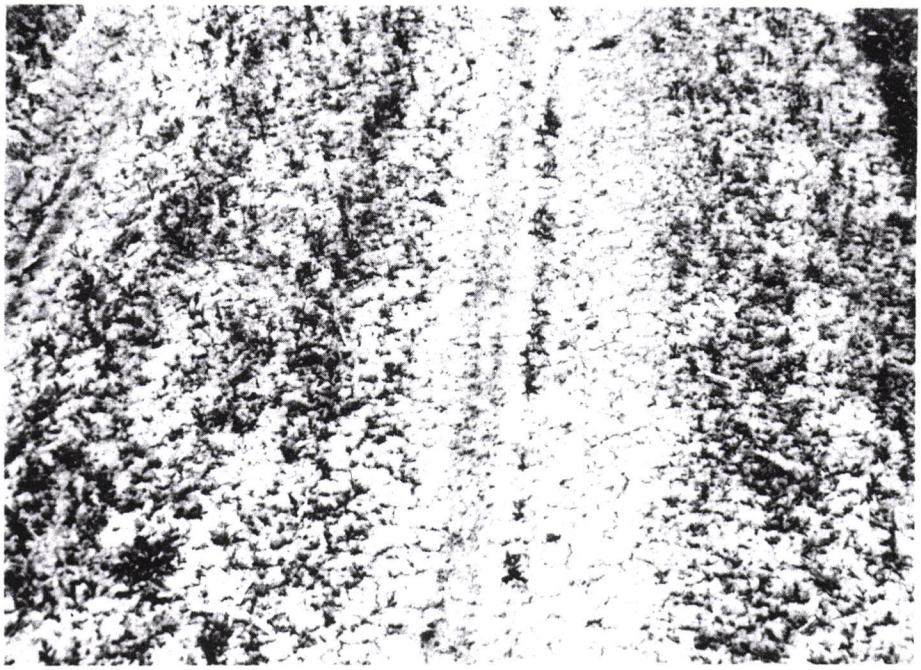
- Preirrigate the field.
- Prepare a seed bed free of clods.
- Weed seeds should be ready to germinate, and the starter fertilizer should be applied before fumigation.
- Soil temperature, when the metham is applied, has to be between 50°F and 90°F.



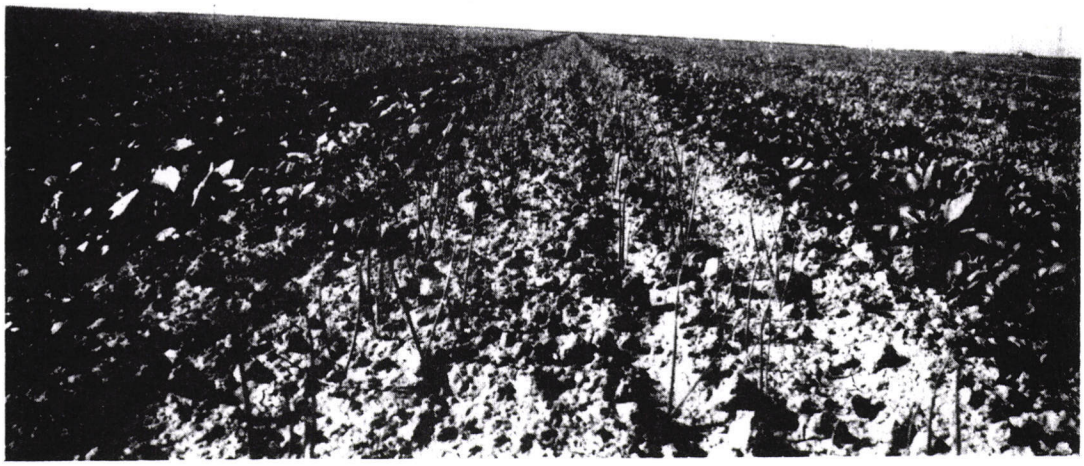
Metham effectively controlled black nightshade and pigweed when applied with an injection blade in a cantaloupe field.

- Apply the fumigant uniformly.
- Do not mix contaminated soil with untreated soil.

Metham, properly applied, can provide effective control of nightshades and other weeds. To avoid contamination of the environment and to insure its safe use, read and follow the recommendations printed on the label. Observe the suggested waiting period before planting.



Metham has been effectively used to control weeds in tomatoes (pictured above), onions (shown below), and in many other crops.



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TOWARD MORE EFFECTIVE WEED CONTROL

Without knowledge of the weed infestation it isn't possible to intelligently plan an economical weed control program.

To help identify weeds, the University of California's "Growers Weed Identification Handbook" may be helpful. It contains colored photographs and descriptions of 263 commonly occurring weeds in different stages of their growth. The pictures, in a sturdy, 3-ring binder, can be purchased for $60.00 from Agricultural and Natural Resources, 6701 San Pablo, Oakland, California 94608, and from the Farm and Home Advisors Office, 1720 S. Maple Ave., Fresno, California 93702.

Being able to identify weeds is but the first step. Keeping records of their presence is essential to use selective herbicides intelligently. Cards, such as the one illustrated below, can be used to keep records of weed infestations. They are available from Cooperative Extension offices, from pest control advisers, and distributors of herbicides.

WEED INFESTATION RECORD

FIELD LOCATION _____ CROP _____ HERBICIDE USED _____
DATE PLANTED _____ DATE NOTES TAKEN _____ PREVIOUS CROP _____

BROADLEAF ANNUALS	Anise	Atriplex	Bassia Five Hook	Black Bindweed	Bristly Oxtongue	Burweed	Carpetweed	Cat's Ear	Cheeseweed
Chickweed	Clover	Cocklebur	Corn Spurry	Cudweed	Dandelion	Dock	Dodder	Fat Hen	Fiddleneck
Filaree	Flaxleaved Fleabane	Ground-cherry	Groundsel	Hemlock	Henbit	Jimson Weed	Knotweeds	Lambsquarters	Lettuce Wild
London Rocket	Mare's Tail	Mayweed	Milk Thistle	Minerslettuce	Morning Glory	Mustard	Nettle	Nettleleaf Goosefoot	Nightshade
Nuttalls Monolepis	Phacelia	Pigweed	Pineapple Weed	Plantain	Puncture Vine	Purslane	Red Maids	Russian Thistle	Scarlet Pimpernel
Shepherd's Purse	Sow Thistle	Spiny Clotbur	Spurge	Sunflower, Common	Tarweed	Telegraph-plant	Toadflax	Turkey Mullein	Velvet Leaf
Venice Mallow	Veronica	Willow Herb	Yellow Starthistle						
GRASSES ANNUAL	Annual Bluegrass	Barley, Volunteer	Barnyard-grass	Bromegrass	Canarygrass	Cupgrass	Dallisgrass	Diffuse Lovegrass	Feather Finger-grass
Foxtails (Bristle-grass)	Jungle Rice	Orcutts Lovegrass	Rabbitfootgrass	Ripgut Brome	Ryegrass	Sandbur	Sprangletop	Wild Barley (Foxtails)	Wild Oats
Witchgrass									
PERENNIALS	Alkali Sida	Bermudagrass	BINDWEED (Morning Glory)	Cattail	Chickory	Heliotrope	Hoary Cress	Johnsongrass	Nutsedge, Purple
Nutsedge, Yellow	Russian Knapweed	Saltgrass	SILVERLEAF NIGHTSHADE (Horsenettle)	Swamp Smart-weed (Kelp)	Tolgoucha	Tule			

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