In addition to requiring the user to obtain a permit from the agricultural commissioner, the regulations prescribe certain conditions to be met by those who possess or use sodium arsenite as follows:

(a) No pesticide containing sodium arsenite shall be applied on exposed vegetation (other than dormant grapevines) unless the vegetation to be treated is enclosed within a good and sufficient fence or otherwise made inaccessible to grazing animals, pets, and children.

(b) No pesticide containing sodium arsenite shall be applied on soil or vegetation (other than dormant grapevines) in any area penetrated by roots of any plant of value, without the written consent of the owner of such plant.

(c) No pesticide containing sodium arsenite shall be kept or placed in drinking cups, pop bottles, or other containers of a type commonly used for food or drink.

(d) No pesticide containing sodium arsenite, whether in concentrated or dilute form, shall be stored, placed, or transported in any container or receptacle which does not bear on the outside a conspicuous poison label which conforms to the label required to be placed on all packages of arsenic compounds and preparations sold or delivered within the State.

These are only procedures that any careful person would observe in the use of a poisonous material like sodium arsenite.

It is just over one year since the regulations became effective. In that time we have heard of no accidental deaths involving sodium arsenite in California and the regulations appear to be serving a good purpose.

SUBSTITUTE HERBICIDES FOR SODIUM ARSENITE

W. B. McHenry
University of California
Davis

If we look back in history, compounds containing arsenic have been useful to man in a number of ways for centuries. Hippocrates, the father of medicine, in the 5th century B.C., recommended a paste of the sulfide of arsenic for the treatment of ulcers and similar disorders.[1] It was during a later era that the toxic properties of arsenic became fully appreciated, when certain of them were put to extensive use by professional poisoners of the Middle Ages.

Records indicate the first use of arsenic as a pesticide in the 17th century when mixtures of white arsenic and honey were used as an ant bait.[2] Later with the appearance of smelting processes for lead, copper, zinc, and iron, relatively crude arsenic compounds became available in increased supply. White arsenic and sodium arsenite came into widespread use as herbicides from 1900 to 1910. Sodium arsenite was first used as a selective weed killer on sugar cane in the Hawaiian Islands. Beginning about 1914 the railroads in America were using countless tons of arsenic as a non-selective contact and soil sterilant.[3] By 1917 sodium arsenite was recommended for field bindweed control here in California, and in 1922 the California Department

of Agriculture reported that, with one exception, all of the commercially available herbicides contained arsenic. From the 1930's to date we have seen a rapid progression of new herbicides including, interestingly, some new forms of less poisonous arsenic.

The early medicinal use of arsenic not withstanding, the inorganic forms of arsenic--the sodium, calcium, and lead salts of arsenic as well as arsenic trioxide--are very poisonous agents. The annual review of news articles by the press reporting accidental poisoning, usually of children and often pets and livestock, attest to the hazards associated with the indiscriminate use of arsenicals by the lay public. The California Department of Agriculture is to be commended for adding the more poisonous arsenicals to the Injurious Materials list. The act of obtaining a permit will emphasize the need for exercising appropriate caution in applying, handling, and storing these compounds.

To discuss substitute herbicides for sodium arsenite as well as for other inorganic arsenicals, we need to look at the various uses of these materials in weed control.

As mentioned earlier, sodium arsenite has been used for years as a contact herbicide. At a 1% concentration, based on active arsenic trioxide equivalent, sodium arsenite will give complete non-selective top-kill. At reduced rates it is occasionally used as a selective contact in grass turf for the control of crabgrass, annual bluegrass, chickweed, and other weeds. As substitutes, weed oil, dinitro, and pentachlorophenol are widely known and used in general contact sprays. More recently, water soluble herbicides such as endothal, diquat, and paraquat are coming into use for top-kill treatments. In turf weed control, the relatively recent group of organic arsenicals including disodium methyl arsonate, ammonium methly arsonate, calcium propyl arsonate, are very effective as selective foliar herbicides for the control of established crabgrass--and are much more selective, I might add. Dalapon is very useful at 5#/A or less for grass control in dichondra. Cacodyllic acid (dimethyl arsenic acid) is finding use as a non-selective herbicide for turf renovation. One should note that while these organic arsenic compounds are from 2.5 to 5 times less toxic than their inorganic counterparts, label precautions for these and all pesticides should be studied and adhered to.

Sodium arsenite is hard to beat for the control of submersed aquatic weeds in static water. However, for alternative herbicides there is endothal, silvex, granular 2,4-D, acrolein, weighted emulsions of aromatic solvents, and chlorinated benzene. These compounds are not completely interchangeable for all uses and requirements made of reservoirs and farm ponds. Acrolein, aromatic solvents, and chlorinated benzene are toxic to fish, silvex should not be used in irrigation or livestock water, etc.

The phenoxy, 2,4-D, closed the chapter on the acid arsenical sprays as a foliar applied translocatable herbicide in the 1940's. Since then the phenoxy family of foliar herbicides has grown to include MCP, 2,4,5-T, 2,4,5-TP (silvex) in the parent acid form, as well as both water soluble and oil soluble forms and the emulsifiable esters. In addition we have amitrole, dalapon, and Banvel-D.

It was in the non-selective soil sterilant category that sodium arsenite and arsenic trioxide were most effectively utilized in vegetation control. In lower rainfall areas, sodium arsenite applied at heavy rates may be effective for four successive years.[4] There are, today, a host of herbicides that are effective substitutes for sodium arsenite and arsenic trioxide. Inorganic herbicides such as borates, chlorates, borate-chlorate mixtures; and the growing organic group, the substituted ureas including monuron and diuron, the triazine family of chemicals including simazine, atrazine, and prometone, the uracils including isocil and bromocil. Then we have the mixtures of these and other herbicides including monuron TCA, erbon, simazine + amitrole, etc. Fumigants such as methyl bromide and CS_2 are effective short-lived sterilants. Again, all these materials are not logically interchangeable for one another for all weed control situations. Their choice should be influenced be economics, weed species to be controlled, crops or ornamentals to be protected, expected precipitation, soil type, etc.

Many of the alternative herbicides I have mentioned are available in the small package line for the home owner. Wisely employed, these weed destroying chemicals can beautify the home while taking the drudgery out of the means to this end. But, for the uninitiated home owner, beware of indiscriminate use. Read the label on the container; discuss your problem with experts. They can often suggest means of gaining the desired end--dead weeds--and point out pitfalls to avoid. These herbicides, as the term implies, are highly proficient in destroying vegetation. Weeds in your brick patio, for example, can be controlled; but the wrong herbicide selection, or the improper use of the right one, can take out your prized shade trees as well. The adage--"If a little bit is good, more is better"--may work with paint bucket and brush on the side of the house, but can be ruinous in both the back 40 and the back yard where herbicides are concerned.

In the realm of selective soil sterilization we should consider substitutes for lead and calcium arsenate in crabgrass control in turf. Within the past five years several excellent preemergent crabgrass herbicides have been made available by industry. Zytron and Dacthal are examples. Betasan is a more recent comer that looks promising in both grass turf and dichondra. Both monuron and neburon can be used selectively in dichondra. Bandane and trifluralin may be available in the near future for grass turf.

Certain uses of inorganic arsenic herbicides have, by natural course of events, already been displaced in some areas of weed control. Inorganic arsenicals remain available and, in terms of weed control performance, are reliable herbicides. These are available to both the large and small consumer. The important objection to them down through the years has been the great poison hazard. Where this is a prime consideration in your selection of an herbicide, there are substitutes available to you for non-selective contact sprays, for selective sprays in turf, in aquatic weed control, in foliar translocatable herbicides, and in both selective and non-selective soil sterilization.

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VACANT LOT WEED CONTROL

Ron Burk
ChemTrol
San Jacinto

For the past four years the ChemTrol Company, with whom I am affiliated, has invested much time and effort in an attempt to establish itself in the vacant lot weed control business. Overall, it has been an uphill battle, with nearly as many disappointments as encouragements. Today I intend to look at vacant lot weed control from the commercial applicators viewpoint. And in doing so, I cannot help but present some of these disappointments and problems, along with the advantages and successes, which we have encountered during these past four years. City vacant lot weed control, like any new phase of weed control, has many problems which must be solved before it can be used on a large commercial scale as general practice. But, unlike other phases of weed control, the primary problems of city vacant lot weed control do not directly involve selection or action of the chemical herbicides. They involve city ordinances, human nature, and a public education process.

The main obstacle for the commercial operator trying to sell a vacant lot weed control program to a city is the existing city ordinances. Most of these were written some years ago when burning and disking were the intended methods of weed control. In various forms, they state that the lot owner is responsible for keeping his vacant lot clean, and that at such time as the weed growth becomes a fire hazard the city enforcement agency, usually the fire department, will take action to eliminate this hazard, and the cost will be assessed to the owner. The key phrase there is "at such time as the weed growth becomes a fire hazard". This will only occur when the weed is near maturity, or has reached maturity, and has dried. It is then too late for chemical control. Granted, there are a few cities who have recognized this problem and have enacted laws to allow proper timing of chemical weed control measures on vacant lots, and some cities have even practiced chemical weed control on a large scale. But these are the exceptions rather than the rule. By far the majority of California cities have laws which do not allow the proper timing of application of herbicides by the cities enforcement agency. Under these laws it is virtually impossible for the city to either practice chemical weed control itself or contract to have it done by