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SUBSTITUTES FOR LEAD ARSENATE ON FRUITS AND VEGETABLES IN CONNECTICUT

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In their efforts to protect crops from injury and destruction by insects and plant diseases, growers have been making more and more use in recent years of protective sprays and dusts. At the same time there has been increasing agitation on the part of consumers and, in turn, of governmental authorities lest substances harmful to man remain on the harvested fruit or vegetable.

Lead arsenate, the most universally employed stomach poison for the control of insects, is also poisonous to man if taken in large enough doses. Both lead and arsenic are sufficiently dangerous poisons to warrant measures to insure their removal whenever they occur on food products in injurious amounts. Lead is considered more dangerous than arsenic, due to its cumulative effect.

The United States Department of Agriculture and various experiment stations have studied this problem for many years. The Secretary of Agriculture has fixed limits as to the amount of various poisons allowed to be present on food products sold interstate. These restrictions are known as tolerances and correspond in general with restrictions placed by foreign nations governing exported fruit. Tolerances set by Federal and State authorities are necessarily low, but are subject to revision as more is learned of the effect of these materials on humans.

The problem facing the grower, if he is to avoid the necessity of removing residue before marketing, is that of, (1) securing insecticides that are less poisonous, or, (2) of employing materials that disappear from the fruit or vegetable through decomposition or evaporation, (3) allowing sufficient time between spraying and harvest for natural removal of residues by rainfall. There are a few insecticides that are harmless to man.

For several years and particularly in 1933, experiment stations have given increasing attention to this problem, testing spraying and dusting materials that are less poisonous than those now commonly used, or regu-

lating their use so that there will be no harmful residue. New experiments have been undertaken in regions where none have been conducted before. The situation in Connecticut is not so serious as in some other states because of the more abundant normal rainfall which removes deleterious substances before the crop is harvested. Nevertheless experiments are in progress to help solve the problem as it applies to Connecticut conditions, and some of the results are reported herein.

In the meantime the grower should put his product in first class marketable condition from the standpoint of residue as well as from any other standpoint. And, regardless of what insecticides are used, it would seem to be good policy for the consumer to wash all fruits and vegetables before eating them. Many harmless carriers or insecticides resemble the poisonous ingredients and the two materials are difficult to distinguish by superficial inspection. Washing will make doubly sure that no poisonous substance is consumed.

Materials Tested

The insecticides that have been prepared as substitutes for lead arsenate are listed below. Many investigators are studying these materials, and, with the exception of one, nicotine bentonite, they have been tested at this Station.

(1) Non-lead arsenicals such as
- calcium arsenate
- magnesium arsenate
- manganese arsenate
- paris green
- zinc arsenate

(2) Fluorine compounds
- barium fluosilicate
- calcium fluosilicate
- cryolite (synthetic)
- potassium fluosilicate
- sodium fluosilicate

(3) Nicotine preparations
- nicotine bentonite
- nicotine-oil combination
- nicotine sulfate
- nicotine tannate

(4) Rotenone preparations
- dusts from derris
- sprays containing rotenone from extracted derris or other plant containing rotenone

(5) Pyrethrum preparations
- dusts with sulfur or other carrier
- sprays used mainly with soaps

(6) Hellebore, ground root of swamp hellebore or itchweed from Europe

Of the non-lead arsenical poisons, calcium arsenate has been tested extensively for fruits, especially apples, and found to be nearly but not quite as effective as lead arsenate for Connecticut conditions. The danger of spray burn to fruit and foliage is considerable and wherever calcium arsenate is used it should be combined with 6 to 8 pounds of lime. Where a fungicide is needed with calcium arsenate, a wettable sulfur is used in preference to lime-sulfur. Calcium arsenate is useful for the control of certain vegetable insects, such as potato and cucumber beetles.

Manganese arsenate, zinc arsenate, magnesium arsenate, and paris green are not recommended for fruits. Magnesium arsenate has been successful and is recommended for the control of the Mexican bean beetle. More experiments with manganese and zinc arsenates are needed.

Barium fluosilicate and cryolite (synthetic) are promising insecticides but need further testing in Connecticut. Other fluosilicates such as sodium and potassium cannot be recommended. Barium fluosilicate has been useful in the control of vegetable insects.

Nicotine preparations are valuable mainly in contact sprays or dusts for aphids, leafhoppers and other sucking insects. Their use has been advocated to take the place of arsenical poisons but in general their killing power is considerably less. Nicotine tannate, nicotine bentonite and nicotine-oil combinations are reported to be successful for control of codling moth. Nicotine is poisonous to man but volatilizes fairly rapidly in the open air. Either pure or in the form of a sulfate, when used as a dust or spray it is probably not dangerous if about three days elapse between the time of application and the consumption of fruit or vegetable.

Rotenone preparations made from cubé or derris are promising both as stomach and contact poisons. However, it is believed that they cannot be generally recommended at the present time for fruit insects because of expense and ineffectiveness against certain important pests. They are much more valuable against vegetable insects and have the decided advantage over arsenical poisons of disappearing from the plants after a short time. A week is probably sufficient time for this to take place.

Pyrethrum preparations have no value as stomach poisons, but kill many insects by contact. Certain combinations are being developed which will be helpful in insect control, but they cannot be recommended for arsenical substitutes because of cost and ineffectiveness for certain insects. Pyrethrum sprays are harmless to man. Hellebore is a mild stomach poison, useful mainly against currant worms. It is considered harmless to man because it loses strength rapidly in the open air.

Specific Suggestions

Fruits

APPLES. The main problem in fruit culture is concerned with residue of poisons on harvested apples. The amount remaining at picking time varies with the season, but with normal rainfall, there is little danger of amounts remaining that exceed the tolerance. On early fruit such as Gravenstein, or Duchess or Astrachan, it is well to omit lead arsenate sprays after the second cover spray (that is on the maggot sprays), and either dust or spray with calcium arsenate or dust with lead arsenate. Dust leaves much less residue at picking time than spray. For late varieties there is much less danger, but at least two months should be allowed between the last spray and the picking date. Obviously there will be certain years when spray removal will be advisable because of scanty rainfall, but for average years this will not be necessary in Connecticut with the present tolerance.

CURRANTS and GOOSEBERRIES. Lead arsenate may be applied when worms first appear. Fresh hellebore (dust or spray) should be used if applications are needed near picking time, or derris dusts or rotenone sprays applied allowing at least one week before picking the fruit. Drift from spraying or dusting fruits or vegetables nearby should be avoided.

GRAPES. Lead arsenate may be applied as needed.

PEACHES. No arsenical spray should be applied after the middle of June. Lead arsenate, lime and zinc sulfate are recommended for early sprays if an arsenical poison is needed, (lead arsenate, 3 pounds, zinc sulfate, 4 pounds, lime, 4 pounds, water, 100 gallons).

PEARS. Lead arsenate may be used as needed.

PLUMS and CHERRIES. Lead arsenate, lime and a wettable sulfur may be used. Apply not later than the middle of June. This is for curculio control.

RASPBERRIES and STRAWBERRIES. Lead arsenate may be used until the fruit sets. If applications are needed later, use rotenone or pyrethrum sprays or derris dusts. Avoid drift from spraying or dusting nearby fruits or vegetables.

Vegetables

BEANS. Green and lima beans may be sprayed or dusted with magnesium arsenate, barium fluosilicate or copper-lime-calcium arsenate dust until the pods form. After the pods form a pyrethrum dust containing 25 per cent pure flowers, or a .6 per cent rotenone dust, should be used to control the Mexican bean beetle.

CABBAGE, CAULIFLOWER, BROCCOLI. On account of the large surface area of such vegetables as cabbage, broccoli and cauliflower, no poisonous insecticides should be used except when the plants are young. For control of cabbage worms, pyrethrum or rotenone (derris) dusts should be used. A pyrethrum dust containing 50 per cent pure ground pyrethrum flowers and 50 per cent inert carrier will control cabbage worms if it is applied while the worms are small. From 10 to 16 pounds of dust to the acre is necessary, depending on the size of the plants. A .6 per cent rotenone dust may be used in the same manner.

CELERY. Pyrethrum or rotenone dusts should always be used on celery, rather than arsenical materials.

LEAFY VEGETABLES. No arsenical poisons should be applied to beets, turnips, lettuce, spinach, Swiss chard, New Zealand spinach, or any other crop if the leaves are to be used for human consumption. Care should be taken not to allow spray or dust applied to other crops to drift and settle on these crops. If insecticides are needed, use nicotine, rotenone, or pyrethrum and wash the leaves thoroughly before cooking.

POTATOES. Calcium or lead arsenate may be used on potatoes at any time.

SQUASH, CUCUMBERS, MELONS. Calcium arsenate is safe when applied to control the striped cucumber beetle early in the season. It should not be used after the fruit forms. Arsenate of lead may be applied to Hubbard squash for control of the squash vine borer, because the fruits are just forming at that time.

TOMATOES usually require no arsenical spray, but if one is necessary it should be applied before the tomatoes set on the vines.