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Frank Melville

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ETHOXYQUIN FOR THE CONTROL OF SCALD OF GRANNY SMITH APPLES

Ethoxyquin application, combined with dual temperature storage, gives satisfactory control of the storage disorder superficial scald in Granny Smith apples.

By F. MELVILLE, B.Sc. (Agric.), Senior Adviser (Fruit)

WEST AUSTRALIAN Granny Smiths are prone to the storage disorder superficial scald, which can appear after as little as 3½ months storage. Control measures are now available, the most recent development being the use of the chemical scald inhibitors, ethoxyquin and diphenylamine.

Predisposing conditions

Superficial scald is a low temperature disorder. In other words, it is accentuated by dropping the temperature of the apples quickly and holding the storage temperature in the low thirties.

Scald is reduced by storage at a higher temperature during the first six to eight weeks of storage and this is the basis of the "dual temperature" method of storage.

Scald is also related to the time of harvest. It is worst in early picked fruit and gradually diminishes as picking proceeds through April.

Most Granny Smiths will scald regardless of time of harvest if kept long enough, but with normal length of storage those picked after the third week in April are, in most years, not seriously troubled by scald. However, growing conditions and seasonal variations influence scald liability; in bad scald years Granny Smiths picked as late as the last week of April have scalded quite severely when stored unwrapped in cartons at 32° F.

Methods of control

For many years oiled wraps containing about 15 per cent. mineral oil were the accepted method of scald control, although they only delayed the onset of the disorder by about six weeks. With the introduction of the dual temperature method storage in conjunction with oil wraps, very good control was achieved for upwards of seven months storage.

The dual temperature method involves holding the apples at about 40 degrees F from picking until the end of May, when the temperature is dropped to 32° F. For adequate protection, dual temperature storage is necessary with all present commercial methods of scald control.

In the late 1950's, investigations were started in this State with a new method of scald control—the use of a scald inhibiting chemical diphenylamine (D.P.A.). This chemical was developed for this purpose in the U.S.A. and the local experiments fully confirmed its excellent scald control properties.

Another similar but less effective chemical, ethoxyquin, was later tested. Although not as good as D.P.A., ethoxyquin, used in conjunction with dual temperature storage, gave quite good control of scald.

With the increasing use of cell pack cartons, necessitating the export of bare fruit, the value of these chemicals became apparent and the two materials were tested extensively.
Without treatment, early-picked Granny Smith apples can become badly affected with superficial scald. Properly used, as recommended in this article, ethoxyquin treatment has given effective control of this storage disorder.

In all experiments D.P.A. proved better in scald-inhibiting properties and maintenance of skin colour, and generally extended the storage and shelf life of the fruit.

Ethoxyquin gave reasonable scald control but shortened the life of the apples because of the onset of core flush, a senescent disorder heralding the end of storage life of the apples. However, for moderate length storage ethoxyquin was satisfactory.

D.P.A. has not yet been approved by importing countries for use on fruit and therefore cannot be used on export apples. However, ethoxyquin is now permitted on fruit for the United Kingdom and Sweden and is also permitted for local market fruit.

ETHOXYQUIN FOR SCALD CONTROL

Two methods of using ethoxyquin which have been tried successfully are—
- dipping the fruit in a water emulsion of the chemical, (modification is the use of a shower of the mixture).
- spraying a concentrated volatile mixture onto the fruit as it passes up the elevator.

Dipping

Ethoxyquin is available commercially as “Stop Scald”. The dipping mixture is prepared by adding the required amount of Stop Scald to water and stirring thoroughly before use. The manufacturer recommends the use of 2 pints of Stop Scald per 100 gallons of water. Experiments with Granny Smiths indicate that satisfactory control of scald is obtained at this level provided the apples are stored under dual temperature conditions.

A concentration of 3 pints per 100 gallons is more effective and should be used if storage beyond August is required.

The ethoxyquin is absorbed into the skin of the apple and prevents or delays the discolouration of the surface cells which gives the typical scald symptoms.

Absorption of the chemical is influenced by concentration, dipping time and temperature of the dip. The normal time of one to two minutes immersion in a washing plant is adequate and there is some evidence that a warm dip is more effective than a cold one. Care is needed to avoid prolonged immersion which may result from stoppage of the plant or from apples.
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being caught up in corners or back eddies in the dipping tank.

The passage of the apples over brushes and foam-plastic drying rollers after the dip removes most of the surface residue of ethoxyquin but experiments have indicated that satisfactory scald control is still obtained.

The permitted upper limit for ethoxyquin on or in apples is three parts per million. This tolerance applies to both local and export fruit. Under normal conditions the residue is well below this figure.

Where single-tank washing plants are used for ethoxyquin dipping, the dip mixture will become dirty quickly and will need frequent changes unless only clean fruit is delivered. In any case no more than 1,000 bushels of apples should be treated per 100 gallons of mixture between changes. For preference changes should be made once a day.

The level in the dipping tank should be maintained by topping up at intervals with the correctly diluted “Stop Scald” mixture. Water or concentrate should not be added to the tank except during the initial mixing.

**Showering**

Ethoxyquin can be applied by passing the apples through a heavy shower of the same mixture as used for dipping, and recirculating the mixture. Equipment must be designed to ensure thorough drenching of the fruit.

This method has been successfully used overseas for treating fruit in picking boxes and also bulk bins by passing the filled containers through the shower. For bulk bins the volume of spray is increased. The mixture is usually collected and recirculated but where this is not possible the excess is allowed to run to waste. These methods of containerised treatment are generally more wasteful than the dipping method.

The boxes and bins must be thoroughly drained if the wet fruit is to be left in the container to dry. On no account should the bottom apples be allowed to lie in a pool of the ethoxyquin mixture.

The addition of a non ionic wetting agent will assist the draining and hence drying of the fruit.

**Elevator spray**

One other method which has given satisfactory results in local experiments is spraying a special quick-drying mixture of ethoxyquin onto the apples as they pass up the elevator. The spray can be applied at any point along the line where the fruit is turning and a short time interval is provided for drying.

In two years’ experiments an alcoholic mixture of ethoxyquin was applied by means of a paint spray. The fine spray dried on the fruit in the space of a few feet, provided the fruit was dry before application.

This method could be useful for the smaller operator. Its use, however, will depend upon the availability of a suitable mixture from the manufacturer and also the development of a suitable applicator.

**Impregnated cartons**

Tests with carton components impregnated with ethoxyquin have not given very promising results. Some control of scald was obtained, but generally not enough for commercial requirements.

**Residue tolerance**

The maximum allowable residue of ethoxyquin on or in the fruit for export and local market is 3 parts per million.

It is important to adhere to recommended methods of treatment and concentration to guard against excessive chemical remaining on the fruit.

**Summary**

- “Stop Scald” used as a water dip at a concentration of 2 pints per 100 gallons should be adequate for export fruit, with dual temperature storage. For longer storage, 3 pints per 100 gallons is a better concentration.
- The same “Stop Scald” dip mixture can be used as a shower to treat apples passing along a conveyor in a single layer or in picking boxes or bulk bins. Adequate drainage of containers is important.
- The addition of a non-ionic wetting agent will give better wetting, quicker drainage and hence quicker drying where special equipment is not available for this purpose.
• The ethoxyquin mixture should be changed after the treatment of 1,000 bushels per 100 gallons of mixture. If the dip becomes excessively dirty it should be changed more often.

• If a suitable proprietary mixture is available a quick-drying spray of ethoxyquin can be applied to apples passing up the elevator or along any suitable conveyor.

• Ethoxyquin residue on or in the fruit must not exceed three parts per million of the whole fruit. Proper use of the methods recommended will keep residue within this limit.

• To get satisfactory scald control with ethoxyquin it is necessary to use dual temperature storage.

• Ethoxyquin shortens the life of stored Granny Smiths, due to the onset of core flush. D.P.A., on the other hand, extends storage life, and when its use is permitted it should be used in preference to ethoxyquin.

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