

per cent of alfalfa hay when fed to growing beef steers or lactating beef cows, and 50 per cent of the value of alfalfa hay when fed to a dry pregnant beef cow.

The literature indicates a very strong possibility that the feeding value of rice straw (at least the available energy content) can be markedly improved by treating the straw with alkali. In some trials the energy value was increased to a level above alfalfa hay. This treatment, of course, does not increase the protein or calcium and phosphorus content. Supplementing these nutrients would be necessary even if energy digestibility was increased.

There are some aspects of the composition of rice straw that are evidently different from most other roughages. On the negative side, the high silica content (average 14 per cent) probably interferes with the utilization of other nutrients and is of no nutritive value. On the plus side, there is a relatively low lignin content and a more digestible crude fiber fraction than is found in other straws and in most average quality hays. The cellulose content is high and since pure cellulose is readily fermented by rumen bacteria (if the molecules are accessible to their enzymes). This fraction has the potential to furnish a substantial amount of energy to the ruminant. The nitrogen-free extract fraction, however, appears to be less well utilized than would be predicted from studies with other roughages.

Poor quality

At the present state of knowledge, it can be concluded that untreated rice straw is poor quality roughage that needs to be fed with supplemental protein, phosphorus, calcium and possibly some trace minerals before it is a suitable feed for even the maintenance of ruminant livestock. For animals at relatively low levels of production—slower growth of steers and heifers or for feeding pregnant or lactating beef cows—some additional source of available energy is also required. Treatment of the straw with small quantities of sodium hydroxide shows great promise as a means of increasing the digestibility of the fraction capable of supplying the ruminant with energy, but the mechanisms and the economics associated with alkali treatment remain to be determined.

W. J. Clawson is Extension Animal Scientist; and W. N. Garrett is Professor of Animal Science, University of California, Davis.

STREPTOMYCIN

in California

J. BLAIR BAILEY
GORDON W. MOREHEAD

STREPTOMYCIN was registered for use in controlling fireblight of pome fruit on the West Coast prior to 1968, however, application was restricted to no later than 90 days before harvest; and cancellation of this use had been under consideration because of insufficient residue data.

Pear growers in California and University researchers were concerned that the use limitations (especially on pears) were too restrictive for current fireblight conditions. Much of this blight appears on pears in mid-June and July—which in some areas of the state is 15 to 30 days before harvest. One major cause for concern has been the possibility that streptomycin might be completely cancelled for use on pears—a severe financial threat to pear growers because of their frequent, heavy losses of fruit-bearing wood and entire trees due to fireblight.

Other factors

Two other factors concerned many growers, researchers, and agribusinessmen. First, the grower who shipped his pears to the fresh market, as opposed to the cannery, frequently encountered rather severe pear russetting when he used the old standby copper-control methods. However, no such russetting was observed on Bartlett pears in California when streptomycin wettable powder (WP) or dust formulations were used. Secondly, there was concern that the two major manufacturers of agricultural streptomycin might not choose to conduct the research necessary to maintain or improve streptomycin's registration status, because of its relatively limited market.

University researchers needed additional efficacy and residue data to support a recommendation in compliance with U.C.'s pesticide policy.

With the wide variation in application

rates and methods brought about by semi-concentrate and concentrate spraying, it also became apparent that streptomycin should be recommended on the basis of total amount of active ingredient in ounces per acre per application (oz/A), rather than in parts per million (ppm). This decision was made because growers were frequently confused and in doubt as to how much material an acre they could legally apply—in relation to the age, size, and number of trees per acre.

1968 field experiments

Field experiments were set up by U.C. researchers to study various formulations and application methods, to collect residue data, and to change ppm ratios to the more understandable active ingredient equivalents. The ultimate goal was to shorten the time limitation on application before harvest from 90 days to a more realistic schedule.

Large-scale field plots were set up in three major northern California pear-growing counties: Mendocino, a coastal county; Lake, an inland mountain county; and Yuba, a Sacramento Valley county.

Streptomycin WP as a 17 per cent active ingredient formulation was used at 4 oz/100 gal, equivalent to a 50 ppm concentration. Three different types of applications were made in the plots. All applications were made at weekly intervals, a total of 17 applications per plot for the season. In full-gallonage (600 gal/A) hand-gun plots, streptomycin WP was used at 4.8 oz/100 gal, equivalent to a 60-ppm concentration. In semi-concentrate (90 gal/A) conventional air-blast speed-sprayer plots, applications of 6.0 oz to 12.0 oz streptomycin (approximately 75 to 150 ppm) were used. In concentrate plots (4 gal/A), using an Econ-O-Mist applicator, 6.0 oz and 12.0 oz streptomycin rates were applied, equivalent to spray-tank concentrations of 1,875 and 3,750 ppm. Although these were extremely high spray-tank concentrations, the amount of active ingredient

Control of Pear Fireblight in California

—1968 and 1969 Field Tests

was approximately the same as that in the semi-concentrate applications.

The amount of active streptomycin in the full-gallone application was 4.8 times greater than the amount used in the concentrate applications. This indicates that a significant saving in chemical cost is possible with the concentrate application. However, it has not yet been proven that concentrate sprays will control fireblight in pears as well as full-gallone treatments, at least in California. In these experiments, there was insufficient blight in any of the plots—including the untreated checks—to calculate comparative control.

Residue analysis

To establish streptomycin residues for fruit, the three application cut-off dates were set 90, 60, and 30 days before harvest. Approximately 4 lbs of fruit were taken from all replicated plots as well as from the untreated check plots on two dates—30 days before harvest, and the day of harvest. The purpose being to have fruit for analysis on which streptomycin could have remained for 60, 30, and 0 days respectively; and also to have untreated fruit for comparative analysis.

While these experiments were in progress in 1968, a joint petition was submitted by the two major streptomycin producers, Charles Pfizer & Co., Inc. and Merck & Co., Inc. to the USDA and FDA for a finite tolerance of 0.25 ppm of streptomycin for pears (which subsequently was established), and for a use cut-off date of 50 days prior to harvest.

The greatest amount of streptomycin residue found in a single sample was 0.13 ppm, while the most residue calculated in any treatment (an average of three replicated samples) at harvest was 0.043 ppm—less than one-sixth of the established finite tolerance.

Unfortunately for experimental purposes, there was very little blight in any of the plots, and the number of blight strikes in the various treatments was not significant. Thus, it was impossible to establish differences in efficacy between

the various application rates. No blight was observed until late June.

Since a need arose for codling moth and mite control, foliar spray oils and azinphosmethyl (Guthion) were combined in the spray tanks with 17 per cent streptomycin WP. No phytotoxicity of fruit or leaves was observed, nor did there appear to be any chemical incompatibility.

The U.C. research proved that streptomycin WP can be used safely, not only in these amounts, but also in combination with certain chemicals; and can be applied by the methods described at weekly intervals (up to 17 times) until 30 days before harvest without exceeding the tolerance of 0.25 ppm on pears under California conditions.

In addition, it was found to be easier and more practical for the grower to calculate the amounts of active streptomycin to be used in ounces-per-acre instead of parts per million. This is true because of the variety of application methods in current use which results in a wide variation in volume-per-acre of total liquid applied.

A tolerance of 0.25 ppm of streptomycin residues was announced by the FDA on July 27, 1968. The 30-day-to-harvest limitation for streptomycin applications on pears was granted by the USDA (based on these experiments). However, some questions remained. Would streptomycin adequately control fireblight of pears under California conditions? Which formulation and concentration (wetable powder or dust) would provide the cheapest and best control? How did streptomycin compare with copper formulations for control? Would a streptomycin application be more effective with a night application when moisture is greater and drying time slower? Would the addition of a humectant to wettable sprays increase absorption by plant surfaces? Would any of the ppm concentrations result in residues that would exceed the maximum legal tolerance of 0.25 ppm? What are the relative costs of the different formula-

tions? Would dust formulations result in phytotoxic reactions by pears?

Experiments in 1969

The 1969 experiments were established to answer the above questions, and were carried out in two widely separated Bartlett pear orchards in Sacramento County. Tests were made with nine different formulations of various rates and types: streptomycin, copper, and formulations that included a treatment for codling moth control (Diazinon plus foliar spray oil). Weather data were provided by a hygrothermograph set up in the vicinity of the plots to record accurate temperature and humidity.

Streptomycin for use in pears, as documented by findings in the two-year U.C. research was shown to be safe on several counts: No phytotoxicity was observed in any treatment, either alone or in combination, in either of the two orchards. No chemical incompatibility was observed with any other material.

Four counts of two-spotted mites (May 19 and 26, June 2 and 30) showed populations consistently and considerably higher in the copper-dust block than in any of the other blocks, in spite of the fact that there was only a single Diazinon plus oil application to all but untreated checks. Noticeable browning and burning of the leaves and some defoliation was observed in the copper-dust block. By June 30 the mite population had reached its highest level with an average of 3.6 mites per leaf in the copper-dust block, but no mites in the untreated check. Numerous brown and green lacewings as well as coccinellids, were found in the untreated check. Pear psylla counts were made several times throughout the season, but none were found.

J. Blair Bailey is Pesticide Safety Specialist and Entomologist, University of California Agricultural Extension Service, Berkeley and Statewide, and Associate in the Experiment Station and Department of Environmental Toxicology, U.C., Davis. Gordon W. Morehead is Farm Advisor, Sacramento County.