spray treatments at the Marysville tests in 1954.

Dunegan observed that in these tests, all the antibiotic treatments were significantly better at the 1% level than the check plots receiving a comparable number of applications of water, and that the number of blight infections increased in the check plots as the number of applications of water increased. Likewise, the number of blight infections, in general, decreased as the concentration and number of antibiotic sprays increased. However, there was no appreciable difference between the treatments receiving three applications of the streptomycin-terramycin mixture at 100–10 parts per million and those receiving five applications at 30–3 parts per million. Too, the additional sprays applied after April 26 at intervals of either seven or 14 days did not give a significant increase in blight control. It was also noted that at the lower concentrations, 14 days was too long an interval between sprays for efficient blight control. The addition of zineb to the spray did not enhance the control.

Dunegan said that the blight control obtained with five or seven applications of the minimum antibiotic concentration (30–3 parts per million) was as good as the results obtained with the tribasic copper sulfate spray. Higher concentrations were significantly better.

A distinct advantage of the antibiotic sprays is the fact that they caused no injury to the fruit. Typical copper injury appeared on the leaves after only one application, copper russet developing on the fruit as the season progressed, and at harvest all the copper-treated plots could readily be distinguished from the other plots because of the roughened, dull appearance of the fruit. The antibiotic treatments did produce chlorotic patterns on the leaves that unfolded early in the season. This reaction was most pronounced in the 100–10 p.p.m. treatments and was present in the 60–6 p.p.m. treatments but in the 30–3 p.p.m. concentrations, chlorotic symptoms developed only occasionally. Copper spray for blight control is still widely and satisfactorily used in many parts of California. In areas where humidity is sufficiently high, however, considerable fruit damage results.

Other large scale tests in California were described by Peter A. Ark and Emlen Scott, University of California. Eight pear growing counties were represented in trials involving 82 acres of Bartlett pear trees. Wettable streptomycin formulations were used at levels of 100, 50, 25, and 10 parts per million, while streptomycin dust, prepared by mechanical blending with Wyoming bentonite and containing 240 parts per million of streptomycin base, was used at the rate of 15 to 60 pounds per acre. In these tests, 232 pounds of 30% streptomycin base formulation and 500 bottles of 265 grams each Agri-Mycin containing 15% streptomycin were used.

Among the results reported by these workers was the control in plots containing 93 trees and in which formulations containing 100, 50, and 25 parts per million of streptomycin base were sprayed on March 29 (25% bloom), April 5 (two days past full bloom), April 13 (calyx), April 21, and 29, and May 6 and 13, or a total of seven sprays. By June 1, the number of blight cuts made per tree was 0.602, 0.645, and 0.924, respectively, as compared to 2.09 cuts per tree in the untreated check of 122 trees and 0.688 cuts per tree in an adjacent copper-lime dust plot of 363 trees.

In another pear orchard, higher levels of streptomycin showed good control of fireblight. Over 400 trees sprayed with 100 parts per million of streptomycin in form of Agri-Mycin required 0.75 cuts per tree, while 150 trees in an untreated check had 4.37 cuts per tree. Spraying 400 trees with 50 parts per million of streptomycin gave 1.61 cuts per tree while 694 trees sprayed with 25 parts per million developed 2.83 cuts per tree. In another experiment, 473 trees were treated with 10 parts per million and had 6.44 cuts per tree.

Prof. Ark, who presented the results, said that streptomycin base at the rate 50 to 100 parts per million can give satisfactory control of fireblight where pear or apple blossoms are sprayed at the right time. Aureomycin shows no tendency to check the blight while Neomycin at 50 parts per million exerts some protective action. He also pointed out, substantiating observations by other speakers, that streptomycin does not appear to cause much russetting on Bartlett pear fruit.

Winter and Young observed that Terramycin HCl and tetracycline were inferior to streptomycin, and Agri-Mycin, which is a formulation of streptomycin and terramycin in a 10 to 1 ratio, gave results equal to but not superior to streptomycin alone. In two tests in commercial orchards in 1954, it appeared that the early and full bloom applications of streptomycin contributed almost equally to blossom blight control on apples, and that the petal fall applications were of minor importances, they said. Tests were also conducted on five Commercial pear orchards and results were favorable.

The speakers, and observers, believe that the satisfactory results of the tests with antibiotics could be far reaching. In addition to being a possible answer for a major problem of the pear industry in the Pacific Coast states, it could conceivably result in a relocation of a part of the industry back to areas east of the Mississippi, where fireblight essentially destroyed the commercial pear industry years ago.

Other diseases which offer themselves to possible control by antibiotics include bacterial spot of tomatoes and peppers, halo light of beans, walnut blight, black leg and soft rot of potatoes, all of which already have yielded to Agri-Mycin in field trials.

Full scale commercial applications of control of blight by antibiotics depend on a downward adjustment in their costs. Though giving better control than any other materials yet used, spraying of antibiotics costs several times as much as other chemicals.

Plant Chemotherapy Held Promising in War on Disease

Direct introduction of compounds to render trees and crops disease resistant demonstrated

NEW HAVEN, CONN.—Plant chemotherapy is a fascinating new attack on tree and crop diseases which is getting pioneering experiments on test plots of the Connecticut Agricultural Experiment Station at nearby Mt. Carmel, James G. Horsfall, director, declared in an address at the station's recent annual field day.

Plant pathologists and other scientists on his staff have been working on the problem of plant disease for several years, but there were on view that day examples, among Dutch elm disease plots, which illustrated their work on a "new frontier."

They had long felt that if they could make plants resistant to disease they might be able to solve diseases which up to now have not been successfully brought under control, such as the Dutch elm malady. Station scientists are attempting to introduce, he said, compounds into the plant to make it resistant, not necessarily by killing the fungus through direct poisoning action, as is

James G. Horsfall, Conn. Ag Experiment Station, discussed plant chemotherapy at the station's field day

done with Bordeaux mixture, but rather by rendering the plant unsuitable for the fungus to grow.

In this technique, oxyquinolinebenzoate has been used in treated trees infected with the Dutch elm disease. However, experimenters believe they have an even more promising compound in 2-methylcarboxymercaptobenzothiazole.

We call this chemotherapy, Dr. Horsfall continued, although in some respects it is not quite comparable with, for example, penicillin therapy for pneumonia. But it is chemotherapy in the sense that it introduces compounds inside a plant so that the plant will not be susceptible to disease. This is equivalent to producing a new sort of plant.

Plant diseases have played an important role in mankind's history, the speaker said. The "barberry law" was promulgated here as early as 1726 when it was found that wheat rust survived winters on the barberry. Relationship between moisture, warmth, and wheat rust changed dietary habits in Europe. Wheat rust forced Central Europeans in the Middle Ages to eat rye, from which came the scourge know as St. Anthony's fire which caused fever, mental failure, gangrene, and death.

St. Anthony's plague gave way in the 18th century when Europeans turned to potatoes for carbohydrates. Then came the potato famine in Ireland in 1844–45 during which a quarter of a million persons died of malnutrition and which forced 1.5 million to emigrate, mostly to America. We now know it was the potato "late blight," against which we have effective spray materials.

Field day visitors at the station were shown experimental work on fruit with new spray combinations for insect and disease control. A great problem in apple orchards today, said Philip Garman, who heads up fruit insect work at Mt. Carmel, is offered by the incompatibility of sprays. Two insecticides for controlling different insects work well separately, but when combined in a spray tank synergism is reversed and efficacy is decreased.

Baldwin spot on apples has become a serious problem. The disease, which causes small brown spots throughout the flesh of the fruit, is believed to be due to a nutritional deficiency. Dr. Garman attributes diseased spots to excess of magnesium, and has sought control with calcium sprays. Calcium is the antidote for high magnesium. The results have been promising.

The common weed killer 2,4-D shows considerable promise in checking verticillium wilt, a serious potato disease in Connecticut, said Paul Waggoner, plant pathologist. Put on the plant alone, or in combination with an antibiotic, 2,4-D has reduced severity of the potato wilt, Dr. Waggoner said. The treatment is not ready for commercial adoption.

Biblical Wheat Rediscovered

Boulgour, a wheat product of high nutritional value and storage life, suggested as solution to wheat surplus

WHEAT SURPLUSES may find a new market of millions in the near future if further investigation bears out a recent "rediscovery," says Sen. Hubert H. Humphrey (D.-Minn.). Answer may be "boulgour"—a parboiled wheat product that looks and tastes somewhat like rice. Its potential use may be as an extender for rice dishes in Oriental countries. Boulgour has an even higher nutritional value than rice and has superior storage qualities in comparison with other grain products, says Humphrey.

Best point of all, Humphrey believes, is that the processed boulgour may be able to undersell rice, imported in grain deficit areas, by 25 to 50%. At least preliminary investigation bears this out. Humphrey is now asking for a more detailed investigation into the potentialities of boulgour.

Humphrey's so called "rediscovery" of boulgour was by Francis Joseph Weiss, food and nutrition consultant who is doing a study for a book, "Foods in the Bible." Weiss ran across the biblical word "Arisah" which means "the first of your coarse meal." Further study showed him that this was nothing more than parboiled wheat, a process of preparing wheat almost forgotten except by people of the Near East. Subsequent study revealed that boulgour is the basic constituent of wheat pilaff, as actually served in this country by people of Near Eastern extraction.

Moreover, the U. S. Department of Agriculture has also rediscovered boulgour in a recent effort to find new ways to use up the wheat surplus. USDA recently offered 500,000 bushels to any miller who would attempt to manufacture boulgour and distribute it in the Far East. Major U. S. millers, however, have done little with boulgour experimentation so far. There are three small companies in the U. S. which process boulgour on a small scale. They supply only a small, new demand in the continental U. S.

Boulgour preparation is a simple process. Wheat grains are soaked in water, boiled until almost all of the water is evaporated, and dried within a day's time. Then chaff is removed and the grain is cracked.

Parboiling at first drives the protein, vitamin, and mineral constituents of the husk and germ into solution. As evaporation continues, Weiss notes, increasing concentration forces the components of these constituents back into the starchy portion (endosperm) or body of the wheat. Weiss estimates the loss at about 15% or less. On drying, the body of the wheat becomes a hard, crystalline mass, containing all of the essential nutrient ingredients. What remains of the husk can be easily removed by rubbing or chaffing. The crystalline form can then be cracked and is ready for eating, usually in the form of pilaff or like boiled rice.

Because of the parboiling action, boulgour is nutritionally superior to rice or flour, Weiss claims (Table). This plus the fact that it should be very cheap to process is what makes the product a good sale possibility in the Far East. Rice on the Singapore market today sells for about seven or eight cents per pound. Export wheat can be delivered f.o.b. San Francisco for about three cents per pound. Processing boulgour by modern methods would add about a half cent to the cost per pound, Weiss estimates. Thus boulgour ready to ship would cost about 3.5 cents per pound. Freight costs to the Far East would boost the price again, but Weiss believes boulgour still could undersell rice at a margin of