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

50% at a maximum and 25% at a minimum. Moreover, storage and waste costs would be negligible, Weiss says, because of the superior resistance developed by parboiling.

Flour by present milling practices cannot compete with rice or boulgour. Exported flour also has the disadvantage that a considerable amount of fuel must be expended to turn it into bread—much more than merely to boil rice. Fuel is nearly as weighty an economic factor in most Oriental countries as food itself. Differences of one cent can spell success or failure of a product. Boulgour requires no more fuel expenditure than rice preparation, Weiss believes. This is discounting preparation of boulgour from wheat. It is the fuel consideration which demands boulgour must be prepared in the U. S. before shipment.

Provided experience bears out the theoretical cost, boulgour appears to be an attractive solution to the embarrassing American wheat surplus and at the same time a practical answer for famines in the Far East plus a superior food in nutritionally deficit areas.

A big problem still remains, however, in countries where rice is the principal diet. There remains the possibility that boulgour may not be readily accepted, even though it is superior. Rice is the traditional food. Quality of rice served by a family is often regarded as a social mark of distinction. There exists no real precedent for a change-over to boulgour, other than the fact that some bordering countries have prepared boulgour since biblical times and are using it today.

Hope is not that boulgour will replace

Composition and Nutrient Value of Rice, Flour, and Parboiled Wheat[a]

[In grams and milligrams per 1,000 calories]

		Milled Rice (Cooked)	*Patent Flour (Enriched)*	*Parboiled Wheat[b] (From White Wheat)*
Protein	grams	21.0	28.9	28.0
Fat	"	0.8	2.8	6.0
Carbohydrates	"	220.1	209.3	224.7
Total ash	"	5.0	1.2	5.1
Calcium	milligrams	67.2	44.0	107.3
Phosphorus	"	378.0	239.3	1,174.0
Iron	"	2.5	8.0	8.9
Copper[c]	"	0.5	0.4	2.2
Manganese[c]	"	2.9	19.9	12.9
Thiamine (B_1)	"	0.1	1.2	157.9
Riboflavin (B_2)	"	0.1	0.7	35.8
Niacin (B_5)	"	3.4	9.6	15.8

[a] Data computed from Composition of Foods, U. S. Department of Agriculture, Agricultural Handbook No. 8, Washington, June 1950, pp. 42 and 50.

[b] Since in this country parboiled wheat is made exclusively from white wheat and the processing losses are negligible, the figures for "wheat, whole grain, white" were taken preliminarily as representing those for parboiled wheat.

[c] Data for copper and manganese computed from Sherman, "Chemistry of Food and Nutrition," 7th edition, New York, 1946, pp. 625 and 631–2.

rice, but that it will be used as a rice extender. Introduction into the diet may have to come at famine times or by a concerted educational effort on the part of nutrition and social experts among the working class. There is also hope that it may be introduced through public service programs. For instance, bread was unknown in Japan until it was introduced in the school lunch program. The children accepted it, grew to like it, and now ask for it in their homes.

Acceptance of boulgour has a good chance of succeeding. A small scale experiment at the Women's Christian College, Madras, India, reports favorable results but on such a small scale as to question national acceptance. India and other rice consuming countries would now like to see a large-scale acceptance test.

Los Angeles Smog Found Cause Of $1 Million in Crop Damage

THE BILL FOR CROP DAMAGE due to smog in the Los Angeles area is estimated to run to about $1 million per year, according to the recent report of the Stanford Research Institute.

The principal crops affected by smog are spinach, endive, beets, romaine lettuce, alfalfa, and oats.

Peculiar types of markings on leafy vegetables have been noticed for some time in the Los Angeles area. These discolorations were named "fog burn" by the farmers because they seemed to be associated with the appearance of severe fog or smog. Crop damage was first observed with leafy vegetables since the market value of these crops, such as lettuce, is closely associated with their appearance. Smog damage usually appears suddenly. One day the plants may have a healthy appearance while a few days later following a heavy smog the plants will appear discolored, wilted, and resemble cooked or burned vegetables.

Lawns and shrubbery are also affected by smog. However, it is not possible to estimate the extent of economic loss to other than economic crops.

As part of the over-all study of smog in the Los Angeles area SRI conducted a detailed research project on the relationship between smog and crop damage. The objectives of this research were to: learn if the crop damage resulted from an airborne contaminant, and if so if its occurrence correlated with other measured aspects of the smog phenomenon; map the areas of crop damage to see if the damage pattern might indicate the origin of contaminants; learn what chemicals could cause damage resembling fog burn; develop fumigation techniques that would duplicate as nearly as possible smog damage observed in the field; accurately describe smog damage to plants as distinct from other injuries.

The SRI researchers report that smog damage to crops is due to phytotoxic effects of airborne gaseous impurities. In a series of experiments designed to duplicate smog conditions, plants grown in greenhouses ventilated with unfiltered, smog, air developed markings similar to those observed on plants grown in open fields. However, plants grown under similar conditions in an atmosphere of filtered air developed no markings.

There was no geographical pattern of smog damage in Los Angeles county indicating that smog damage is not due to local area conditions.

Institute workers were able to duplicate most of the various types of plant injury by laboratory fumigations. Typical smog injury was obtained by placing the plants in an atmosphere with the reaction products of ozone and unsaturated hydrocarbons or ozone and automobile exhaust. No other gaseous mixtures were found which could produce smog type effects on plants.

An experimental smog mixture was developed consisting of reaction products of ozone and 1-hexene which would duplicate most of the effects observed in field crops. Gasoline vapors, blamed by some for smog damage, did not produce injury at concentrations equal to or far in excess of those which would be expected in the Los Angeles atmosphere.

The Stanford report is a summary of research conducted by the institute in Los Angeles county during the last 6 years. The report discusses the peculiar problems of Los Angeles smog. One rather unique condition contributing to the smog problem in that area is the presence of an inversion ceiling in the atmosphere for about 260 days of the year. This ceiling prevents upward turbulence from carrying off the pollutants which are discharged into the atmosphere. Thus the materials which are discharged into the atmosphere as a result of the burning of fuel and waste are trapped over the area and the resulting interactions between these combustion products and the atmosphere lead to the formation of smog.

The chemical activity resulting in smog may be due to the presence of large

Typical Crop Damage Due to Smog

	Tan Necrotic Areas
Spinach **Endive** **Beets** **Radish** **Celery**	First observed within a few hours after smog. Damage is first observed as a "cooked" grey green color on surface of leaf. This is usually followed by progressive dehydration of the affected areas until shriveled brown areas develop throughout the entire thickness of the leaf and leave tan necrotic spots. Chlorosis is often found throughout the tissue.
	Silverleaf
Spinach **Romaine Lettuce** **Endive** **Beets** **Celery**	Oily appearance develops on surface of leaf within 4 to 8 hours after smog, depending upon severity. Lower surface develops a definite silvering after 1 to 3 days. Following a light smog the silvering effect is very faint and does not usually progress into more advanced stages.
	Upper Surface Glazing
Spinach **Radish**	Less frequently observed than Silverleaf. When it does occur, is very noticeable as glazed areas on the upper surface of the leaf, usually white to silvery in color. This type of injury causes heavy crop losses since the leaves break down rapidly after harvesting.
	Chlorosis
Spinach **Endive** **Beets** **Radish** **Celery**	Observed most frequently in young plants. The leaves become yellowish in color, are curled and appear to have tiny punctures on the upper surface.
	Lower Surface Bronzing
Spinach **Romaine Lettuce** **Celery**	Initial symptom is oily appearance as in case of silverleaf, but it becomes shiny brown rather than silver. Usually appears in small spots rather than large areas.