California AGRICULTURE

Progress Reports of Agricultural Research, published by the University of California College of Agriculture, Agricultural Experiment Station

Application of Micronutrient Elements to Crop May Avoid Failure and Cost is Low

D. I. Arnon

Important crops in certain areas are saved from failure by application of small amounts of micronutrient chemical elements—sometimes of not more than 20 ... the acre.

Invest...

absorbed by hay crops that may be poisoned by it

More research is necess...

Quick Decline of Oranges Believed Virus Disease

Quick decline of oranges sti... largely confined to certain part... Los Angeles County, although s... cases have been seen in north... Orange County, in western San B... nardino County, and some suspec... cases have been noted elsewhere.

In early studies of the disease a sig... nificant characteristic was noted, namely, that it affects only oranges budded on sour orange stock. Oranges on sweet stock are unaffected.

Recent findings emerging from transmission experiments, together with all the other facts and observations which have emerged, ... beyond much doubt that ...

Further Improvements Needed Before Mechanization of Cotton Growing Reaches Full Efficiency

J. P. Fairbank

The mechanical cotton picker is the center piece of cotton mechanization, the hoped for answer to the current labor cost of 100 hours per acre for hand picking.

... cotton picker is not a new ... patented way back ...

dles traverse the cotton plants and when one of them touches an open boll, the fiber wraps around the spindle.

As the spindle retracts into a housing, the cotton is doffed into ... stream, thence in...

Veterinary Scientists Prove That One Type Of Mastitis Can Be Controlled Successfully

O. W. Schalm

Research in recent years has demonstrated that at least one form of mastitis can be cured.

... of bacteria have ...

... and palpation of the milked-out udder for scar tissue.

These tests depend for positive result on the existence of ...

Control of Coddling Moth With DDT Spray on Apples and Pears Good in Investigational Work

Arthur D. Borden

During the past three seasons of investigational work with DDT for the control of codling moth on apples and pears the results have been excellent.

It has ...

The second application should be started 15 to 17 days after the beginning of the first spray. The third application, if required on early harvested varieties, should be applied at least three weeks before harvest. On late varieties of pears and apples ...

Army Of 23 Million Wasps Is Winning Fight To Control the Oriental Fruit Moth In State

Glenn L. Finney

With a record ... season ... an army of 23 million has ... aged in California's battle against the dread Oriental fruit moth.

It was an army of parasites doing ... yeoman work to save the state's orchards. It was an army propagated and sent into the fields by the University's Division of ...

... long production season 1400 pounds of A-1 ... toes are set ... among 84 production units.

In 84 special boxes groups of moths fasten approximately 20,000 eggs on each of 84 ... total ...

Removal of DDT Residue From Pears, Apples Successfully Accomplished By Washing

W. M. Hoskins

One of the important undertakings of the Division of Entomology and Parasitology during the past three years has been a detailed study of the use of DDT (dichloro, diphenyl, trichloroethane) for control of codling moth under the various conditions ... exist in pear orchards of the ...

... request of pear growers ... of method...

basis several more materials were disqualified.

Those remaining gave varying results with DDT-sprayed pears, but no one alone was satisfactory with heavily laden ... eventually it was found th... ...binations of two ... sults ...

Progress Reported in Search For Effective Control of Bovine Brucellosis

C. M. Haring

Results obtained by University of California veterinarians in cooperation with sixty-five dairy and beef cattle owners throughout this state over a period of several years, make it possible to announce an encouraging degree of success in the control of ... Bang's disease, or ...

laboratory of the State Dep... of Public Health.

Reactions to Vaccine

Vaccination can be injur... undernourished or sick anima... in healthy calves it produce... a mild and harmless reactio... cently vaccinated calves give p... blood ...

Avocado Tree Decline Report Shows Progress

Condensed from a report by Robert W. Hodgson, Assistant Dean of the College of Agriculture, covering a two-year study of Avocado Tree Decline conducted cooperatively by the divisions of Irrigation and Soils, Horticulture, Plant Pathology, Soils and Plant Nutrition and Orchard Management of the College of Agriculture, Los Angeles and Riverside campuses.

In many cases the primary ... the spread of avocado tree ... the progressive extension of ... tion of waterlogging from ... where it first developed to surrounding areas which in turn become waterlogged and develop tree decline.

Tree decline has been confined ...

Selection and Management of Turkey Breeding Stock Are Subjected to Studies

V. S. Asmundson

One of the simplest ways of increasing egg production of turkey breeder hens has been the use of artificial lights. This is effective provided the day is long enough—about 14 hours—and the light bright ...

sufficient number kept over to allow for loss either from fighting or from the tendency of some males to become excessively heavy and unfit for breeding purposes. The birds that are ... should not be used. However, ... excessively ...

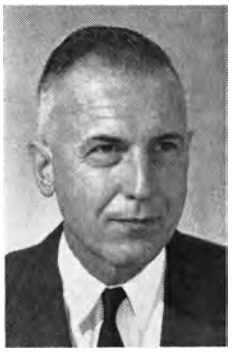
. . . 20 YEARS LATER

THE FIRST ISSUE OF CALIFORNIA AGRICULTURE was produced and distributed in December, 1946 — 20 years ago. World War II had just ended and many in the armed forces were still overseas waiting to return home. The shortage of automobiles was easing and one manufacturer had dared to come out with a radical design called the "bustle back" that would be adopted by the whole industry. England was gossiping over a rumor that their Princess Elizabeth was showing interest in a young Greek prince named Philip.

Farmers, like most other people, were beginning to catch their breath after living and working through four years of wartime economy. It was a time to try to forget the recent past, to take a good look at the present, and to start planning for the future. Wartime research had unleashed the energy within the atom. Scientists (with the University of California in the forefront) had developed many new deadly weapons—both physical and chemical. Peacetime conversion of this scientific capability was a major consideration. The answers to many questions lay in research, and the facilities for research had long been well established in our colleges and universities through the agricultural experiment stations of the Land-Grant College system.

Scientists in the California Agricultural Experiment Station, who had done much to help farmers maintain high levels of production through the war years, turned their attention to scientific discoveries made available by wartime research for the solution of the many problems of farmers, food processors, and distributors. Nerve gases developed for wartime use against human beings were found to be useful against plant pests, and radioactive isotopes (by-products of atomic research) made excellent "tracers" for studying problems connected with both plant and animal life—to mention only a few of the new tools. The publication CALIFORNIA AGRICULTURE was started to report research progress made by these scientists and to get this information quickly to the farmer.

During its first year of publication, CALIFORNIA AGRICULTURE was a four-page newspaper printed in the popular tabloid format. In 1948 the format was changed to the present 16-page magazine printed on high-quality paper. Circulation of the publication, then as now, was by mail subscription to individuals, upon request. The press run for any one issue of the monthly publication has varied upward to 40,000 copies. Approximately two-thirds of the copies go to California farmers and agribusinessmen. The remainder go to individual researchers, libraries, educational institutions, and governmental agencies worldwide.



C. F. KELLY

Director, University of California Agricultural Experiment Station.

Along with the establishment of state agricultural experiment stations in the Land-Grant Colleges, the (Federal) Hatch Act of 1887 also provided, in part, ". . . that bulletins or reports of progress (in research) be published at said Experiment Stations at least once in three months, one copy of which shall be sent to . . . such individuals actually engaged in farming as may request . . . ." In California, bulletins report new research that has been completed, whereas CALIFORNIA AGRICULTURE offers a continuing report of progress on research still under way Authorship of most of the articles is within the experiment station staff; however, as a result of the increasing emphasis on field research, an increasing number of Agricultural Extension Service farm advisors and specialists also participate.

From the California Agricultural Experiment Station's statewide program of research, a wealth of information has become available to farmers, processors, home gardeners, stockmen, foresters, and consumers. In addition to the circulars, bulletins, and monthly reports of progress in CALIFORNIA AGRICULTURE during the past 20 years—all of which have some immediate practical application—thousands of papers and articles have been published by the Station's staff members in journals and other scientific media circulated throughout the world. The California scientists in return, have received and read thousands of similar reports and kept in constant communication with colleagues in related fields—with the aim of focusing the total knowledge gained from research on specific problems in agriculture.

CALIFORNIA AGRICULTURE can be justifiably proud of its part in getting agricultural research information to California farmers, agribusinessmen and researchers. From a modest beginning 20 years ago, the magazine now counts its circulation in the thousands. Hundreds of copies are also sent to foreign countries every month, and the many letters received from grateful readers attest to the fact that a worldwide need is being fulfilled.

On the opposite page are reproductions of faded headlines of articles that appeared in the first few issues. The following summary of reports from today's experiment station researchers reveals a few of the many achievements that followed these articles in the next twenty years:

Cotton

Mechanization in cotton was something very new in 1947. The following year saw the beginning of a cooperative growers program to study the subject.

the research continues . . .

By 1962 about 90% of the California crop was being mechanically harvested, thanks not only to improvements in the harvesters, but to precision planting, machine topping, chemical defoliation and other practices that grew out of the program. Close cooperation between U.C. plant pathologists and researchers with the USDA Cotton Field Station, Shafter, resulted in development of Acala 4-42 cotton with its tolerance to Verticillium wilt, which had seriously crippled the early cotton industry in California. Sufficient seed was available by 1949 to allow commercial-scale distribution, and the value of this cotton disease research to California growers since then has been inestimable. Further research is in progress on a virulent form of Verticillium wilt that is now causing serious losses to cotton growers in the San Joaquin Valley.

Tomatoes

Today's research in mechanization also includes projects with fruit and vegetable crops, and constitutes a major effort in both northern and southern California. One outstanding success in the past few years has been the development of the tomato harvester by U.C. agricultural engineers. Commercial machines now harvest more than 70% of the canning tomato acreage in the state. Plant breeders also played an important role in mechanization successes by developing a new tomato variety with an elongated shape as well as other qualities permitting a one-time machine harvesting operation. Research on cultural practices to allow maximum yield and quality of these new varieties has also been an essential part of the mechanization program.

Development of fumigation techniques with methyl bromide for control of broomrape (a parasitic seed plant attacking tomatoes at their roots, and capable of destroying the crop) is an accomplishment of the past 10 years—through work of U.C. plant pathologists, assisted by research workers with the State Department of Agriculture and commercial engineers who designed the soil injection equipment.

Strawberries

Soil fumigation of strawberries with mixtures of chloropicrin and methyl bromide for control of Verticillium disease as well as of many insects, nematodes, and weeds has contributed greatly to to-

from Tulelake

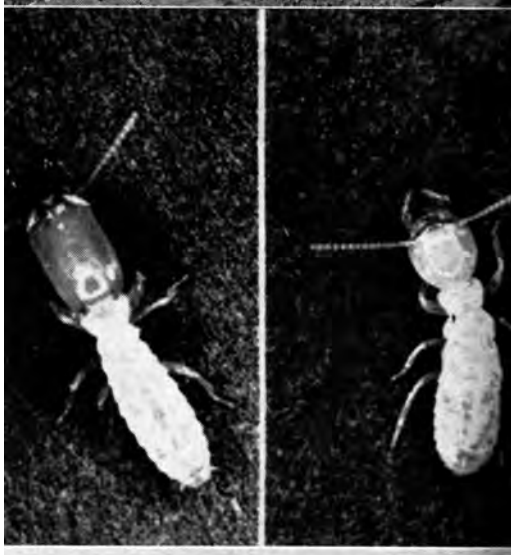
Tulelake Field Station is located next to the Oregon border in Siskiyou County and is concerned mostly with research in field and vegetable crops adapted to the area—particularly barley and potatoes—as well as exploratory work on new crop possibilities.

to Imperial

Imperial Valley Field Station is located near the Mexican border in an ideal environment for desert agricultural research. The experimental work is concerned mainly with field crops, alfalfa, livestock management, and vegetable crops.

from termites

Termite research is only a part of the extensive program for control of pests and of diseases of both plants and animals. Experiments are being conducted at all 10 of the field stations and by many departments of the four University campuses involving agricultural research.



to tomatoes

The mechanical tomato harvester shown here owes its existence to prototypes developed by UC agricultural engineers. The success of commercial machine harvesting was also dependent upon plant breeders who developed a tomato variety with an elongated shape and other qualities making it more adaptable to the one-time, mechanical harvesting program. Research on cultural practices involved in this machine adaptation has also been an important phase of experiment station work in recent years.

day's production of more fruit on only a fraction of the California acreage in production in 1946. Just the year before (1945), U.C. plant pathologists had released the two world-famous strawberry varieties, Shasta and Lassen, which were resistant to the destructive yellows virus complex.

Citrus

Quick decline in citrus was found to be caused by the tristeza virus, which was transmitted from one tree to another by an insect vector. By testing hundreds of different rootstocks, scientists at the Citrus Research Center found that certain rootstock-scion combinations were tolerant of the virus, and the threat to southern California's citrus industry by quick decline was practically eliminated. In recent years, urbanization has hit many of the old citrus areas of southern California, and the resettlement of a considerable acreage north of the Tehachapis into the southern end of the San Joaquin Valley has caused another set of problems for growers and scientists. Agricultural engineers are also busy attempting to mechanize all possible aspects of citrus production, from pruning through harvesting.

Brucellosis

In 1946 the incidence of brucellosis in California's dairy herds was about 18%, although investigations aimed at controlling the disease had been going on for more than 10 years. By December 1946, U.C. scientists were ready to report on their research and make certain recommendations. These recommendations, printed in CALIFORNIA AGRICULTURE, implemented by state legislation, and adopted by the dairy industry, were largely responsible for the decline of brucellosis to less than 1% today. California is now a modified-accredited, brucellosis-free state and 22 of the 58 counties are fully certified as brucellosis-free. Research continues with emphasis on the critical identification of the various strains of the causative organism and on better methods of diagnosing this destructive cattle disease.

Pesticides

For a number of years before 1947, the chemical recommended for control of codling moth on apples and pears had been lead arsenate—a dangerous stomach poison for humans if accidentally consumed. DDT showed promise of giving safer and better control, as reported in CALIFORNIA AGRICULTURE, February, 1947. Further investigations led to the introduction of dozens of new and improved chemicals—to the point that pest control recommendations for most crops are now published only on a year-to-year basis (and many of these have to be supplemented during the year). The 1966 programs published for apples and pears still list DDT as an acceptable control measure for codling moth, but show two other, newer, chemicals as being preferable. Lead arsenate no longer is mentioned in the spray schedules.

Residues

DDT has been replaced in many cases with shorter-lived chemicals so that the necessity for washing to rid crops of certain chemical residues has been reduced or eliminated in some cases— except for material destined for use in baby food. The University has set up a special pesticide residue research laboratory for continuing work in the protection of food products.

Micronutrients

The study of micronutrients in the soil has become very important, and research pointing up the need for these trace elements in soil has been of great value to farmers. Citrus crops, for example, have been shown to need varying amounts of iron, manganese, zinc, copper, boron, and molybdenum. A deficiency of just one of these elements may seriously affect tree vigor, productiveness, or fruit size. Testing for and recognizing excesses or deficiencies of soil elements from aluminum to zirconium is the subject of an 800-page book published in 1966 by the Division of Agricultural Sciences, with contributions by twenty staff members. This book is considered the "bible" on the subject of soil nutrients, and is being purchased by scientists all over the world.

Mastitis

Over the past 20 years, research in mastitis has come a long way, thanks to the work of experiment station scientists, with the cooperation of agricultural extension service staff members. The California Mastitis Test (CMT) is now applied to thousands of cows at monthly intervals here and in other states. This test provides a quick and easy method for the dairyman to detect the disease before severe damage from the infection develops. The use of CMT has also resulted in recommendations for upgrading milking equipment and techniques, not only in California, but throughout the nation.

Integrated control

Colonization of the wasp *Macrocentrus ancylivorus* to control the Oriental fruit moth in peach orchards continued from 1944 until 1947. Over 58,000,000 parasites were released. In 1947, when the pest dwindled to nondetectable numbers, the program was discontinued. In 1954 the Oriental fruit moth again became a pest. Although control practices involving the use of the newest insecticides were promptly adopted, the moth continued its damage, especially in cling peach orchards. In 1964 a project to develop an integrated control program for pests of peaches was initiated with the cooperation of the Cling Peach Advisory Board. The use of parasites, both native and imported, including *M. ancylivorus* plus the judicious use of insecticides and the appropriate cultural practices are now being coordinated to achieve efficient control of the Oriental fruit moth and other pests of peaches. Such integrated control projects—combining biological and chemical control with cultural practices and resistant varieties—have since contributed to the solution of insect and plant disease problems in some crops. One noteworthy example of the successful use of integrated control in recent years was the project for regulating the population of the spotted alfalfa aphid. A research program for integrated control of grape pests, particularly the grape leafhopper, has been expanded in recent years, with industry support.

Poultry

Selection and management of turkey breeding stock, along with other problems of poultrymen have received considerable attention. The experiment station's research has resulted in better methods of artificially inseminating birds, as well as designs for houses in which both light and temperature are closely controlled by automatic machinery. Today 80 to 90% of all California turkeys are hatched by means of artificial insemination, and are started under light- and temperature-controlled (LTC) housing to increase growth rate and feeding performance of the birds.

Avocado root rot

In 1946 the role of the fungus, *Phytophthora cinnamomi,* in avocado root rot was not clear. Research has since shown it to be the principal cause of the disease. An extensive collecting and testing pro-

gram has shown that there are differences in rootstock susceptibility, and that some small-fruited species of the genus *Persea* (native to Latin America) are immune to the disease, but not graft-compatible with our commercial avocado species. Discovery of the primary role of *P. cinnamomi* in the disease has led to research on control of the fungus by both chemical and biological means. Effective fumigants have been found, and a non-phytotoxic chemical for use in irrigation water gives additional promise for control. Much is now known about the fungus; further research (under way) is needed before the problem can be considered solved.

Enzymes

The project by University researchers started in 1947 to study the role of enzymes in the processing of fruits and vegetables has resulted in "... more advances in this field during the past 20 years than were made during the preceding 100 years" according to the author of the original article in CALIFORNIA AGRICULTURE. The problems were attacked by plant physiologists, plant biochemists, food microbiologists, and enologists. Controlled-atmosphere storage, improved ripening procedures, and improved methods of inhibiting and controlling undesirable enzymatic changes during processing and storage were developed and introduced—all resulting in the reduction of losses during harvest, storage, processing, and distribution of foodstuffs.

Foreign aid

Another development in the aftermath of World War II was the interest in helping the emerging nations. The production of food and fiber being of major concern nearly everywhere, agricultural scientists have been called upon to supply information, technical assistance, and training programs for the underdeveloped parts of the world. California scientists have been outstanding participants in the foreign assistance programs while continuing to help produce more and better food and fiber for the greatly increased population of this country. CALIFORNIA AGRICULTURE has played its part in the international exchange of scientific information by offering a continuous report of progress in California agricultural research to scientists and students in all areas of the world.

Influence of... Shaded Mangers, And Increased On Reducing Heat

V. E. MENDEL · W. N. GARRETT

FEEDLOT PERFORMANCE of British breeds of beef cattle fed during the summer months in the irrigated desert valleys of California averages 15% less than the performance of those fed during the cooler portion of the year. Heat stress is the major factor responsible for this lower performance.

The experiment reported here was designed to study three independent methods for improving feedlot performance during the period of heat stress at the Imperial Valley Field Station, El Centro. The methods were based on the following assumptions: (1) that a reduction in the amount of heat re-radiated from the feeding area to the animals as they ate could reduce heat stress; (2) that a reduction in the density of the hair coat might enhance convective and evaporative heat losses from the surface of the skin to reduce heat stress and, (3) that an ample supply of readily digestible calories (in the form of fat) could reduce the heat increment (waste heat associated with an animal utilizing a feed) and thereby reduce the total heat load.

The methods tested included shading the mangers; clipping the hair (from the entire upper portion of the body), and feeding a medium energy (4,333 gross cal/gm dry matter), high protein (15% crude protein) ration for comparison with a high energy (4,725 gross cal/gm dry matter), high protein ration.

Digestion trials

Ninety-six animals were used in this experiment, of which half were steers and half heifers, separately penned. Digestion trials were conducted with steers during the fall following comple-

TABLE 1. COMPARATIVE TEMPERATURES OF FEED SURFACES IN SHADED AND UNSHADED CONDITIONS

Time	Shaded	Unshaded
	°F in manger	
7 A.M.	84.9	86.0
1 P.M.	102.2	131.0
3:30 P.M.	102.9	119.1
	°F in feed storage box	
7 A.M.	87.4	86.9
1 P.M.	103.1	131.8
3:30 P.M.	102.4	115.7

TABLE 2. COMPARATIVE RESPONSE OF HEREFORD CATTLE, FED RATIONS OF TWO ENERGY LEVELS, TO SHADES OVER THE FEED MANGER OR TO CLIPPING THE HAIR FROM THE UPPER PORTION OF THE BODY

	Intermediate energy		High energy		Intermediate energy		High energy	
	Shaded	Unshaded	Shaded	Unshaded	Clipped	Not clipped	Clipped	Not clipped
No. of animals	24	23	24	23	23	24	23	24
Initial weight, lb	626	622	622	624	625	623	618	627
Daily weight gain, lb	2.87	2.82	1.90	1.97	2.82	2.86	1.94	1.93
Daily energy gain, megcal.	6.41	6.45	4.49	4.93	6.48	6.38	4.77	4.64
Slaughter data:								
Dressing, %	60.8	60.5	58.9	59.6	60.5	60.9	59.7	58.8
Body fat, %	22.1	22.7	21.8	23.0	22.6	22.2	22.4	22.5
Corrected carcass,* lb	675	673	596	630	675	673	617	608
Feed intake and utilization:								
Daily feed consumption, lb (DM)	18.99	18.94	15.01	15.22	18.91	19.02	15.19	15.03
Feed weight/gain, lb (DM)	6.63	7.00	7.89	7.73	6.98	6.65	7.82	7.81
Energy gain/100 lb, megcal	32.09	31.06	28.21	29.27	31.24	31.91	28.37	29.12

* Carcass weights adjusted to equivalent caloric content.