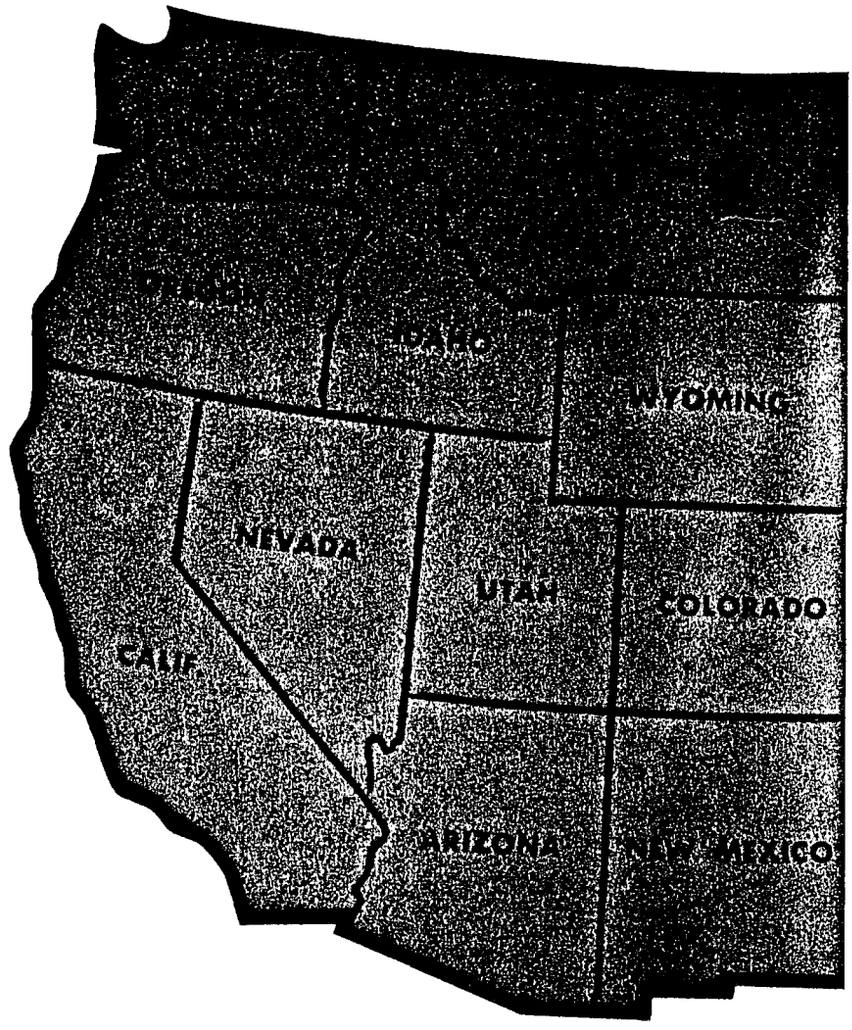
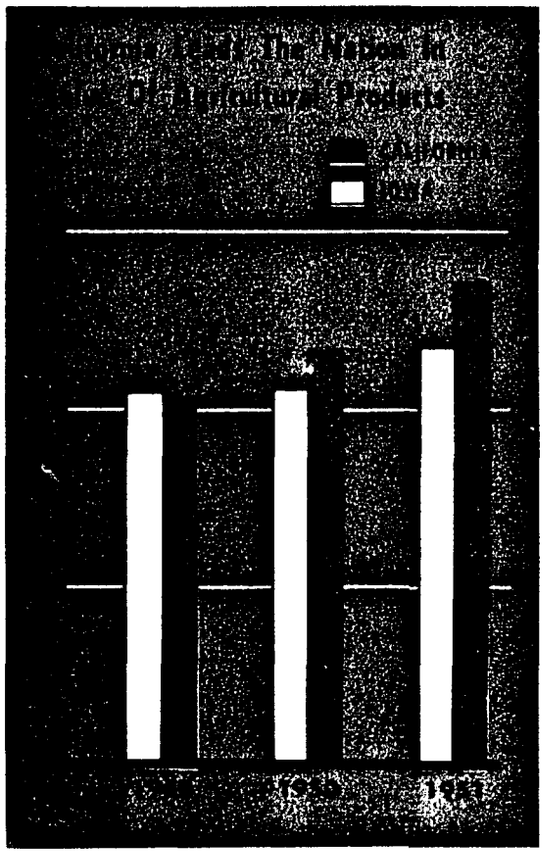
A Growing Market for Agricultural Chemicals





With California now the leading state in value of agricultural production, and neighboring states increasing in importance, it was only fitting that the American Chemical Society's Divisions of Agricultural and Food Chemistry and of Chemical Marketing and Economics organize for the Los Angeles ACS meeting a symposium on the marketing of agricultural chemicals. And in that atmosphere, it was logical that at least part of the symposium be slanted toward the western outlook.

New agricultural chemicals constantly are reaching the market as a result of industry's research programs: it has been estimated that 80% of the $300 million pesticide market in 1952 was represented by items which were not available in 1945.

The marketing of these products, especially the more recently developed pesticides, is governed by many factors not ordinarily encountered in day-to-day chemical activity. Crop uncertainties, insect infestations, and the multiple state and federal regulations all must be given careful consideration. Symposium papers by authorities on the outlook and marketing problems, summarized here, take these and other factors into consideration to offer the latest thoughts on the subject.

. . . advances in the scientific field of agriculture represent combined achievements of research, product development, and market study . . .

Introductory Remarks

I. BERGSTEINSSON
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FARM EXPENDITURES for fertilizers and pesticides have risen to record heights but we have by no means reached the limits in either case. The expenditures for farm chemicals fall within the wide range of $500 to $850 million annually, or 1.5 to 2.5% of the total United States farm income. In either case these are large sums but they are scheduled for further increases. We still have a long way to go before the optimum use of fertilizer is reached, and as far as pesticides are concerned, insects continue to take a large toll in damage to plants and animals. To the costs of fertilizer and pesticides must be added the expense of control measures, estimates for which range anywhere from $1.6 billion to $4 billion, including the cost of insecticides plus the damage by insects.

Efficiency on farms meanwhile has increased. Cash income from farms in the United States during 1951 was $33 billion, of which farm crops represented 40%. While crop acreages have remained virtually constant for the past 30 years at around 400 million acres, the value of farm crops and the yield per acre have risen very noticeably, particularly in the past 10 or 12 years. This increase in efficiency has contributed, and will continue to contribute, to our high standard of living. Increased agricultural production has resulted in no small degree from the increased availability of chemical plant foods, and to the protection afforded to plants or animals by agricultural insecticides, fungicides, fumigants, and herbicides.

In fact, many of our important crops would disappear, or would be of such inferior quality that they would be unsalable if these chemicals were unavailable. Just how far have we progressed toward the most advantageous use of available chemicals, and what further progress may we expect? History records many disastrous crop failures which we would now consider avoidable. In Biblical times locusts came and devoured the corn crop. Successive failures of the potato crop in Ireland led to famine and mass migration of the population. Even within recent years, before the advent of the chlorinated insecticides, grasshoppers destroyed large acreages of crops in the United States.

In Holland, a large portion of the Zuider Zee was reclaimed by building dikes to keep out the salt ocean water, after which the land was conditioned with large amounts of gypsum. This project added a half million acres of highly productive agricultural land to the country's crop acreage. Three species of insect and one snail which had become firmly established in the United States have now been eradicated. This is encouraging when you consider that many insects develop new strains with a tolerance for a given poison. The broad aim in chemical market research is to find wider, more diversified, and more efficient use of existing chemicals, as well as to uncover potentialities for new chemicals.

. . . marketing practices and problems of the industry present a real challenge to management . . .

Agricultural Chemical Marketing Practices

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THE PESTICIDE INDUSTRY is confronted with three major factors which contrast it sharply with most industries, and especially the industrial chemical business. They are: (1) short use season; (2) large variation in annual demand; and (3) rapid obsolescence of chemicals because of new developments.

As to the short use season, the total annual need for a chemical in a specific area to handle a particular problem may be limited to as brief a time as a single day, and at best it will not extend for more than 10 or 12 weeks. Here are a few illustrations: Cotton normally comprises 20 to 30% of the national insecticide market. Major insect attacks come from the boll weevil, bollworm, leafworm, red spider, and aphis. Numerous control chemicals are used; still 80% of this large market is applied during a six-week period.

In fruit thinning, chemicals must be applied at a critical stage of blossoming and this condition may last but a day or so. Otherwise there will be no need for chemicals until next year. In some states cutworms may destroy whole fields of seedlings, and chemicals must be used at once. Grasshoppers, mormon crickets, aphids, and leafhoppers rapidly multiply to tremendous proportions, and the opportunity for chemical use is also of brief duration.

The longest use period for a major chemical is probably for DDT or lead arsenate for control of the codling moth. This may extend to 12 weeks. To sum up for a given market area, the average use time of an agricultural chemical against a specific pest is of short duration, probably less than 10% of the year.

Even more difficult than the short use season is the large variation in requirements, over which the industry has no control whatever. Nature determines the size and intensity of the insect population, the severity of freezes, the heat, humidity, drought, or excessive rainfall. These all regulate insect population, fungus problems, and the growth of weeds. Crops were so seriously damaged by drought in 1952 that the pesticide use was cut to a small fraction of average consumption.

Factors in obsolescence and changing chemicals are the industry's tremendous research programs since World War II which have brought many new products into the market. Prior to 1946 no DDT was used for pest control. Its consumption now is around 80 million pounds a year, and it has largely displaced lead arsenate, and other chemicals to an extent. Other items which have followed DDT are BHC, lindane, TEPP, toxaphene, DDD, parathion, methoxychlor, aldrin, dieldrin, Aramite, chlordane, Heptachlor, Captan, 2,4-D, 2,4,5-T, and others.

. . . sources of data should be examined carefully for reliability and completeness . . .

Sources of Information for Market Surveys of Agricultural Chemicals

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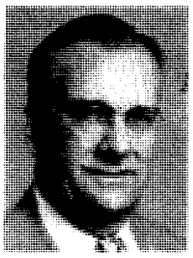

MANY SOURCES of information are open to those conducting market surveys of agricultural chemicals. Interest is usually focused on supplies and usage of materials. Domestic supplies and disappearance at the producers' level can be estimated rather precisely from data on United States production, imports and exports, and inventories. Production figures on minerals such as arsenic, clays, coke and coal chemicals, copper sulfate, lime, mercury, phosphate rock, potash, sulfur, talc, and pyrophyllite, may be had from the Bureau of Mines.

Inorganic chemicals are published by the industry division, Bureau of Census, in its "Facts for Industry" series, issued monthly. There are also annual summaries. Data are provided on synthetic ammonia, ammonium nitrate, ammonium sulfate, calcium arsenate, lead arsenate, copper sulfate, and sodium chlorate. The U. S. Tariff Commission also publishes a "Facts for Industry" series with monthly and annual figures, and the organic chemicals covered include benzene, benzene hexachloride, carbon disulfide, carbon tetrachloride, DDT, 2,4-D, and 2,4,5-T.

Bureau of the Census' foreign trade division publishes import data through its Report No. FT 110, by commodity and country. Imports reported include benzene, arsenic trioxide, pyrethrum flowers, cube root, and red squill. There are also export data published in FT 410 for many items, including copper sulfate, DDT, lead arsenate, and calcium arsenate. Weed killers and agricultural insecticides not elsewhere coded are reported under a basket code number.

The chemical industry provides much production information through trade associations. Principal groups in farm chemicals are the National Fertilizer Association, the American Plant Food Council, the National Agricultural Chemicals Association, the Pacific Insecticide Institute, and the Manufacturing Chemists' Association. Individual manufacturers are helpful but usually are reticent concerning their own operations. Data concerned with usage at the consumer level may have to be obtained as estimates by local experts at State experiment stations and extension services, and from the U. S. Department of Agriculture.

Requirements are evaluated in pesticide surveys conducted by the Production and Marketing Administration, Department of Agriculture. The studies for 1951 and 1952 were made under sponsorship of PMA State Committees by a special technical advisory group in each state. Represented in these groups are the State Agricultural Experiment Station and Extension Service, State Department of Agriculture, State Livestock Sanitary Association, other bureaus and branches of the U. S. Department of Agriculture. In general, the combined State reports on the quantities of pesticides estimated to have been used or required were in reasonably close agreement with calculated domestic disappearance data.

. . . the uncertainties are so numerous, the problems so great, and there are so many unpredictables . . .

Market Outlook for Fertilizers

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CIRCUMSTANCES which affect the market for fertilizers are land area, population, available farm labor, new fertilizing methods, and prices. Their discussion and interpretation indicate that fertilizer usage in this country will continue to grow, even though the long trend may be marked by minor recessions. Of United States land area of 1920 million acres, only 350 million are cultivatable. Since 1920 we have increased production of food by the equivalent of 102 million acres, through conversion of land from use for animal food to human food production and through more scientific farming.

In 1920 there were some 3.25 acres in cultivation to feed each individual, but by 1940 this had been reduced to 2.25 acres. By 1960, with population increasing at from 6000 to 7000 per day, that area will have shrunk to 2 acres per individual. It is figured that by 1975 the nation will need the added production equivalent from 115 million acres to feed and clothe the population at our present standards of living. But there is not that much new land available. We might get 45 million additional acres through conversion of land which now sustains draft animals as farm mechanization is completed, and from irrigation and drainage projects, flood control, and land clearing.

This still leaves a 70-million acre deficit and the alternatives of either reducing exports, importing food, or increasing production on the land we have.

An alarming disappearance of farm labor and an increase in farm size are two other factors in analyzing the fertilizer market. Since 1940 we have lost more than one million farm workers to offices and factories. In 50 years farm labor has dropped from 38% of the national labor force to 12%, but where one farm worker produced food for eight persons in 1910, he now produces for fifteen. The trend from team and wagon to complete mechanization of most farm operations has minimized the effect of labor losses in agriculture.

The most important factor in market analysis, the amount spent for fertilizer, varies widely from state to state. In East Coast sections it is as much as 17 cents out of each dollar of the previous year's income; in Texas it is as little as 1.9 cents. The national average has fluctuated between 5.2 cents per dollar of income in 1925 to 6.5 cents in 1950, but the trend is upward.

The index of fertilizer prices has increased from 100 in 1910–14 to 139 in 1951, while that for the things the farmer buys has increased at the same time to 271. Again on the basis of 100 for 1910–14, farm prices received rose to 302 in 1951. This is a very favorable ratio for fertilizers. As to fertilizer usage, consumption can be expected to rise 11% in nitrogen, 10% in available phosphoric acid, and 17% in potash between the fiscal years 1952 and 1953. Consumption for any decade in the future should be substantially higher than the previous decade.

. . . the market outlook for special-use agricultural chemicals outlines a frontier with vast room for expansion . . .

Market Outlook for Defoliants

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American Cyanamid Co., San Francisco, Calif.

THE MARKET OUTLOOK for defoliants and for all special-use agricultural chemicals presents a frontier with vast room for expansion. Agriculture is undergoing a revolution. The "gee and haw" team of a few decades past has given way to mechanization and chemicalization. Cotton defoliation has become thus far the principal use for defoliants as it is essential for the best use of mechanical harvesters. The cotton grown from the high plains of Texas to the Pacific is more than 45% mechanically harvested.

Machines are not the only reason for defoliation. It protects the crop from late insects, disease, and weather damage. Leonard Lett, National Cotton Council's agronomist, reports that close to 3 million acres of cotton were defoliated in 1952, almost six times that of 1946. Thousands of chemicals have been screened for possible use in defoliation, and at present only two have found widespread use. They are, cyanamide, its derivatives or related compounds, and several different chlorate formulations. The physiological explanation is not clear at this time, but it appears to be related to inhibition of the plant hormone auxin.

Foliage response is quite like that to exposure to high concentrations of industrial-urban smog. Defoliable plants will shed leaves from one to two weeks following exposure. Different plants and different varieties will show varied response to defoliants. The Acala cottons of the West are more difficult to defoliate than the shorter stapled varieties of the Old South.

In the Southeast, calcium cyanamide dust is the principal chemical used and it is applied at roughly one-half the dosage required under arid conditions. Recommendations must vary according to crop condition. Soluble cyanamide or chlorate sprays are used for tougher, less active foliage and calcium or sodium cyanamide dusts for more active and usually dense foliage. While the defoliant market presents opportunities for expansion it is not based on increasing acreage as much as it is on growth from within—increasing yield and quality of its products. But there is a personnel problem, also a lag in the development of equipment. Proper application timing is essential for best results.

This is an educational problem requiring much help. In practice, 10 lb. of defoliant must contact, roughly, 30 million square inches of "cooperative" leaf area, because only those leaves ready to react and those receiving sufficient deposit will ultimately shed. The airplane is the only readily available tool for the application. Applied to the top of the crop, the deposit will vary several hundred percent on the plant surfaces. Therefore, plants must tolerate the high concentrations yet the defoliant must be effective at lower concentrations.

Defoliable crops other than cotton are peppers, castor beans, and ramie. Defoliants may also be used for grain and seed crop dessication, for combined top-killing and hardening of potatoes, and for tomato "defoliation" to prevent loss from rot.

. . . there is urgent need for an educational program on the use of soil conditioners . . .

Market Outlook for Soil Conditioners

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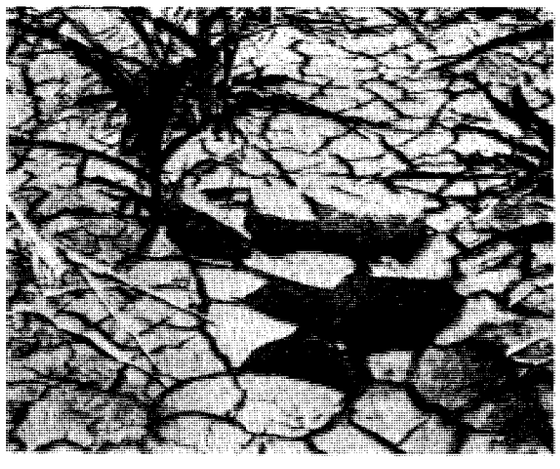
PROPER SOIL structure has been the object of scientific study for many years and large tonnages of established chemicals have been used annually for correcting structural abnormalities in the soil. Among them are lime, gypsum, sulfur, and inorganic chemicals and minerals like sulfuric acid, sulfur dioxide, calcium polysulfide (lime sulfur), and the sulfates of iron and aluminum.

The productive capacity of a soil is determined by four major factors: fertility, soil moisture, texture, and structure. Of these four, structure is paramount because of its influence on the growth promoting factors, and an example is seen in the crop demand for 300 to 1000 pounds of water for each pound of dry matter produced. The ability of the soil to absorb and release this great amount of water demands a good structure. The two principal factors which contribute to structural deterioration are tillage operations and the chemical composition of irrigation water.

Calcium and/or organic matter should be major ingredients in all soil conditioners. This is true for soils which have undergone mechanical compaction or puddling as well as those which have been dispersed by a high Na:Ca ratio. Briefly, the functions of a soil conditioner are to: reduce or correct soil alkalinity; reduce or correct soil acidity; and improve the mechanical condition or tilth.

The word "lime" is applied in this field to any form of calcium capable of correcting soil acidity. Some 25 million tons are used annually in the United States, largely in humid areas where rainfall leaches away calcium reserves in the soil. Its principal value is in neutralizing soil acidity and for supplying calcium as a plant nutrient. Gypsum is the leading soil conditioner. Tonnage of sales has risen from 8000 in 1934 to 301,000 in 1943, and 611,000 in 1951. The development of accurate methods

A soil thats needs a conditioner



for determining the pH of the soil was a great step to more efficient liming. Methods are now available for determining the gypsum absorbing capacity of soil and for calculating the amount which should be added to high sodium irrigation waters. Sulfur is an excellent conditioner for alkali soils in that it is readily oxidized to sulfuric acid in soil.

The essential role of organic matter in soil structure has been emphasized by introduction of the so-called polyelectrolytes. Humus long has been known to have important aggregating properties, and among those mentioned are the mucilagenous polysaccharides and polyuronides. The polyelectrolytes were developed from research designed to synthesize a chemical substance which would simulate the natural soil binding organic compounds. The experiments with these materials have been extremely encouraging. Among other things they impart water-stable aggregation, gain in water-holding capacity, and better aeration. The crop benefits are better germination percentage, and easier seedling emergence in heavy soils.

. . . the curve will continue upward . . .

Market Outlook for Herbicides in the West

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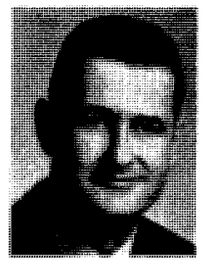
The Dow Chemical Co., San Francisco, Calif.



IT IS NOT EASY to develop market outlook surveys for herbicides. Accurate, over-all historical records of usage are not available, and many factors which directly affect the consumption of weed killers cannot be foreseen. These include such things as the economic well-being of agriculture, changes in the biological complex and its environment, and the introduction of technological improvements. In some sections of the chemical industry short-time market forecasts can be made within accuracy of ±5%, and they can be accurate within 20% of their long-time forecasts. If we can estimate this year's market for herbicides within 20%, and that for 1957 within 50%, we are not doing badly.

A number of things began to happen in the weed killer business around 1948. The old-line materials were still popular but there were also many new products. 2,4-D and the substituted phenols were being employed as selective and contact weed killers. 2,4,5-T, TCA, and IPC were on the horizon. Today, there are at least 25 different basic materials employed as herbicides, and there must be 50 or more different manufacturers, exclusive of formulators, participating in the market. It might be guessed that the value of today's national products of all weed killing chemicals is in excess of $35 million, based on manufacturers selling prices.

In the matter of terminology, any classification of herbicides is arbitrary. How products are grouped depends not only on the materials themselves but on how they are used, the dosages employed, and the methods of application. The sterilants are usually employed to render the soil unfit for plant growth for a long period of time. They include arsenicals, sodium chlorate, borax, and borates. Temporary soil sterilants kill or inhibit plant growth for short periods of time. Among these are carbon disulfide and high dosages of TCA, substituted phenols and their salts, 2,4-D and its derivatives, IPC and its 3-chloro derivative commonly termed Chloro IPC. Selective weed killers are applied when it is desired to reduce weed competition in a crop. Used in low dosages are 2,4-D substituted phenol salts, TCA, 2,4,5-T, and IPC.

Eight states in the West offer an estimated market for 2,4-D this year of 3,850,000 pounds; 2,4,5-T, 200,000 pounds in terms of acid; substituted phenols and their salts, 430,000 pounds; sodium TCA, 280,000 pounds; borax, borate and related compounds used alone or in combination with sodium chlorate, 3,230,000 pounds; sodium chlorate, used alone or in combination with borax, or related compounds 7,050,000 pounds. In most instances these figures show moderate to good sized increases over last year.

. . . protection of the investment in his crop remains a primary consideration for the farmer . . .

Market Outlook for Insecticides in the West

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FACTORS WHICH have specific effects on the demand for insecticides are vitally important to the manufacturer and distributor of these commodities. They may be biological in nature, such as unpredictable and variable degrees of insect infestation. They could be chemical, as the appearance of more effective materials; or governmental, an example being restrictive requirements which preclude the practical use of a compound.

Some uses for insecticides, especially those of a protective nature, are fairly predictable from year to year, but, by and large, most insecticides are used upon the appearance of insects in destructive numbers. Substantial demand for insecticides on the other hand can be wiped out by natural factors, such as a late freeze which destroys a fruit crop or a plant disease which assumes epidemic proportions. When certain insects begin to show resistance to DDT, many begin to feel that this phenomenon would badly upset the market for our most widely used insecticide. Recent thinking, however, is that the power to survive chemical treatments may be a characteristic possessed by relatively few insects.

While modern insecticides are highly effective, there is ample room for improvement in almost any segment. More effective materials are quickly substituted for less effective ones, especially in large-scale operations. The systemic organic Systox for controlling spider mites on cotton is a good illustration. When any product offers a grower an easier, cheaper, simpler, or safer way of doing a job, it will rapidly reduce demands for other products. Wireworm control for potatoes involved laborious cultural practices, expensive and cumbersome soil fumigation work, and hazardous treatments with benzene hexachloride and lindane. Now the vogue is aldrin, and each in turn displaces the other by virtue of definite, practical advantages.

There may be marked temporary

effects on local demands which frequently stem from rumors and facts concerning hazards to operators or to a crop from a given chemical. This type of market influence has increased greatly in the past few years with new insecticides. Federal, state, and county officials, research and regulatory, often influence demands more than they realize. So will a grower's visit to an experimental plot, or certain progress reports. On the other hand, restrictive rules and regulations may make it impossible for a grower to use a well established material. Delays involved in getting permission to apply some organic phosphates have definitely retarded the use of parathion.

It is the considered opinion of many well-informed people that we are at present consuming only about one half of the insecticides needed for efficient utilization of the productive agricultural capacity of California. Relatively large proportions of crops are lost to insects every year, needlessly. In terms of the 1953 growing season there is little reason to believe there will be any over-all decrease in insecticide use.

. . . the market potential for fungicides is highly variable . . .

Market Outlook for Agricultural Fungicides in the West

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The Rohm & Haas Co., San Francisco, Calif.

WESTERN MARKET for agricultural fungicides is a highly uncertain affair which renders calculation of demand potentials very difficult. In general, most crops in the western U.S. are grown under semi-arid conditions and are not subject to extreme potentials of attack by fungus or bacterial disease.

A profitable crop can often be grown without the intensive use of fungicides or bactericides, and in some seasons growers have found that fungicide applications can be a waste of effort and money. They will risk a "no-treatment" program in some years when control measures would be profitable.

The most consistent spray programs are applied to tree crops where the farmer has a large fixed capital investment to protect. Copper fungicides, sulfur, and lime sulfur, are well entrenched in this market. They are fungicidally effective and relatively inexpensive. The newer organic fungicides are finding a limited place in applications where their greater safety justifies their higher cost per acre.

Fruits and nuts are extremely variable in their fungicide requirements. Cherries are a negligible factor in the market while peaches offer a large fungicide potential. Only a minor part of the prune and plum acreage receive treatment. Growers of vegetable and field crops are inclined to eliminate all possible expense on fungicides, and for the most part have no serious disease losses. Celery gets a larger acreage percentage treatment than any other vegetable, but even here it will seldom exceed 50%. Lettuce growers are more concerned with market fluctuations than with foliage diseases.

In addition to diseases attacking the aerial part of plants, another phase is concerned with soil organisms which attack plants in the root zone. A fraction of this potential market is represented by the small tonnage of chemicals sold as seed protectants. Any method of eradicating a fungus in the soil, however, is costly from the viewpoint of both material and labor. Treatment costing $300 to $400 per acre can sometimes be justified on specialty crops such as strawberries. Aside from carbon disulfide, chemicals used against soil fungi are negligible.

The idea of systemic fungicides has long intrigued chemists and plant pathologists. The farmer needs something that would inhibit the growth of a disease after it has attacked a plant. Some soil infesting diseases such as *Fusarium* and *Verticillium* wilts never have been adequately controlled. The organisms travel in the sap stream of the plants, and only a systemic fungicide offers an obvious solution. It should be kept in mind, however, that such a chemical treatment would still have only a small percentage of the total acreage as a potential market.

On the West Coast, the climate is not favorable to either fungicidal or bacterial plant diseases and the potential market is relatively small as compared to the total acreage of crops.

. . . the fields of grain fumigants and soil fumigants are open to considerable expansion . . .

Market Outlook for Agricultural Fumigants in the West

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THE OLDEST AND BEST KNOWN fumigant is hydrogen cyanide, and, of hundreds of potential fumigants, HCN alone is of any value on citrus trees. Its great toxicity, extreme rapidity of action, along with relatively low phytotoxicity, made it ideal for citrus fumigation. However, development of scale insects resistant to HCN and development of parathion curtailed its use on citrus down to practically nothing. Some still is used in flour mills and on stored products.

Methyl bromide, developed in California through the efforts of the late D. B. Mackie, has taken over in the last 15 years certain fumigant fields almost entirely. First is the dried fruit field (figs, dates, seedless raisins) where HCN and ethylene oxide were formerly used. Flour mills are another major outlet for methyl bromide. With its great penetrating power and its chemical nonreactiveness, methyl bromide is recognized now as the preferred fumigant for nearly all food products. It is used almost exclusively for plant fumigation in connection with quarantine. Other general space fumigants include chloropicrin, ethylene oxide, and carbon disulfide, but the volume in all of these is small.

Among spot fumigants are those used in semienclosed spaces in mills where accumulations of flour and debris occur, and those used in package fumigation. In mills, spot fumigants are chloropicrin, ethylene dichloide, and ethylene dibromide, developed in that order. Bulk packages of raisins are treated with a few milliliters of ethyl formate or isopropyl formate prior to filling with fruit and sealing. This practice has almost

eliminated rejections. Grain, principally wheat, is fumigated in storage if held over for a season, with one or another of the chlorine or bromine compounds, and in a heavy solvent like carbon tetrachloride. Demands for better care of stored grain should bring about an increase in the use of grain fumigants.

Soil fumigation is a field that has grown rapidly since the war. Such soil pests as wire worms and nematodes cause great losses in field and truck crops. The fumigants are ethylene dibromide, dichloropropene-dichloropropane mixture, and ethylene dibromide. More recently, ethylene chlorobromide has shown promise. In greenhouses and seed beds, chloropicrin has been used for control of weed seeds and the damping-off organisms. It has two serious disadvantages, cost and phytotoxicity. In the past year it has been found that methyl bromide can be safely and economically used to fumigate insects, nematodes, weed seeds, and fungi, without damage to plants in adjacent beds.

. . . regulations governing the sale of agricultural chemicals have become multiple and complex . . .

Regulatory Aspects of Sale of Agricultural Chemicals

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THERE ARE NO Federal regulations for fertilizing materials but almost every state has a law governing their sale. California regulations are similar in operation to laws in other states, but are more inclusive as they apply to any substance or mixture of substances intended to promote the growth of plants, increase their productiveness, improve the quality of crops, or produce any chemical or physical change in the soil. Under these provisions the new poly-electrolytic soil conditioners come within the scope of the law, but are defined as soil amendments and do not require registration.

In contrast to fertilizers, pest control materials are subject to a Federal law regulating shipment in interstate commerce. Each different pesticide must be registered and properly labeled before it can enter interstate shipment. In addition, some 40 states have laws governing the sale of pest control materials within a state, and efforts are being made to achieve uniformity in these laws through a uniform law drafted by the Council of State Governments. There is also excellent cooperation between the states and the Federal Government in the matter of labeling, sponsored by the Association of Economic Poisons Control Officials. In California, enforcement is assisted by sampling and analysis of products offered for sale, and some 2000 official samples in this state are drawn and analyzed each year.

In addition to labeling, there are other important fields of regulation for agricultural chemicals. There are laws affecting commercial application and use of pesticides, also laws with regard to permissible spray residues on produce offered for sale. About one third of the states have laws governing custom applications or the agricultural pest control business. In California one must be licensed before hiring out to apply pest control materials. Those using aircraft are given a written examination concerning the nature and effect of pest control materials.

The greatly increased use of agricultural chemicals has caused concern over their potential hazards. This has been intensified by the use of aircraft and new types of ground equipment for distributing chemicals over large areas. Careless application in high winds near sensitive crops has caused widespread damage. Careless handling of toxic chemicals has caused death and injury to workmen, and as a result some states have rules designed to prevent accidents.

. . . the extension idea might profitably be taken up by other forms of business enterprise . . .

Agricultural Extension Service and Its Activities Related to Sale of Agricultural Chemicals

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BECAUSE GROWERS follow the advice of the extension worker in the matter of new chemicals and their application, it is essential that the manufacturer of these products cooperate closely with the various state extension service organizations. In the national extension service there is a medium of communication with farm customers that compares most favorably in size, geographic coverage, and effectiveness, with the sales organization of any major corporation marketing farm service materials. Some 9500 well-trained workers serve in more than 3000 communities in 51 states and territories and reach more than 6.5 million families.

When a new chemical is introduced the farm advisor holds farmers back from premature use until there is sufficient information upon which to base a sound recommendation. When such information is made available he interprets it for the farmer. When the material becomes available, he tests it under local conditions with the cooperation of the specialist, experiment station, or industry representative. If the product develops permanent value he will become its permanent advocate.

How can the agricultural chemical industry take the fullest advantage of the valuable assistance on part of extension workers throughout the country? Work with extension personnel before recommendations are made up will eliminate possible confusion between manufacturers' advice and that of experiment stations and extension workers. Manufacturers should beam information about their product direct to state and county extension personnel. They will be found receptive to advice, experience, and information, but this does not mean glittering advertisements. What is wanted is sound information containing the facts.

Manufacturers should avoid unwarranted emphasis on cost rather than upon effectiveness. The cheapest formulation per pound or per gallon may not be the cheapest per acre of successful treatment. There has been a shift to farm appreciation of quality. In labels, it is well to consider always the wide variety of people under different conditions who must read them. Such things as freezing temperatures, extreme heat, and hard water should be anticipated. The farm advisor can also help in preparing marketing plans.

The more industry's sales techniques are patterned on the extension methods of teaching and demonstration, the more successful they will be.