

This farmer has added a planting attachment to a one-hand, wooden plow so that he can furrow and plant in a single operation in Chapingo, Mexico



Probably the greatest single limiting factor in the world's food production is soil fertility. Latin America's agricultural future is bright. Knowledge and skills developed with U. S. help will contribute measurably to the quality and rapidity of progress

Technical Aid and Agricultural Chemistry

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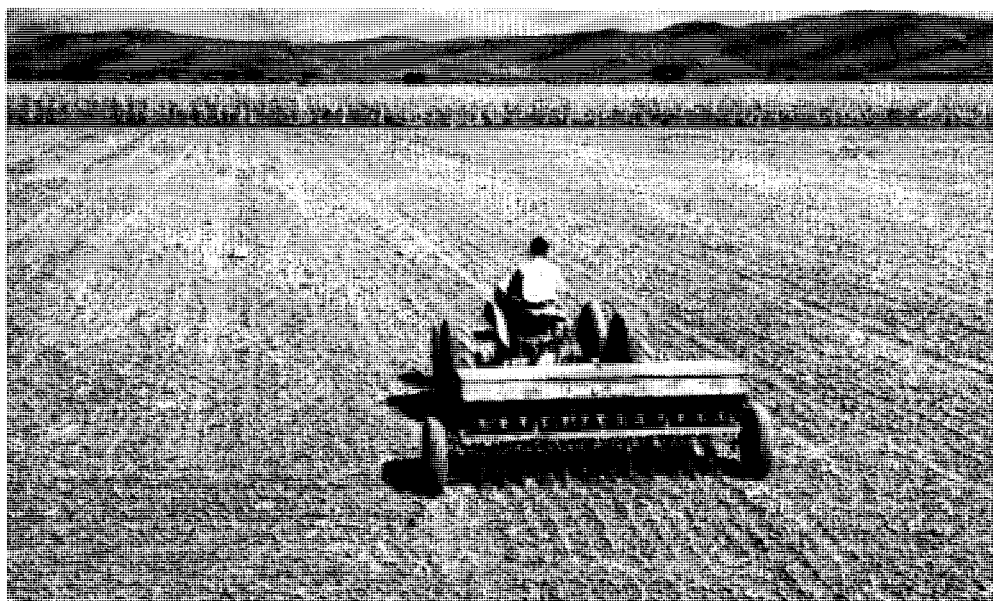
A NUMBER OF INTERNATIONAL AGENCIES are engaged in technical assistance projects throughout the world. Included are United Nations organizations, the U. S. Foreign Operations Administration, the Colombo Plan, philanthropic foundations, and religious and educational groups. Many of these efforts involve agriculture and are stimulating the scientific approach to food production in hitherto underdeveloped areas. At the same time, modern agricultural aids, including machinery, fertilizers, and other chemicals are becoming more readily available. And the extension of these benefits on an increasing scale throughout the Western Hemisphere is producing significant improvements in agricultural production. As technical assistance programs increase in number and gain from experience, their efforts should result in still greater opportunities for agricultural development and growing demands for agricultural machinery and chemicals.

An examination of agriculture in Latin America suggests that only a small fraction of the total potential production is harvested each year. This may be

attributable in certain areas to underpopulation, but more importantly to the limitations of existing agricultural practices, systems of communication, power supplies, land-holding patterns, and credit facilities. Gains are being made in many sectors of the Americas south of the Rio Grande; and Mexico, Venezuela, Argentina, Brazil, and Colombia are typical of those countries making rapid strides in the improvement of highways

and airways systems, the extension of rural electrification, and the development of power resources.

At least several Latin American countries are studying their own systems of land-holding and management in the belief that modifications are needed for increased production. All recognize that the need for credit applies to every aspect of production from the purchase and improvement of land, to loans for



Seeding wheat after turning under a green manure crop in the state of Michoacán, Mexico



On small farms disease and pest control can be accomplished with hand equipment. In Morelos, Mexico, beans are being treated for the control of pod weevils



Hand fertilization of tomatoes in Morelos, Mexico

Harvesting increases blocks of beans with an experimental threshing machine in Chapingo, Mexico



seed, fertilizer, and machinery; and agricultural credit is being more widely extended. As a result, interest rates are falling, and there is prospect that major benefits to production and farm income will be obtained. All of these advances are reflected in the extension of cultivation, increased agricultural production, and more efficient marketing.

Soil Fertility is Greatest Limiting Factor

Perhaps the greatest single limiting factor in food production in the world today is the level of soil fertility. In many of the so-called underdeveloped areas cropping has been practiced so intensively for so many years that their soils have been essentially exhausted, with pitifully low average yields. If these could be supplied with adequate amounts of the essential elements, principally nitrogen, appreciable increases in yield could be expected. This need for fertilizers is becoming recognized.

In Mexico, for example, it is estimated that the fertilizer demand (principally for N and P) will have grown from less than 50,000 tons in 1940 to approximately 800,000 tons in 1955. And this is only the beginning since Mexico can and undoubtedly will absorb several times this amount in the years to come. Much of this will have to come initially from external sources since local production cannot be expected to supply the growing demand. However, in January, 1955, the Mexican government announced plans for the construction of three new ammonium sulfate plants, which in addition to the one already in operation are expected to have a total capacity of from one half to three quarters of a million tons annually.

In South America, Chile has been exporting the bulk of its nitrate production but recognizes that increased quantities must be used locally. Peru is expanding its production of corn, wheat, cotton, sugar cane, and potatoes with the result that increased quantities of fertilizers are required each year, and these are being imported to the limit which local economy permits. Colombia's agricultural production is increasing markedly, especially cereals, potatoes, cotton, and coffee. This is due in considerable measure to research on these crops which has resulted in improved methods and materials for higher yields, which has created a demand for increasing quantities of inorganic fertilizers. Similarly, agricultural developments in many parts of Brazil have moved ahead rapidly, and programs involving the production of wheat, corn, rice, cotton, coffee, sugar cane, etc. are expanding in response to need.

Although nitrogen is the primary nutrient element most needed in support of agricultural production throughout Latin America, response to phosphorus



Improved varieties permit the increased use of fertilizers. Here ammonium sulfate is being applied to the soil prior to the sowing of wheat in Michoacán, Mexico

is reported in most of the soils which are deficient in nitrogen. Therefore, inorganic fertilizers containing both nitrogen and phosphorus are of great importance in support of increased agricultural production, and in some regions potassium or lime or both are also required. Relatively little is known about trace element deficiencies in much of Latin America, but deficiency symptoms have been reported in connection with the production of cotton, citrus, beans, and sugar cane.

Diseases and pests of crop plants are major limiting factors to agricultural production in many areas of Latin America. Traditionally control of diseases and pests has largely been one of efforts to escape heavy damage through cultural practices. For instance, the underplanting of cereals has frequently been practiced in the belief that thin stands suffer less from rust and smuts than do heavy stands. Whether or not this is

a demonstrable fact, the result is the same, since underplanting results in underproduction. Similarly, the potato, which is host to numerous pests and diseases, has tended to migrate upward on mountain slopes and into high mountain valleys in an effort to escape these. Experience has taught that under such conditions there may be less insect damage and a lower incidence of virus diseases. It is quite true that it is often possible to grow potatoes at altitudes at which major insect pests and vectors cannot exist, but here again this practice is penalized by reduced production. Modern methods are bringing potatoes down the mountain sides to broad level plains or valleys, where the benefits of mechanization in conjunction with the chemical control of disease and pests result in dramatic increases in yield.

The introduction of new crops into Latin America has posed additional disease problems requiring modern agricultural techniques for their solution. For example:

The vast increase in cotton production has brought about the wider distribution of cotton pests and diseases and the need for large quantities of insecticides and fungicides in Mexico, Peru, Brazil, and Colombia.

The Sigatoka leaf spot disease on the banana throughout the commercial banana areas has stimulated the regular use of copper fungicides without which the crop cannot be successfully grown. In Central America, Colombia, and Ecuador spraying bananas for disease control has become standard practice in commercial plantation.

The bean, which is the basic protein source for much of Latin America is the prey of a variety of pests and diseases, and recent research through technical

assistance programs has demonstrated that in many areas yields can readily be doubled or even trebled through the control of such pests and diseases as the bean pod weevil, the bean beetle, anthracnose, root rot, leaf spots, and virus diseases.

Similar examples might be cited in connection with the production of most of the important food and other basic crops grown. Among those which are receiving most attention and which are yielding to the use of modern pesticides are late blight of potatoes and tomatoes, virus diseases of potatoes, tomatoes, beans and truck crops, nematodes attacking vegetable crops, seedling blights of cotton, and diseases of the vine.

Pesticide Imports Now Considerable

The use of pesticides and fungicides throughout Latin America has now reached a point at which the quantity of materials imported by the several countries has reach considerable proportions. Initially these were almost all in the form of a finished product, but in recent years an increasing number of mixing plants have been established, permitting the importation of basic compounds for subsequent elaboration and packaging. At the same time there has been marked increase in the importation of equipment for the application of sprays, dusts, and mists, since relatively little is manufactured locally.

The list of those compounds which have been tested or used in the control of plant pests and diseases is an extensive one. Perhaps dusts and sprays containing copper have been or are still of greatest importance, although sulfur in various forms and zinc preparations are also well known. Numerous fumigants including methyl bromide, formaldehyde, and carbon disulfide have been widely used, as have a series of seed protectants including seresan, Semesan, Spergon, Granosan, copper carbonate, Cuprocide, Fermate, Arasan, Parzate, and Zerlate. For the control of insect pests the commonly used compounds include DDT, lindane, chlordan, Toxaphene, parathion, aldrin, BHC, and nicotine sulfate. These lists are not complete but demonstrate that the newer insecticides and fungicides are being widely tested throughout the region and utilized where proved valuable.

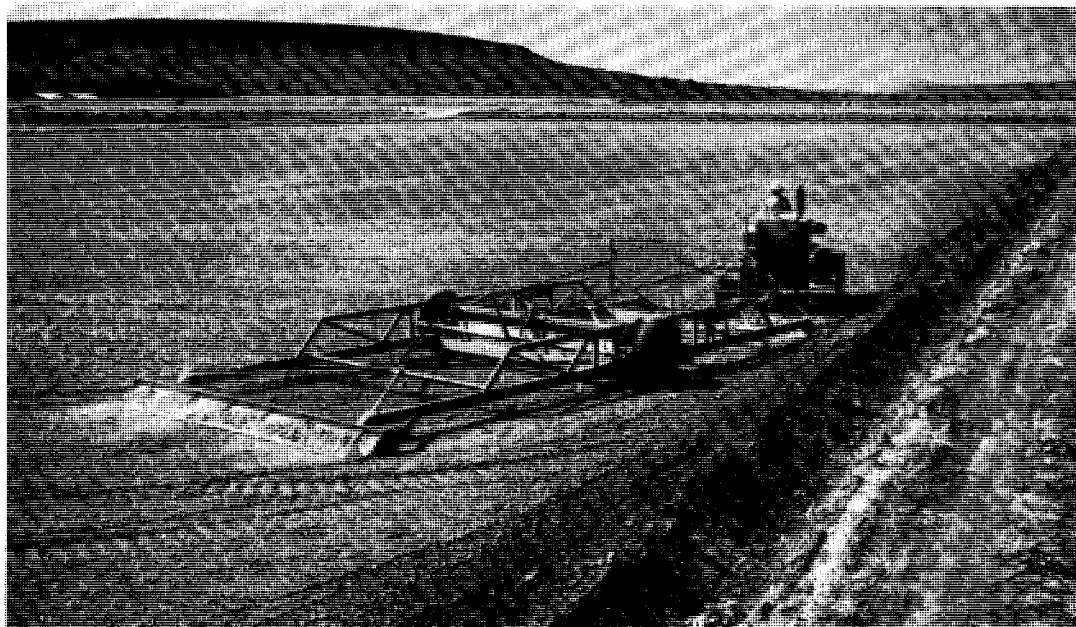
The possibility that systemic fungicides or insecticides may one day come into general use is of growing interest. These would be of special benefit in those areas which must import large quantities of agricultural chemicals and machinery, with the accompanying heavy additional expenses involved in transportation costs, local taxes, and middlemen. Systemic chemicals would be a great boon to the agriculture of underdeveloped areas be-

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Land leveling operation in preparation for the sowing of wheat in Michoacán, Mexico

cause of their ease of application, the reduced frequency with which they would have to be applied, and the smaller quantities of materials involved. Studies of systemic fungicides and insecticides are still in the experimental stage, but there is some evidence that certain synthetic, organic compounds as well as antibiotic substances from microorganisms may be both effective and economical. Specifically, experiments on the control of wheat rust with systemic chemicals have been in progress in Mexico for several years in a technical cooperation program.

Weed Problem Compounded

One interesting development in Latin America is the greatly expanded use of herbicides in crop production. The fact that so much of the area lies in the tropics and subtropics permits year-round cultivation and, at the same time, compounds the problem of weed competition in agricultural production. Moreover, where mechanical aids to cultivation are limited, and regular sanitary practices for weed control are little known, weeds take tremendous annual tolls. Improvements are being made in cultural practices to control weeds, including deep plowing, disking, and frequent cultivation; and flooding has also been used successfully where water is available for this purpose. Weed control in connection with tree crops has been accomplished through the planting of cover crops and the use of hand flame-throwers.

In recent years physical methods for the control of weeds have been joined by chemical control measures. Various chemical substances have been used in the past for the control of weeds along railroad rights-of-way, irrigation ditches, and road sides, but only during the last

decade has the use of herbicides in connection with cultivated crops become widespread. The most spectacular application of herbicides to crop production is in connection with small grains, and thousands of acres of wheat are successfully treated each year in Latin America. This has stimulated research on weed control in other economic crops, and progress has been made with the control of weeds of corn, cotton, rice, vegetables, bananas, citrus, and beans. As might be expected, the compound most commonly used is 2,4-D in some form. A number of newer herbicides are presently being tested for probable future use and include such products as 2,4,5-T, DN-PE (ammonium salt of dinitro-*O*-*sec*-butylphenol), PCP (pentachlorophenol), DN-GENS (amyl analog of DN-PE), trialkyl amine salt of 2,4-D, and sodium salt of 2,4-D ethyl sulfate. Without doubt as new methods and materials become available these will be applied rapidly and generally throughout much of Latin America, with resultant benefits to production.

As average crop yields improve, it is to be expected that much of the resultant additional income will be invested in modern mechanical aids to the practice of farming. In many instances these may be at first, and for some time to come, simple devices which can be made available to the small operator. However, as land tenure and management methods improve there will be a growing demand for agricultural machinery designed to fit local needs. Undoubtedly Latin America will depend chiefly on the United States to provide the tools necessary for an expanding agricultural industry, and the degree to which this country responds and the understanding with which it attempts to fulfill these needs will have profound influence on

the future economy of all concerned. In the past there have been some instances in which salesmanship has been substituted for service to agricultural needs, with the result that benefits to production and good will were both lost, at least temporarily. Here again, technical assistance programs can be helpful in underlining the specific needs of a given area in terms of both kind and quantity.

From present evidence it would seem that the future of agriculture in Latin America is bright and that the great gains still lie ahead. Truly promising is the growing awareness of the importance of using improved varieties under appropriate soil management techniques and in conjunction with mechanical and chemical aids to production. Coincidentally, the extension of systems of communication, improvements in rural electrification, and increasing sources of agricultural credit will all catalyze and complement the other factors involved in the progress of agriculture. It can be anticipated that there will be dramatic future accomplishments in agriculture and industry in all of Latin America and that technical aid will continue to play an important role in these developments. The knowledge and skills provided to underdeveloped areas through sister relationships between American and foreign agricultural colleges and the activities of FAO field parties and those of philanthropic foundations and other agencies with similar objectives will contribute measurably to the rapidity and quality of the progress made. And it is to be expected that commercial organizations will respond by producing mechanical and chemical aids to agriculture in such forms and at costs which will make them generally available, with resultant benefits to human welfare.