

VOLUME 27, NO. 3
1971

minnesota science

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UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

interview with the DIRECTOR

The 1971 Minnesota legislative session may have been one of the most rough and tumble meetings between state leaders in recent memory. Scarcely before the gavel's ring had cleared the chambers, lawmakers were engaged in one energetic tussle after another. Hearings on University appropriations, alone, lasted some 84 hours. Apparently, this was one area in which both the Senate and House saw a chance to pare down the state's operating budget for the next 2 years. The Minnesota Agricultural Experiment Station was but one of the many sectors of the University forced to take sharp cuts in requests for additional funds over the next biennium. Station Director William F. Hueg, Jr. requested a \$2,485,000 increase for the first year and an additional \$912,000 the second year. However, the legislature granted only about one-tenth of that figure. We asked Dr. Hueg what these lower appropriations would do to the Station's research pro-

grams over the next 2 years.

EDITOR: You asked for an increase of \$2.5 million in state funds for the coming year and got only \$251,300. Naturally, you must be disappointed?

HUEG: Yes, we are disappointed. But at the same time, we are well aware that the Legislature was faced with enormous pressures to hold the line on spending. Then, too, some legislative action was favorable to our program.

EDITOR: Are you referring to the \$10 million appropriation for the first phase of the Animal Science-Veterinary Medicine building?

HUEG: Yes. This has to go down as one of the major achievements of the 1971 Legislature. The new building is vital to our research program in Animal Science. It will also provide space for resident teaching, continuing education, and service activities of the Institute of Agriculture. We are also appreciative that we will be able to complete the turkey and swine research units at the Rosemount Station with the \$567,460 earmarked by the Legislature. Other building appropriations include \$1 million for the

Forest Products Laboratory, \$188,000 for Soil Science addition and greenhouse, \$200,000 for planning the Home Economics addition, and \$578,500 for various facilities at branch stations. All these physical improvements will enhance our research capabilities.

EDITOR: But getting back to the \$2.5 million increase in research funds you asked for—and didn't get—isn't the cut-back in your original request going to curtail your plans for new programs and maybe a few established projects?

HUEG: Yes and No. First, you should realize that we actually gained \$251,300—over and above last year's appropriation. This "new money" will enable us to carry out a few new projects. But we had hoped to add several new projects and greatly strengthen our efforts in areas that are already funded. We based this increase on total program needs if we are to keep pace with the rate of adoption of technology.

EDITOR: Does this mean that the total research program will be weakened?

HUEG: No. But we are forced to make even tighter decisions on our priorities than we have in recent years. This will mean that some departments will be forced to close out certain projects or do



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"The new Animal Science-Veterinary Medicine building has to go down as one of the major achievements of the 1971 Legislature."

without supporting personnel.

EDITOR: In other words, each department will have to absorb the increased costs imposed by inflation, salary adjustments, and boosts in equipment costs, supplies, and operating expense?

HUEG: That's essentially right. And remember, too, that a considerable amount of the support we receive is either earmarked for specific research projects or progress on existing projects does not warrant termination now. We can only shift a portion of the total budget. Take the most recent appropriation, for example. Of that new \$251,300, the Legislature earmarked \$75,000 for wild rice research. We believe that we can make a solid contribution to this new and expanding field crop industry. It is also an area of research that we have had a long-standing interest in. But the point is this: the \$75,000 is fully committed to that project—and that project alone. This takes away some of the flexibility that is so essential to administering a research enterprise as ambitious as we have here in Minnesota.

EDITOR: What is the possible long-run effect of the 1971 appropriation?

HUEG: To answer that, we simply have to look at the decades of the 1930's, 1940's, and 1950's when the nation's agricultural productivity advanced at a phenomenal pace. Since 1960, however, the rate of productivity has greatly slowed down. And in the past year or two, it has disappeared. Decade by decade, farm output per unit of total input—in capital and labor—advanced 14 percent in the 30's; 13 percent in the 40's; and 24 percent in the 50's. But in the 1960's output increased only 2 percent and since 1965 productivity has actually declined. Obviously, this is not the time to cut back on agricultural research.

EDITOR: On the whole, how would you sum up the 1971 Legislative session?

HUEG: I think I've indicated partly already that it was a "rough and tough" session. But when we look at the decisions on appropriations for both the research program and the buildings, we are appreciative of the support given by the legislators and by the people of Minnesota who assure these appropriations through their interest and continuing support.



Minnesota Science is published by the University of Minnesota Agricultural Experiment Station, Institute of Agriculture, St. Paul, Minnesota 55101.

Director — W. F. Hueg, Jr.

Editorial Committee — Craig Forman, chairman; Paul Addis, Harold Dziuk, Joan Gordon, James Houck, Jean Lambert, A. J. Linck, and David McDonald

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CONTENTS

Research in a Growing Minnesota William F. Hueg, Jr.	2
Nature: Man's Ally Against the Aphid Edward B. Radcliffe and Henry W. Nance	4
Economic Dimensions of a DDT Ban Calvin Brints and Dale C. Dahl	7
New Crops for Irrigated Sandy Soils R. G. Robinson	10
Minnesota's Usury Law: Hindrance to Home Building? Mathew Shane	12
Foreign Direct Investment: What Agribusinessmen Should Know Michael E. Murphy	15

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NATURE:

Man's Ally Against the Aphid

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Green peach aphids are one of the most destructive insects attacking our nation's potato crop. In spite of intensive use of insecticides, this insect costs U.S. potato growers an estimated \$50 million annually. Losses are primarily caused by aphid-borne virus diseases. These viruses are responsible for potato stocks "running out." Other types of injury can occur if aphid populations are unusually high. Plants may be injured by the saliva that aphids inject when they feed. Heavily infested plants wilt from the loss of sap, especially when soil moisture is inadequate.

On summer host plants, such as potato, aphid populations consist only of females, which reproduce without mating. The young are born alive and under optimum conditions mature within 8 days. Green peach aphids have an almost unbelievable reproductive capacity: In our laboratory, aphids reared on 'Norland' potatoes produce an average of 97 offspring. Let us assume each aphid is capable of producing 100 nymphs. Let us also assume her daughters and granddaughters are capable of doing the same. Under these conditions, a single aphid could give rise to 1 million great-granddaughters. And most would be born within the lifetime of that original female! For-

Research workers scour an experimental plot at Grand Rapids, Minnesota, in search of aphids. Actually, the aphids were abundant, especially in fields sprayed with a broad spectrum insecticide and fungicide. In one artificially infested potato plot, aphid populations reached 50,000 per plant after weekly applications of both carbaryl and a fungicide.



Unfortunately for man, being an aphid is a highly hazardous occupation. For that matter, it is fortunate for the aphids too, since they would quickly increase to fantastic numbers and eliminate the plants they feed on.

Factors limiting green peach aphid populations are diverse. Climate, the condition of food plants, parasites, predators, and insect diseases all keep aphid populations in check. For example, at low temperatures aphids develop more slowly. Similarly, when temperatures rise above 90°F., reproduction ceases. Sharp rains may wash the insects from plants, and high humidity favors the spread of fungus diseases among the insects.

The physiological condition of the host plant is also important: Some crops are much more susceptible than others. More will be said of this later when we consider the possibility of developing aphid-resistant potato varieties.

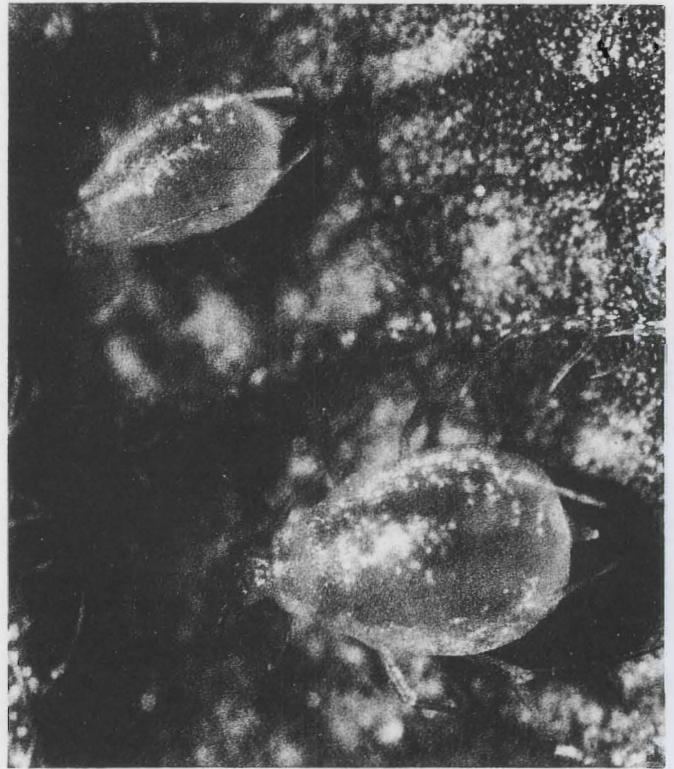
APHIDS, THEIR ENEMIES, AND CHEMICALS

Aphids are defenseless, soft-bodied insects of limited mobility. These characteristics make them vulnerable to an array of natural enemies, both predators and parasites. Generally, we fail to appreciate the importance of natural enemies, until for some reason they do not exercise their usual influence. Sometimes certain insecticide treatments alter this influence. Most insecticides recommended for potatoes have a broad spectrum of effectiveness: They not only kill the various pests, but also the natural enemies of these pests. If these chemicals are sufficiently effective, then the mortality of natural enemies is of little consequence. But if the treatment is only marginally effective, the destruction of natural enemies may result in a spectacular resurgence of pest populations.

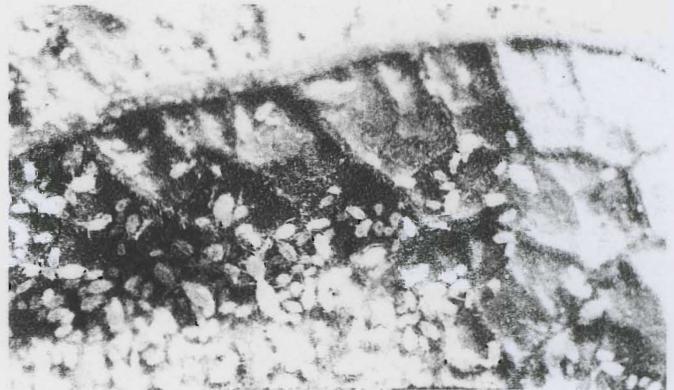
Insecticides are not the only agricultural chemicals that may favor aphids. We have found that sometimes fungicides also enhance green peach aphid populations. Aphids, like their host plants, are subject to fungus diseases, although, of course, the disease organisms are different.

Experiments conducted last summer at Grand Rapids dramatically demonstrate the principles we've described. We had one field that was not treated with any insecticide or fungicide throughout the summer. Populations of green peach aphids in this field reached maximums of 4 to 5 aphids per plant. On another plot, we applied carbaryl weekly. Carbaryl is a very useful broad spectrum insecticide, but it is quite ineffective against green peach aphids. It is well-known that carbaryl treatments favor green peach aphid populations by selectively poisoning natural enemies. Aphids in that plot reached maximum populations of 2,400 per plant. On plots sprayed with both carbaryl and a fungicide, green peach aphid populations reached maximums of 3,500; 4,300; or 5,500 per plant, depending on the fungicide used. In late August, 4 to 5 percent of the aphids in treated plots were infected with fungus diseases. Where no fungicide was applied, 22 percent of the aphids were infected.

In another field, instead of relying on natural infestation, we introduced aphids on green peach aphid-infested cabbage plants placed at 20-foot intervals in the potato rows. Aphid populations were then "sprayed up" by weekly applications of both carbaryl and a fungicide. In that field, aphid populations as great as 50,000 per plant were observed. In a nearby field, a systemic insecticide was used at planting, and foliar sprays were applied weekly from July 1. Although the treatments used are recommended



Two views of the green peach aphid: above are two aphids born at the same time. The smaller aphid at the top was raised on a partially resistant potato variety, which prevented the nymph from reaching maturity. Below, hundreds of aphids cluster on the underside of a potato leaf that was sprayed to eliminate these pests. Chemicals, however, actually led to greater aphid populations.



control measures, green peach aphids were much more abundant in the treated field than the one not treated at all!

Commercial potato production is scarcely practical without insecticides because of the many and varied pests that attack the crop. Yet it seems evident, at least in theory, that unnecessary applications and excessive rates should be avoided. Unfortunately, poor judgment on spraying can be so costly growers generally apply insecticides on a routine basis. This practice, besides being detrimental to biological control, also speeds development of insecticide resistance in pests.

(Continued on next page)

AN ALTERNATIVE APPROACH

A possible solution to this dilemma would be to develop aphid-resistant potato varieties. This approach has been used successfully against several aphid pests of other crops.

For the past 6 years, with cooperation from University horticulturists, we have made an extensive survey of wild potato species. Nearly 1,000 different wild entries have been evaluated as possible sources of green peach aphid resistance. We found certain wild potatoes have appreciable levels of aphid resistance. If this resistance can be transferred to a parental stock, development of resistant varieties should be possible.

Some critics argue that resistant varieties must possess total immunity. This is not true. It is entirely possible that varieties having partial resistance would sufficiently reduce the reproductive potential so that natural control agents would provide adequate pest suppression. We know this is true for the great majority of plant feeding, and, therefore, potentially injurious, insects.

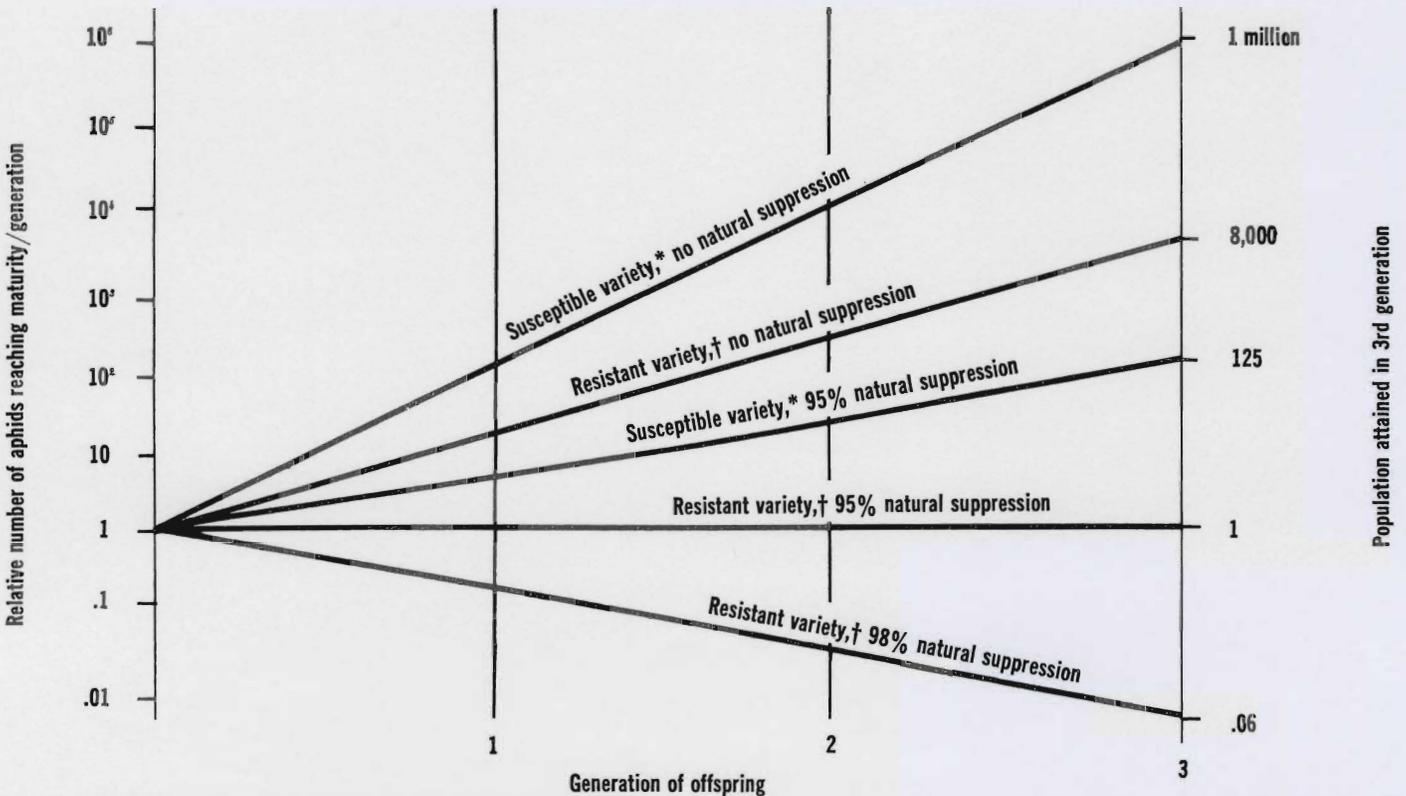
Let us assume, that by using this partially resistant variety we could reduce the reproductive capability of the green peach aphid from 100 to 20 nymphs. The potential third generation population would be not 1 million, but only 8,000. This still represents a tremendous potential for increase, but remember that natural mortality negates

95 percent or more of that potential. The addition of even partial resistance could increase the environmental pressures on aphid populations to the point where treatment might be unnecessary (see graph). Resistant varieties, unlike chemical sprays, have little adverse effect on natural control agents.

In our field trials, even the most resistant wild potatoes are infested with some aphids. In part, the explanation is that they migrate to the resistant plants from nearby susceptible plants. In the lab we find that aphids reared on some wild entries attain only 1/8 to 1/10 their normal size and produce few, if any, offspring. On a few wild entries, we have never been able to rear newly born aphids to maturity. But on the variety 'Norland,' we have yet to lose an aphid before maturity. Clearly, the levels of resistance occurring in some wild species are great. Incorporating any degree of resistance into our commercial varieties would be desirable since host plant resistance is completely compatible with the use of insecticides.

Some of the most resistant wild species are genetically compatible with the cultivated potato. Incorporating this characteristic into cultivated varieties should be possible. It will be no simple matter for the plant breeder; he must produce a potato that is both resistant and of acceptable quality in all other respects. We believe this is not only possible but an entirely reasonable expectation.

Influence of partial host plant resistance on green peach aphid populations (theoretical).



* Based on laboratory data for aphids reared on 'Norland' potatoes.

† Hypothetical resistant variety assumed to reduce reproductive potential of aphids to 20 percent that on 'Norland' potatoes.

ECONOMIC DIMENSIONS OF A DDT BAN

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Much concern has been voiced about DDT as a hazard to humans, animals, and the natural environment. DDT decomposes slowly and has a tendency to collect in the fat tissues of man and animals. These findings have resulted in heated accusations that DDT presents a direct threat to the well-being of the world population. Public reaction has led to government and private investigations of DDT's effects on man and his environment. And there are strong advocates for an outright ban on the use, production, and sale of DDT in the United States.

As economists, the question that the proposed DDT ban raises in our minds is this: What economic impact will the ban have on the chemical industry and those farmers who have relied on DDT for pest control? To find the answer, we turned to recent data on the domestic use, production, and export of DDT. These figures then provide a basis for discussing the economic effect a DDT ban would have on three agricultural sectors: manufacturers of agricultural chemicals, pesticide formulators, and farmers.

USES OF DDT

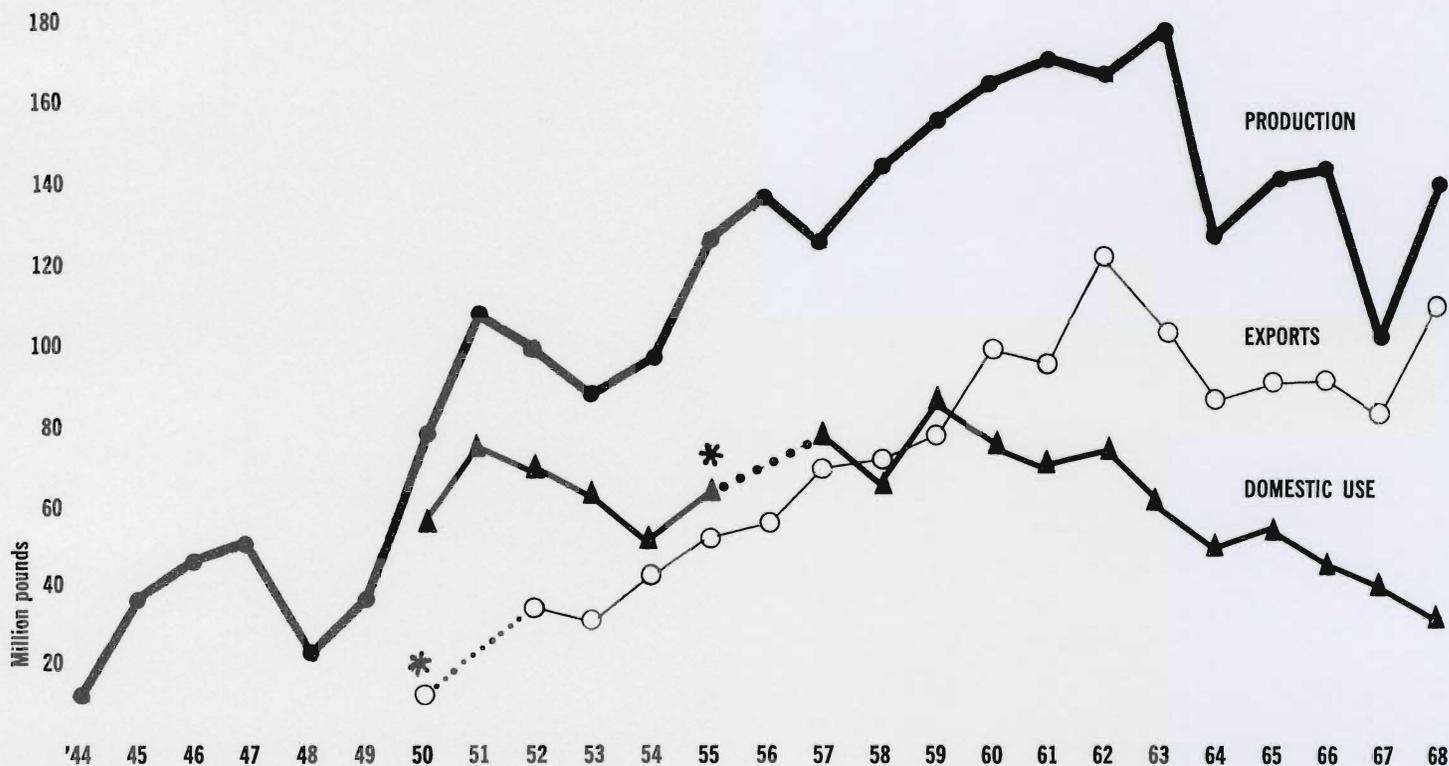
DDT is one of the most widely used chemical compounds in the world for eradicating insects. Its use has been instrumental in controlling large numbers of pests that endanger human life, animals, food and field crops, and forested areas. DDT's pest-killing properties includes a relatively long residual life. But the comparative safety of its handling makes it effective and desirable for many control purposes.

Farmers are major users of DDT in the United States. They account for over two-thirds of the nation's total use. About 95 percent of the DDT used on farms is applied as insecticide on crops. Cotton, alone, accounts for about three-fourths of the DDT used on farms.

The domestic trend is definitely away from the use of chlorinated hydrocarbon insecticides, such as DDT, TDE, dieldrin, aldrin, endrin, and heptachlor. Major reasons for this downward trend are: (1) increasing ability of insects to develop resistance or even immunity to DDT and similar compounds, (2) development of new substitutes that have lower potential for storage in fat tissues, and (3) discontinuation by the United States Department of Agriculture (USDA) of non-labeled DDT use. In fact, since 1967 the USDA has reduced its purchases of DDT for domestic uses by some 95 percent. Specific action discontinuing non-labeled use was taken in November 1969.

Since 1959 domestic use of DDT has been declining rather steadily. In 1959 domestic use was about 78.7 million pounds and by the end of 1967 this figure was down to 32.7 million pounds. Assuming the trend continues, 1970 domestic use of DDT should fall to about 20 million pounds (figures not yet available).

Figure 1. U.S. DDT domestic use, production, and export trends, 1944-1968



Source: Data table.

NOTE: "Exports" and "Domestic use" may not be added to "Production" due to inventory changes.

* Data unavailable.

PRODUCTION OF DDT

U.S. output of DDT comprises over two-thirds of world production. This output is declining, but production is still high: About 114 million pounds of DDT were produced in 1966, down from 178 million pounds (the all-time high) during 1962.

The number of U.S. companies producing DDT has also been shrinking over the past 20 years. In 1950 thirteen companies were in the industry, but by 1969 only five remained. These companies include: Allied Chemical Corporation, Diamond Alkali Company, Lebanon Chemical Corporation, Montrose Chemical Corporation, and Olin Matheson Chemical Corporation. Montrose produces more than half the world's DDT. In the latter part of 1969 and early in 1970, Allied, Lebanon, and Olin Matheson discontinued production. This left only two U.S. companies in production.

Although in recent years overall production and exports have declined, domestic use has fallen more rapidly. Despite these decreases, however, the relative safety in handling DDT, its effectiveness in controlling insects and its low cost will probably provide domestic and foreign producers a market for some time to come.

DDT EXPORTS

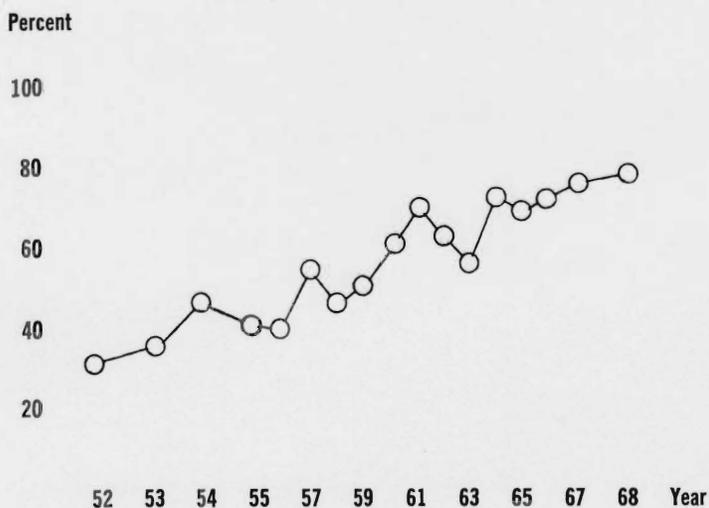
Exports now take about 80 percent of the United States' DDT production (see Figure 2). In 1967 (latest figures available), shipments to three countries—India, Pakistan,

and Brazil—accounted for more than two-thirds of the export tonnage of DDT powder. But even DDT exports are on the general decline. Although this single insecticide totaled over 80 million pounds shipped, it accounted for only about 8 percent of total U.S. pesticide exports. (The data table indicates the production-export relationship of DDT from 1958-1967.) The 80 million pounds going to foreign nations in 1967 was only about half the amount shipped in 1964.

Several factors have contributed to the decline in DDT exports. During the past decade, some former DDT importers have built their own manufacturing plants and have been able not only to supply their own needs but have become exporters themselves. Other factors contributing to the decline in U.S. DDT exports include development of insect immunity and new, more specific substitute products.

More than half of the DDT exported is in the form of wettable powder, most of which is used to control malarial mosquitoes. It is still the insecticide most used worldwide despite the trend away from such long-lived residual pesticides. Overall, however, DDT usage in the U.S. and abroad is on the downswing. Total government purchases for foreign uses, by contrast, continue to gain because of programs conducted by organizations such as the Agency for International Development. This agency's DDT purchases totaled \$12 million in 1968, and larger orders were placed during 1969 and 1970 as its foreign programs expanded.

Figure 2. Proportion of U.S. DDT production exported, 1952-1968



Source: "DDT Used in Farm Production," Agricultural Economic Report No. 131, April 1969.

DDT production, exports, and producers' domestic disappearance, United States, 1944-68

Year	Production*	Exports*	Domestic disappearance†
	1,000 pounds	1,000 pounds	1,000 pounds
1944	9,626	n.a.	n.a.
1945	33,243	n.a.	n.a.
1946	45,651	n.a.	n.a.
1947	49,600	n.a.	n.a.
1948	20,240	n.a.	n.a.
1949	37,904	n.a.	n.a.
1950	78,150	7,898	57,638
1951	106,139	n.a.	72,688
1952	99,929	32,288	70,074
1953	84,366	31,410	62,500
1954	97,198	42,329	45,117
1955	129,693	53,252	61,800
1956	137,659	57,194	n.a.
1957	124,545	64,096	71,000
1958	145,328	70,111	66,700
1959	156,741	74,987	78,682
1960	164,180	98,964	70,146
1961	171,438	94,616	64,068
1962	167,032	123,378	67,245
1963	178,913	101,955	61,165
1964	123,709	84,627	50,542
1965	140,785	90,414	52,986
1966	141,349	90,914	46,672
1967	103,411	81,828	40,257
1968	139,401	109,148	32,753

* Year ends December 31.

† Year ends September 30.

Source: *The Pesticide Review* 1969, USDA, ASC; (Production) Tariff Commission; (Exports) Bureau of the Census Report FT 410; and (Disappearance) Calculated from production, export, and producers' inventory data.

EFFECTS OF A DDT BAN

The economic effects of an outright ban on DDT would be felt by many different groups of people. Consider the DDT manufacturer, the formulator, and the farmer.

Manufacturer. The effect on the two U.S. manufacturers of DDT would probably be slight. There are two main reasons for this: (1) a large proportion of DDT production is exported, and (2) sales of substitute insecticides are almost certain to increase. In addition, a DDT ban would force no significant change in the number of either company's employees. Representatives of both producers have stated that employees in DDT plants could and would be given other company positions if the chemical is banned.

Formulator. In the chemical industry, the most severe and immediate hardship from a ban would be felt by formulators, the firms that package the product for sale. There are some 180 formulators in the U.S. They are generally small, independent firms that deal in a limited number of products. Most firms employ less than 10 people. They receive DDT in powder form; then they mix, package, and ship it to pesticide distributors who in turn sell to retail outlets.

Most of the current substitutes for DDT are liquid products. These liquid substitutes, of course, must be packaged in glass, plastic, or metal containers. Converting a processing system from powder to liquid products would require different equipment involving considerable expense to the small formulator. Processing of substitute products would also require a retraining program for employees. For these reasons, formulators would be the hardest hit in the chemical industry.

Farmer. Several problems arise in the attempt to assess the impact of a DDT ban on the farmer. First, the rate of agricultural pesticide use varies among crops and from one year to the next. Year-to-year variations reflect fluctuations in the intensity of pest infestation and weather conditions. These differences, in turn, cause large variations in the numbers and kinds of treatments, and in the resulting average annual rates of use per acre.

Despite these difficulties in citing "normal" DDT use rates, we can still get some indication of the probable effect that a DDT ban would have on the farmer over the long run. For example, consider cotton—the crop that accounts for more than three-fourths of farm DDT use. A 12-to 15-day spray schedule is recommended for most insect infestations if DDT is used. However, if an organic phosphate pesticide is used, a 4- to 6-day spray schedule is advised. This, of course, not only increases spraying costs because more applications are needed, but also because DDT substitutes cost more. The increase in cost for insect control on cotton is estimated to be about \$2.20 per acre treated.

Examples such as this, coupled with the absence of any evidence to the contrary, seem to support the conclusion that an outright ban on DDT would increase production costs for the American farmer. Formulators would also suffer from a ban because their processing setup is specialized and difficult to adapt inexpensively and rapidly to substitute products.

Finally, we can say that neither of the DDT producers will suffer severe economic hardship due to a U.S. DDT ban. In fact, the pesticide producers would probably do a much larger volume of business because of the increased demand for higher-priced, shorter-lived substitutes for DDT.

NEW CROPS for Irrigated Sandy Soils

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Farmers on irrigated soils want new crops! Crops that provide more than \$100 per acre gross income. Crops that require minimum labor. Crops that can be easily and safely stored. Crops that have ready markets.

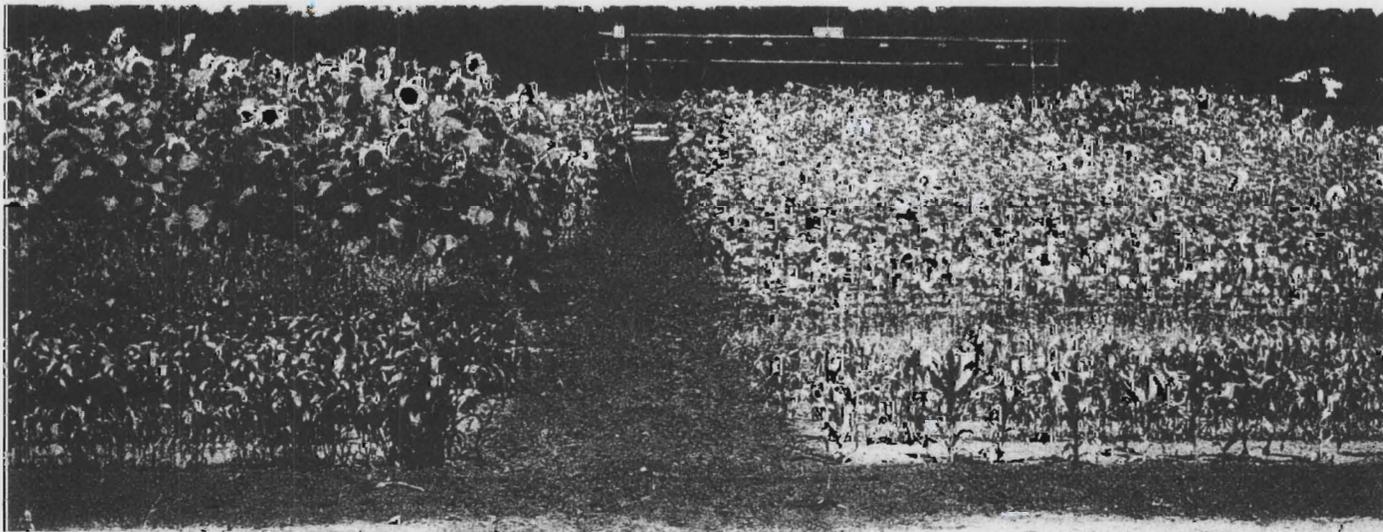
Corn and, sometimes, soybeans meet these requirements. But most of the other crops on Minnesota's irrigated acres are perishables such as potatoes, vegetables, and small fruits. These perishable crops are often profitable, but they may require much labor, specialized equipment, expensive storage, and troublesome marketing procedures. Because of these problems, many farmers grow only corn on their irrigated lands. These farmers need other crops for rotation and to spread the risks of crop production.

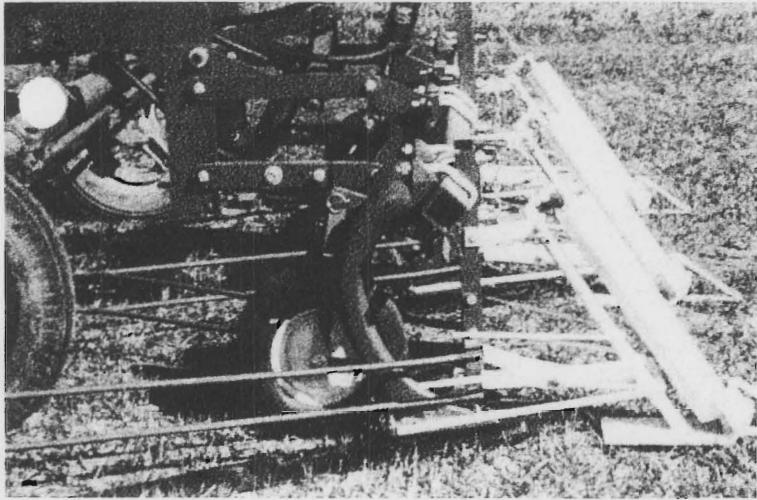
Several new field crops are being tested at the Sand Plain Experimental Field near Elk River. Three of these crops not presently grown under irrigation in Minnesota are sunflower, pinto beans, and grain sorghum. Like corn, they are grown in cultivated rows and harvested by combining. All three crops and corn were grown under four different environments—all replicated three times. One group of each crop was left untreated, the second group was irrigated, the third received only fertilizer, and the fourth was both irrigated and fertilized. Response of the crops to these four treatments is shown in the table.

EXPERIMENTAL DETAILS

The irrigation and fertilizer treatments provided enough water and fertilizer so that lack of these factors was not likely to limit yields. Water was applied through a portable applicator designed by Experiment Station agricultural engineers. Soil tests showed that phosphorous was very high on all plots, and that potassium was very high on fertilized plots and medium to high on unferti-

Irrigation, alone, did not significantly increase yields of any crops in research plots at the Sand Plain Experimental Field near Elk River. However, the combination of irrigation and fertilizer greatly boosted yields (see table on page 11). The sunflower plot on the left received both irrigation and fertilizer while the plot on the right was only irrigated.





Pinto beans are harvested with a front-mounted puller. Blades that run below the soil surface uproot vines and a series of rods guides vines into windrows. Vines are later raked into larger windrows to dry.

lized plots. These sandy soils are low in nitrogen. All fertilized plots were sidedressed with 100 pounds of nitrogen per acre after planting and again 3 to 7 weeks later.

Rows were 30 inches apart for sunflower, sorghum, and corn, and 24 inches apart for beans. Plant populations per acre were 22,000 for unirrigated and 27,000 for irrigated sunflower; 12,000 for untreated, 15,000 for fertilized, and 22,000 for irrigated corn; and 90,000 for sorghum. Beans were planted at 80 pounds per acre. Planting dates for sunflower were May 2, 1969 and May 4, 1970; May 26 both years for beans and sorghum; and May 26, 1969 and May 4, 1970 for corn.

The results reported here are average yields of Arrowhead, Mingren, Peredovik, and P-21 ms x HA60 sunflower, U.I. 114 pinto beans, Minnesota 1 hybrid grain sorghum, and Minhybrids 519 and 6301 corn.

BOTH IRRIGATION AND FERTILIZER NEEDED

Irrigation without fertilizer did not significantly increase yields of any crop. In fact, it reduced the yield of grain sorghum, and delayed flowering and maturity of all crops. Fertilizer without irrigation brought higher sunflower yields, but it did not significantly affect yields of other crops.

The combination of irrigation and fertilizer resulted in very high yields. These yields greatly exceed the 1969-70 Minnesota state average pounds per acre yields of 914 for

Comparative yields in pounds per acre from untreated, irrigated, fertilized, and irrigated + fertilized plots of sunflower, pinto beans, grain sorghum, and corn at Elk River, 1969-70

Crop	Untreated	Irrigated*	Fertilized	Irrigated + fertilized
Sunflower	506	683	872§	2397§
Pinto beans	503	680	483	2576§
Grain sorghum††	1434	757§	1243	5611§
Corn††	1405†	1960	1565†	7294†§

* 1969. Adjusted to be comparable with 1969-70 data.

† 1970. Adjusted to be comparable with 1969-70 data.

†† Yields on a 15 percent moisture basis.

§ Yields significantly lower or higher than untreated.

sunflower, 1,150 for pinto beans, and 4,760 for corn. Thus, irrigation and fertilizer together made the relatively cheap, sandy soil highly productive.

SUNFLOWER

Sunflower in both shell and dehulled forms is Minnesota's leading "nut" crop for human food and birdfeed. Other varieties are used for industrial and food oils. Marketing contracts are usually available before planting, and current contract prices have been running from 4.5 to 6 cents per pound.

The sunflower is well adapted to irrigated sandy soils. The crop can be planted before May 15 and usually matures before corn. Sunflower's greatest need for irrigation occurs during the month after heading. This critical month starts in early July in southern Minnesota and after mid-July in northern Minnesota.

PINTO BEANS

Pinto beans are a high protein food crop harvested as a mature dry bean, but they are sold by food stores in either dry or canned form. The crop is usually planted during the last week in May, and harvest begins about September 1. By that time most pods are yellow, but a few leaves and immature pods remain. Immature pods are green and they develop a red striping as they mature. Beans are harvested with blades resembling long plowshares that are pulled below the soil surface. The uprooted bean vines are guided into windrows by steel rods on the harvester. Then, vines are raked into larger windrows. Drying in the windrow usually takes a week provided there is no rain. Drying time is the most hazardous week in bean production. Sandy soil has a distinct advantage over silt and clay soils because it dries faster after rain and permits earlier combining.

A potential hazard from frequent irrigation may be spread of bacterial blight if infection is present.

Marketing contracts are usually available before planting. The price often ranges from 5 to 6 cents per pound or a guarantee of market price only.

GRAIN SORGHUM

Grain sorghum is a feed grain with a feeding value about 95 percent that of corn. Sorghum should be planted between May 25 and June 5 in the southern half of Minnesota. It is not adapted to northern Minnesota because cool weather after mid-August causes flower sterility and low yields. Comparative yields of sorghum and corn do not encourage production of grain sorghum. However, if disease or insect control requires crop rotation rather than continuous corn production, then grain sorghum can be planted after corn without risk of injury from herbicide residues. Also, sorghum does not have a critical period such as the silking stage of corn when a short drought can drastically lower yields. This is a decided advantage when irrigation water supply is uncertain or limited.

SUMMARY

Sunflower, pinto beans, and grain sorghum are potential new crops for some of Minnesota's irrigated farms. Sunflower and pinto beans are more risky than corn or soybeans, especially in southern Minnesota. Sorghum is less profitable than corn. All are possible rotation crops. Prices vary from year to year, so relative price will be an important factor in choosing among these and other crops.

MINNESOTA'S USURY LAW

Hindrance to Home Building?

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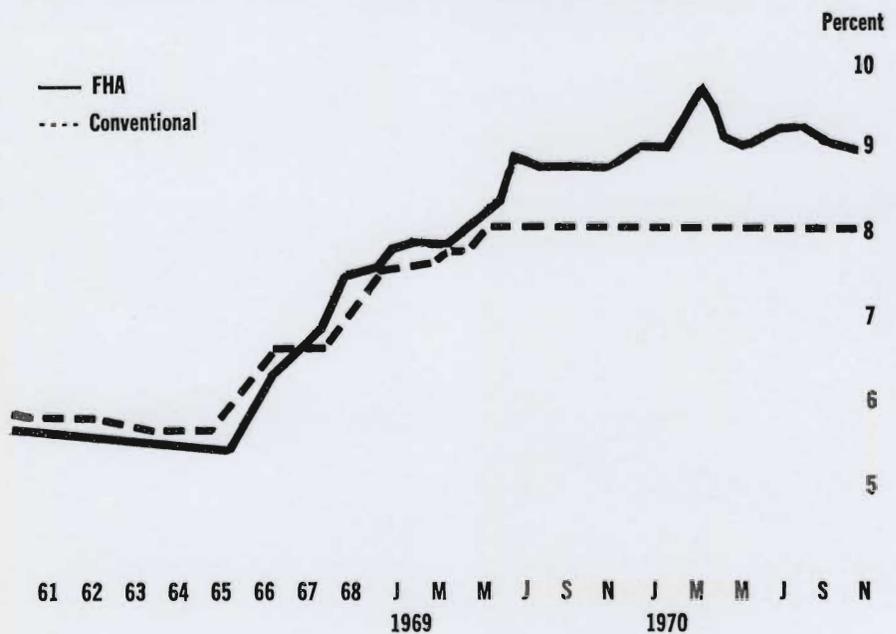
Minnesota's usury law sets maximum allowable interest rates. When the law was originally enacted in 1877, it allowed lenders to charge a maximum of \$12 annual interest per \$100 loaned. In 1923, that limit was reduced to \$8 per \$100 per year. However, as the usury law stands today, the \$8 limit is binding only on consumer and farm mortgage loans. All other classes of loans have either been exempted from the usury law or have higher limits. Bank installment and credit union loans, for instance, have a maximum limit of about 12 percent, while small loan companies may charge anywhere from 15 to 33 percent interest, depending on the amount of the loan.

As the law developed historically, it was intended as a protection for consumers and farmers against the payment of "unreasonably" high interest rates. However, as we shall see, despite its good intentions, the actual effect of the law has been to reduce the number of housing starts in Minnesota in the last 2 years. Thus, it has neither protected the consumer and farmer nor permitted a rational allocation of the resources of Minnesota.

RESTRICTION OF INTEREST RATES

Interest rates are the price people pay for borrowing money, and prices are a means of rationing goods in a market economy. When the price mechanism is working right, supplies of goods—whether it's homes, cars, clothes or money—are equal to the demands for them. However, when a ceiling is imposed on a price, such as by a usury law, supply will no longer equal demand and shortages will develop. Thus, since the state usury law imposes a restriction on interest rate movements, it can be interpreted

Conventional and FHA effective interest yields, Twin Cities lenders, 1961-70.



as the belief that some distortion in the money markets not found in most other markets is being corrected. Implicitly, it singles out bankers as if they were somehow different from other businessmen and suggests that they would charge exorbitantly high interest rates unrelated to the cost of loans if the law didn't prevent them from doing so. It further assumes either that restrictions of interest rate movements will not restrict the flow of credit or that it is sometimes desirable to restrict the flow of credit.

Since the usury law dictates the maximum allowable interest rate, it is only when that limit is exceeded that the credit markets are affected. As can be seen in the chart of conventional and FHA mortgage rates, the Minnesota mortgage rate never reached nor surpassed the eight percent limit prior to 1969. The obvious question arises: Why didn't bankers charge the maximum allowable rate throughout the period? One answer is that banks can only partially control the rates they charge on loans and pay on deposits. Since banks are only one of several different types of financial institutions, they must charge a rate that is competitive with rates available in other credit markets. Otherwise they risk losing their customers.

NATIONAL MONETARY POLICY

A comparison of yields from FHA mortgages and national corporate bonds over a 9-year span strongly suggests a close association between these two very different yields. (See Table 1) In the 1960's, the yields from corporate bonds and mortgage loans moved in the same direction. The difference in the average annual rate of yield was slightly less than 1/2 percent (.49). However, this differential narrowed from an average of .55 in the first 6 years to .38 in the remaining 3 years. This narrowing reflects the fact that Minnesota mortgage lenders, given the potential public reaction to very high interest rates, responded more slowly to money market conditions than the unrestrained corporate bond market. However, the point worth noting is that during the 1960's the range of the differential between bond rates and Twin Cities mortgage rates was only one-quarter of one percent. This strongly suggests that the competitive Minnesota mortgage rate is determined by factors not controlled by Minnesota mortgage lenders. Instead, it is national money market conditions together with national monetary policy that determine the national interest rates. It is in response to these national interest rates and money market conditions that Minnesota mortgage rates are set.

As the graph of conventional versus FHA effective interest rates shows, the competitive yield for FHA mortgages rose above the usury limit of eight percent in June 1969. Since this limit is only binding on conventional and farm mortgages, we should be able to observe its impact on the housing market.

ANNUAL HOUSING STARTS

During the decade of the 60's two distinct trends emerged in the home and apartment building market. First, the total number of housing starts rose from 13,077 at the beginning of the decade to a high of 27,503 starts during 1968. However, with the advent of increasingly higher interest rates in 1969, the number of starts declined to 26,273. The following year, the total number of housing starts fell even more sharply to 21,049 as FHA interest



During the 1960's apartment construction took a dramatic upswing, while one- and two-family housing starts declined sharply as interest rates rose above nine percent at the end of 1969. The state usury law is the single most important factor in explaining the relative shift from private to apartment house construction, according to the author.

rates rose above nine percent before falling at the end of 1970. (See graph).

The second trend in housing starts during the decade was the increasing proportion of apartment houses to private one- and two-family residences. In 1961, apartment housing starts made up only about 44 percent of total housing starts. However, by 1969 apartment housing starts comprised over 66 percent of all housing starts in Minnesota.

Comparing 1969 (when the usury law initially became binding on mortgage credit) to 1968, the number of new housing units declined by approximately 4 1/2 percent. This decline is entirely explained by the 27 percent decline

Table 1. Interest rates on new Twin Cities mortgage loans and corporate bonds, yearly averages and differentials, 1961-69

Year	Twin Cities FHA mortgage yield*	Corporate bond yield†	Differential
1961	5.58	5.08	.50
1962	5.58	5.02	.56
1963	5.47	4.86	.61
1964	5.42	4.83	.59
1965	5.36	4.87	.49
1966	6.23	5.67	.56
1967	6.58	6.23	.35
1968	7.35	6.94	.41
1969	8.19	7.81	.38

* Quoted in "House and Home"; adjusted by the average points charged. The FHA rate, which is not restricted by the usury law, was used in computing yield.

† From *The Economic Report of the President*, February 1970, pp. 242-3.

in one- and two-family homes. The number of new apartment building starts, whose financing is not subject to the usury law, increased over 9 percent. Throughout the latter part of 1969 and into 1970, when the return from commercial loans was consistently above the usury limit, the available long-term funds went mainly to commercial enterprises. Only small amounts of mortgage money were left to finance new private residences. Note from table 3 that during the first 6 months of 1969 (before the usury law was binding) the decline in private housing starts was only about 7½ percent. But during the second half of 1969 and all of 1970 the decline was over 33 percent.

This decline indicates that far from protecting the consumer, the Minnesota usury law has resulted in severely reduced funds for private home buyers, while expanding those available to other users of credit. Since the usury limit has had a binding effect only on home mortgage borrowers and since home buyers, unlike corporate and business borrowers, cannot move to other forms of finance, the usury limit has prevented home mortgage borrowers from competing effectively for funds. This factor led to the drastic reduction in private housing starts during the latter part of 1969 and throughout 1970.

FUNDS AVAILABLE TO MORTGAGE LENDERS

We have seen that the discriminatory effect of the usury law is the single most important factor in explaining the relative shift from private to apartment housing starts. However, the total level of mortgage lending is largely

Table 2. Total number of housing starts, number of one-and two-family housing starts, and percentage of private to commercial housing starts in Minnesota, 1961, 1965, 1968, 1969, and 1970

Year	Total housing starts*	One- and two-family housing starts*	Percentage
1961	13,077	7,323	55.98
1965	18,485	9,001	48.69
1968	27,503	11,182	41.74
1969	26,273	8,790	33.45
1970	21,049	7,432†	35.61†

* From *Building Permits, Annual Summary*, The Federal Reserve Bank of Minneapolis.

† Estimated by projecting the January-November 1970 figure for the entire year.

Table 3. Number of and change in percentage of one- and two-family housing starts in Minnesota, quarterly, 1968-70

Quarter	1968*	1969*	1970*	Change in percentage	
				1968 to 1969	1968 to 1970
I	1,897	1,689	1,008	-10.07	-46.87
II	3,216	3,045	2,232	- 5.29	-30.68
I+II	5,113	4,734	3,240	- 7.41	-36.63
III	2,873	2,248	2,588	-21.73	- 9.89
IV	3,196	1,808	1,604†	-43.43	-49.81
III+IV	6,069	4,056	4,192	-33.17	-30.93
Total	11,182	8,790	7,432	-21.38	-33.52

* From Ninth Federal Reserve District Building Permits, monthly release.

† Based on October and November figures only, projected for the full quarter.

determined by the supply of savings deposits and other savings funds available to mortgage lenders. Since the usury limit does not directly affect the ability of mortgage lenders to obtain savings funds, the law would have little impact on the total level of mortgage loans made. But there are other restrictions, usually referred to as regulation Q, that regulate the interest rates that banks can pay on savings accounts.

Different types of savings accounts have different restrictions. Most ordinary accounts are limited to interest payments of 5-5½ percent per year. Yet with interest rates on the national bond markets rising continually from 5.67 percent in 1966 to over nine percent in 1970, a great incentive was provided for individuals to withdraw their savings from banks and buy bonds instead. Such a movement of funds has been especially evident since the middle of 1969, when savings invested in bonds rather than bank accounts could earn up to an 80 percent higher return.

Table 4 indicates how recent trends in savings have affected Minnesota mortgage lending. Although the dollar volume of new loans increased over 13 percent in the first half of 1969, it fell almost 13 percent from the second half of the year through the first 6 months of 1970. This is consistent with the trends observed in new housing starts over the same period. The fact that there was an increase in new mortgage loans in the second half of 1970 implies that housing starts can be expected to increase during the first half of 1971. Recent reductions in the prime interest rates also seem to indicate this.*

CONCLUSION

What can we conclude about the usefulness of the Minnesota usury law in protecting the consumer from paying "unreasonable" interest rates? During most of the previous decade, the usury limit was not binding and so it had no effect at all. But during the period when the competitive mortgage rates were greater than the 8 percent limit, there was a noticeable reduction in funds available to home buyers—which implies a corresponding drop in the number of private housing starts and home purchases. Since the state usury law appears neither to protect the interests of the home buyer nor to permit the resources of Minnesota from being allocated on a sound, sensible basis, it should be modified or repealed.

*Early results from 1971 support this claim. Housing starts in Minnesota in the early months of 1971 increased substantially from their 1970 levels.

Table 4. New mortgage loans of savings and loans associations, Minnesota, quarterly, 1968-70*

Quarter	1968	1969	1970	Change in percentage	
				1968 to 1969	1968 to 1970
— millions of dollars —					
I	58.1	64.9	44.3	+11.70	-23.75
II	102.9	117.3	96.2	+13.99	- 6.52
I+II	161.0	182.2	140.5	+13.17	-12.73
III	98.2	98.4	119.9	+ 0.20	+22.09
IV	110.7	83.5	110.3	-24.57	- .55
III+IV	208.9	181.9	230.2	-12.93	+10.20
Total	369.9	364.1	370.7	- 1.57	+ 2.16

* Source: The Federal Home Loan Bank of Des Moines, Iowa.

FOREIGN DIRECT INVESTMENT

What Agribusinessmen Should Know

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On January 1, 1968, The Office of Foreign Direct Investment (OFDI) was created within the U.S. Department of Commerce by President Lyndon Johnson. The OFDI was directed to issue regulations designed to limit the flow of American capital to foreign countries. The effect that Foreign Direct Investment Regulations can have on Upper Midwest agribusinessmen is hardly remote. Statistics indicate that over half of America's export dollars are earned here in the Midwest. Records of the Minnesota Department of Economic Development show that over 100 state agribusiness firms are presently exporting goods to foreign countries and the number is growing.

Large numbers of American businesses have become direct investors in foreign countries without knowing it. For this reason you should know in a general way what a direct investor is and what requirements a direct investor must meet under the regulations. Information provided here, however, is only a summary of some of the basic regulations. Full details of what a direct

investor may or may not do can be found in a copy of the regulations and in the OFDI's General Bulletin.

DEFINITION OF TERMS

Foreign Direct Investment Regulations begin with a general prohibition against "positive direct investment by a direct investor (DI) in affiliated foreign nations (AFN) in Schedule A, B, and C countries . . . during any year. "The terms "direct investment," "direct investor," and "affiliated foreign national" are defined, and foreign countries included in Schedules A, B, and C are listed.

The term "direct investment" is broadly defined. It includes the *net* transfer of capital ("positive" and "negative") made by a direct investor during the year to all "affiliated foreign nationals" (AFN), incorporated or unincorporated, plus the direct investor's share in the reinvested earnings of the AFN.

A direct investor is defined as any U.S. citizen (incorporated or unincorporated) who has at least a 10 percent interest in an AFN. An AFN is any corporation, partnership, or business venture in which a U.S. citizen has a 10 percent interest and which is organized under the laws of or conducted within a foreign country.

"Schedule A" countries are the less developed countries of the world, exclusive of the Communist bloc countries. Among the "Schedule B" countries are England, Japan, and the Middle East oil nations. "Schedule C" is basically Western Europe. Restrictions placed on investments in Schedule C countries are the most severe, while restrictions placed on Schedule A countries are the least severe.

It is easy enough for an American businessman to determine whether or not he has an AFN in the form of a branch or subsidiary. It may also be easy for him to determine whether he has created an AFN by entering into a joint venture in corporate or partnership form. The question is more difficult, however, where an American businessman is selling abroad through a sales agent or several agents.

A foreign "business venture" encompasses those business activities engaged in by the firm itself, an employee or partner of the firm, or by employees or partners of the firm's AFN. The General Bulletin provides that the term "employee" is not necessarily to be understood as synonymous with the meaning of that term for federal tax purposes. The Bulletin goes on to say that:

An agent working substantially full time for a U.S. principal and having a stock of goods from which orders are filled or having authority to accept orders or otherwise execute contracts on behalf of his principal may be considered an employee (for FDIR purposes).

If, for example, the U.S. business sells its products in Latin America, Japan, or Europe through agents who have authority to conclude contracts for the firm and if the firm maintains an inventory, a warehouse, or even display facilities in the foreign country, the business may well be considered to have AFN's in those parts of the world. This assumes, of course, that the U.S. investor is entitled to 10 percent or more of the business venture's profits.

On the other hand, a firm can be a direct investor

and still not be affected by requirements of the regulations.

WHO SHOULD REPORT?

The first concern of an American firm whose business is expanding abroad is whether and under what circumstances it must file reports with the Office of Foreign Direct Investment. As soon as the firm's investments abroad total \$100,000 or its annual earnings abroad reach \$50,000, the firm is required to file both a Base Period and Annual Report. Prior to January 1, 1971, cumulative quarterly reports were required only of firms whose direct investments exceeded \$1 million during the year. The quarterly report figure has now been hiked to \$2 million.

The amount of investments that a firm may make in Canada each year is unlimited. However, the firm must still submit reports to the OFDI.

HOW MUCH INVESTMENT?

The next question that concerns the direct investor is, "How much foreign direct investment is his firm allowed?" The direct investor may choose among several different "allowables" by which his company will be governed in any given year. If the firm elects to be governed by the "historical allowable," its investments are limited to specified percentages of its average annual direct investment in the years 1965 and 1966. The percentage varies according to the schedule of foreign nations: 110 percent in Schedule A, 65 percent in Schedule B, and 35 percent (or more under certain circumstances) in Schedule C countries.

Under an alternative plan, the firm may choose the "earnings allowable" method, which permits direct investment in each of the geographic scheduled countries up to 40 percent of its AFN's earnings for the preceding year.

For the firm that neither did business abroad in 1965 and 1966 nor had foreign earnings in 1970, there are the "minimum allowable" or the "alternative minimum and Schedule A supplemental allowables." Prior to January 1, 1971, the former placed a \$1 million worldwide limit on the firm's direct investments in the year it elected an allowable plan. (The figure is now \$2 million.) Supplemental allowables, added in 1970, permit the firm to invest an additional \$4 million above the minimum allowable, provided the entire \$4 million

is invested in a Schedule A country or countries.

In addition to the allowables already mentioned, it is possible for a firm to increase its direct investment to the extent of its "incremental earnings." This plan was also added in 1970.

LONG-TERM FOREIGN BORROWING

There are ways to get around the specified foreign investment limitations. The principal means provided in the regulations is the long-term foreign borrowing (LTFB). In general, a firm may deduct amounts received from foreign sources on debt obligations that mature at least 12 months from the original date these obligations were incurred. As the firm reduces its indebtedness in subsequent years, it must recognize such reductions annually as a direct investment to the extent that the proceeds of the obligations resulted in capital transfers to an AFN. Regulations require that special records be kept of long-term foreign borrowing.

Besides limiting the amount of capital that a firm may invest annually in an AFN, regulations also place a monthly \$100,000 (or alternatively a specified "historical") ceiling on "liquid foreign balances" held by a firm. (The monthly figure for 1970 was only \$25,000.) Regulations state circumstances under which another person's foreign balance will be deemed "held" by a direct investor. The direct investor or his firm need not be concerned with liquid foreign balances in Canada, unless the balances there represent transfers from other foreign nations to avoid the effect of the regulations.

LESS RESTRICTION?

Federal Direct Investment Regulations have been revised several times since they were introduced in 1968. If a trend can establish itself over a 3-year period, it would seem that the regulations are becoming less rather than more restrictive. Whether or not the agribusinessman in Minnesota is presently affected by these regulations, it could be important for him to at least be aware of them. The day may not be far off when they will affect many more Minnesota agribusinessmen, either because (perish the thought) foreign investment restrictions will be tightened or because (relish the thought) the Minnesota agribusinessman's share in international trade will continue to grow.

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