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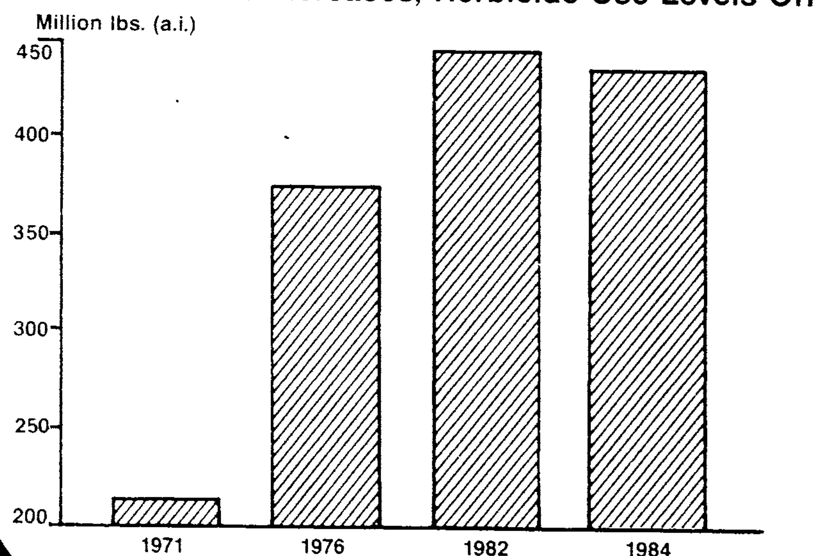
After Dramatic Increases, Herbicide Use Levels Off



Herbicides applied to major field crops

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This issue of the *Inputs Outlook and Situation* should have reached you much faster than past issues. We have accelerated our production process to speed delivery of timely data and analysis to you.

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SUMMARY

Farm pesticide use in 1985 could range from 500 to 545 million pounds active ingredient (a.i.), compared with around 507 million in 1984. Acreage planted to major field crops next year may be about the same or up slightly from 1984, depending on markets, weather, and farmers' participation in commodity programs.

The domestic pesticide supply, excluding imports, is expected to be down 1 percent in 1985, but supplies will be adequate. Manufacturers are projected to raise production 9 percent after reducing inventory carryover by 18 percent. Pesticide exports are forecast to increase 6 percent in 1985, assuming a relatively strong U.S. dollar.

Going into the 1985 planting season, manufacturers' list prices are likely to remain unchanged for herbicides, while declining 3 percent for insecticides and 1 percent for fungicides. However, prices for individual products could vary significantly at the farm level.

In 1982, farmers spent $4.3 billion for pesticides according to the Census of Agriculture. California producers spent $470 million, 11 percent of the total. Other leading States included Illinois with $345 million, Iowa $330 million, Minnesota $225 million, and Texas $210 million. Herbicide use in the major field crop producing regions (excluding California) rose 22 percent between 1976 and 1982. Herbicide tank-mixes, which have become more important in farm weed control programs, accounted for 55 percent of the 450 million pounds (a.i.) applied in 1982.

Several corn and soybean pesticides currently are under review by the Environmental Protection Agency. Other pesticides will enter the same process. Removal of major pesticides from the market could cause average corn and soybean yields to decline substantially. In the extreme case, for example, removing all soil insecticides could reduce the average corn yield 9 percent. Withdrawing all seed treatments could lower average corn yields about 5 percent and soybean yields about 2 percent.

Removal of all herbicides could lead to yield reductions of about 21 percent for corn and 33 percent for soybeans, and could affect crop prices. Also, cultivation would have to increase. Withdrawing individual insecticides, fungicides, or nematicides, assuming biologically effective and cost-efficient alternatives are available, generally would result in only minor yield losses.

With farm financial conditions not expected to improve next year, and with capital costs forecast to remain constant or rise, farm machinery purchases are expected to show little change from the depressed 1984 forecast of $7.4 billion.

After rebounding strongly in 1983/84, fertilizer use is expected to be up about 2 percent in 1984/85, reflecting a slight increase in crop acreage. Overall spring 1985 fertilizer prices will reflect a stable fertilizer supply-demand situation with only slight increases projected.

Farm energy use in 1984 is forecast to climb 7 percent from last year, as most of the PIK-diverted acreage was returned to production. Farm prices for gasoline, diesel, and LP gas are projected to be mostly unchanged in 1985. Total U.S. petroleum demand apparently will increase for the first time since 1978.

PESTICIDES

Demand

U.S. farm demand for pesticides in 1985 is expected to equal 1984 use with field crop acreage similar to 1984 levels or up slightly. Actual 1985 crop acreage will be largely determined by market and weather developments and farmers' participation in commodity programs which will not be known until after the signup period ends on March 1, 1985. For participants, the wheat program calls for a 20-percent acreage reduction and a 10-percent land diversion; for feed grains, a 10-percent voluntary acreage reduction; for upland cotton, a 20-percent voluntary acreage reduction and a 10-percent paid land diversion; and for rice, a 20-percent voluntary acreage reduction and a 15-percent paid land diversion.

Total pesticide use on major field crops in 1985 could range from 500 to 545 million pounds active ingredient (a.i.), compared with 507 million estimated for 1984 (table 1). Herbicide use will account for about 85 percent of total pesticide use, and corn and soybeans will account for 80-85 percent of all herbicide use. Corn and cotton are expected to use about 70 percent of the insecticides, and peanuts will account for 75 percent of all field crop fungicide use.

Pesticide use is directly affected by the crop acreage planted and climatic conditions during the growing season. Weed seeds are present in every acre of U.S. cropland and if weeds are not controlled, severe crop losses could occur. For example, in 1982, 93 percent or more of the acreage planted to corn, soybeans, cotton, peanuts, and rice was treated with herbicides. Farmers treated 71 percent of the tobacco acreage, 59 percent of the grain sorghum acreage, and 40 to 45 percent of the wheat, barley, and oat acreage with herbicides. Over the past decade, farmers have treated 35 to 40 percent of the corn acreage with insecticides, primarily to the soil for control of corn rootworm larvae. The extent of foliar insecticide use is heavily dependent on the size of overwintering insect populations and how climatic conditions during the growing season affect insect reproduction. In 1982, insecticide use ranged from a low of 1-3 percent of the wheat, barley, and oat acreage treated to a high of 85 percent of the tobacco acreage.

Disease is generally not a significant problem in the production of most field crops because disease resistance is bred into new varieties. An exception is peanuts, where 80 to 90 percent of the acreage is treated with fungicides.

Supplies

Pesticide supplies available for domestic use in 1985 are projected to be down 1 percent

Table 1—Estimated pesticide demand for U.S. field crop farmers

Crop	1984 planted acreage	Projected 1985 use: Herbicides	Insecticides	Fungicides
	Million	Million pounds (active ingredients)		
Row:				
Corn	79.8	238 - 256	29.4 - 31.7	.07
Cotton	11.0	16 - 17	15.3 - 16.8	.16
Grain sorghum	16.2	14 - 16	2.3 - 2.6	0.00
Peanuts	1.6	4 - 5	.9 - 1.0	5.50
Soybeans	68.2	119 - 130	10.4 - 11.4	.07
Tobacco	.8	1 - 2	2.8 - 3.3	.35
Total	177.6	392 - 426	61.1 - 66.8	6.15
Small grains:				
Barley and oats	24.2	6 - 7	.1 - .2	0.00
Rice	2.9	14 - 16	.5 - .6	.07
Wheat	79.5	17 - 19	2.4 - 2.6	.93
Total	106.6	37 - 42	3.0 - 3.4	1.00
Total	284.2	429 - 468	64.1 - 70.2	7.15

from 1984 (table 2). Production is expected to up 9 percent, but the inventory carryover o the 1985 season is expected to be down 18 percent from a year earlier. Exports are projected to be up 6 percent in 1985, but will be strongly influenced by the strength of the dollar.

Herbicide supplies are forecast to be down 4 percent in 1985, at 680 million pounds (a.i.). Supplies will be adequate to meet major field crop use, which is projected to range from 430 to 470 million pounds (a.i.). Insecticide supplies are projected to be up 11 percent, and fungicide supplies up 4 percent.

During the 1984 crop season, manufacturers substantially reduced their inventories by amounts ranging from 16 percent for herbicides to 43 percent for fungicides. As a result, manufacturers expect to increase production for the 1985 crop season, with herbicides up 5 percent, insecticides 17 percent, and fungicides 27 percent.

This increased output will raise overall plant capacity utilization rates to 70 percent for the 1985 production year (table 3). This follows rates in the 50-percent range in 1983 and 1984. The PIK program announced in January 1983 caught pesticide manufacturers by surprise. Their production plans were made several months earlier, and even though they reduced output during the remainder of the year, inventories built to high levels going into the 1984 crop season.

Herbicide producers are expected to operate at 74 percent of capacity in 1985, a substantial increase over 1984. Insecticide producers plan to operate at 59-percent capacity, compared with 30-35 percent in 1983 and 1984. Operating capacity for fungicide producers is expected to be down slightly, but still similar to 1980-83 levels.

After 2 years without plant expansion, herbicide manufacturers are projecting a 1-percent increase in capacity for 1985 (table 4). Several new herbicides have been introduced in recent years and more are on the horizon. Insecticide plant expansion continues

Table 2--Pesticide production, inventories, exports, and domestic supply

Item	Quantity (active ingredients) 1/ 1984	Pro- jected 1985	Projected change, 1984-1985
	Million pounds		Percent
Herbicides:			
Production	560	586	5
Inventory carryover	268	226	-16
Exports	122	132	8
Domestic supply	706	680	- 4
Insecticides:			
Production	172	202	17
Inventory carryover	63	52	-17
Exports	69	70	1
Domestic supply	166	184	11
Fungicides:			
Production	52	66	27
Inventory carryover	21	12	-43
Exports	27	30	11
Domestic supply	46	48	4
All pesticides:			
Production	784	854	9
Inventory carryover	352	290	-18
Exports	218	232	6
Domestic supply	918	912	- 1

1/ Production for surveyed producers only. These ms produce a major portion of all U.S. farm ticides.

Source: USDA survey of basic pesticide producers, October 1984.

Table 3--Pesticide facility utilization rates

Year	Production as a proportion of capacity: Herbi- cides	Insecti- cides	Fungi- cides	All pesticides
	Percent			
1975	92	74	93	84
1976	91	85	82	86
1977	85	76	77	80
1978	81	87	83	83
1979	74	85	84	80
1980	77	79	84	78
1981	74	72	68	73
1982	84	68	70	80
1983	66	33	71	54
1984	54	35	76	47
1985 1/	74	59	68	70

1/ Projected.

Source: USDA annual survey of basic pesticide producers.

to follow its up-and-down pattern of recent years, while no plant expansion is projected for fungicide production.

Expenditures and Prices

Farm-level pesticide expenditures were estimated at $4.3 billion in 1982, based on data from the Census of Agriculture (table 5). Data reported by farmers are for all pesticides used on crops and in orchards, and cannot be broken out by categories such as herbicides, insecticides, and fungicides. Not included in the total are pesticide expenditures for noncrop areas and livestock.

California farmers spent about $470 million for pesticides in 1982, representing 11 percent of the U.S. total. States with the next largest expenditures were Illinois, Iowa, Minnesota, and Texas. These five States accounted for 37 percent of the U.S. total.

Pesticide prices quoted by manufacturers in 1985 are projected to be unchanged for herbicides, but down 3 percent for insecticides and down 1 percent for fungicides (table 6). These are aggregate prices and do not reflect price changes for individual products. At the farm level, herbicide prices declined an estimated 6 percent from May 1983 to May 1984, led by a sharp reduction in prices of atrazine, trifluralin, and 2,4-D. Farm-level insecticide prices dropped substantially between 1983 and 1984, primarily due to declines in synthetic pyrethroid prices. Fungicide prices have been quite stable in recent years.

Table 4--Pesticide production capacity expansion

Year	Herbicides	Insecticides	Fungicides	All pesticides
		Percent		
1975-76	19	2	0	12
1976-77	23	8	12	16
1977-78	3	4	3	3
1978-79	4	3	22	4
1979-80	2	1	3	2
1980-81	3	0	0	2
1981-82	4	7	0	5
1982-83	*	*	NA	*
1983-84	0	6	0	1
1984-85 1/	1	1	0	1

* = Less than 1 percent.
NA = Not available.

1/ Projected.

Source: USDA annual survey of basic pesticide producers.

Regional Use

Based upon results of 1976 and 1982 USDA Pesticide Use Surveys, herbicide use

Table 5--Farm pesticide expenditures by State, 1982 1/

State	Million dollars	State	Million dollars
AL	62.9	MT	43.5
AK	--	NE	141.1
AZ	60.0	NV	2.9
AR	114.2	NH	1.4
CA	468.9	NJ	14.5
CO	33.0	NM	8.5
CT	3.4	NY	56.2
DE	10.9	NC	111.6
FL	165.4	ND	116.9
GA	111.5	OH	140.0
HI	16.4	OK	31.1
ID	52.7	OR	56.7
IL	344.6	PA	47.4
IN	174.0	RI	.6
IA	332.0	SC	59.0
KS	95.0	SD	53[illegible]
KY	57.1	TN	5[illegible]
LA	117.1	TX	208[illegible]
ME	9.9	UT	5.3
MD	27.4	VT	2.0
MA	4.9	VA	50.3
MI	114.2	WA	102.3
MN	224.1	WV	5.0
MS	140.2	WI	90.0
MO	130.1	WY	6.3
U.S. total			4,282.9

-- = None reported.

1/ For field crops, vegetables, orchards, pasture, and rangeland.

Source: 1982 U.S. Census of Agriculture.

Table 6--Pesticide price changes

Item	1982-83 1/	1983-84 1/	Projected 1984-85 2/
		Percent	
Herbicides	-4	-6	0
Insecticides	8	1	-3
Fungicides	3	NA	-1

1/ Weighted average May prices paid by farmers.
2/ Quoted manufacturer prices.

Source: USDA annual survey of basic pesticide producers.

increased 22 percent in major producing regions, excluding California, while insecticide and fungicide use declined 45 and 19 percent, respectively (table 7). Increased herbicide use was brought about by several factors including a larger share of acres treated for weed control, increased use of tank-mix applications, and the expansion of soybean acreage from 50 million planted in 1976 to 71 million in 1982. Over 40 percent of the herbicide use was in the Corn Belt, followed by the Lake States and Northern Plains at 14 and 12 percent.

Insecticide use was down 45 percent between 1976 and 1982. Most of the reduction occurred in the Delta, Southeast, and Appalachia. These regions have considerable cotton acreage and farmers have switched to synthetic pyrethroids, which are applied at rates as low as 0.1 pound (a.i.) per acre. Traditional cotton insecticides (EPN, methyl parathion, and toxaphene) were applied at rates of 0.5 to 2.0 pounds (a.i.) per acre and their use dropped substantially between 1976 and 1982. Insecticide use in the major corn growing regions stayed the same or declined slightly. Historically, about 35 to 40 percent of the corn acreage is treated annually with insecticides, primarily for corn rootworm larvae control.

Fungicide use declined by 1.5 million pounds (a.i.) between 1976 and 1982. About 65 percent of the fungicides were used in peanut production. The largest decline occurred in the Southern Plains, where 1.8 million pounds (a.i.) were reported used in 1976, compared with 213,000 pounds in 1982. In 1976, almost half of the fungicides used in the Southern Plains were in wheat production, while in 1982, less than 1,000 pounds were reported used by farmers in the region. Yearly fungicide use is highly variable because disease pressure is affected by rainfall and extended periods of high relative humidity.

About 450 million pounds of herbicides (a.i.) were used on the major field crops in 1982 (table 8). Corn production accounted for 244 million pounds, and 56 percent of the total was used in the Corn Belt. Soybean production was the second largest herbicide user with 127 million pounds and 46 percent of the total used in the Corn Belt. Most herbicide use on wheat is in the Lake States, Northern Plains, and the West. Herbicides are used extensively in the hard red spring wheat and the soft white wheat areas. There has been a large increase in herbicide use on wheat in the Appalachia, Southeast, and Delta regions from 140,000 pounds in 1976 to almost 900,000 pounds in 1982. Wheat acreage in these regions increased from 2.7 million in 1976 to 9.6 million in 1982. Much of the wheat is grown in double cropping systems where herbicide use to control weeds is a necessary practice. Also, farmers in these regions are now treating wheat as a cash crop rather than a cover crop to protect the soil during the winter.

Herbicide Tank-mixes

Many herbicides are applied singly, but there is a growing trend towards the use of herbicide tank-mix applications, in which two or more herbicides are mixed and applied together in one operation.

Farmers use herbicide tank-mix applications to increase the spectrum of weed control and to hold down weed control costs. Some herbicide products control primarily grasses while others control primarily broadleaf weeds. In addition, a given broadleaf or grass herbicide will not control all species in that category. By combining two or more herbicides in a single tank-mix application, more weed species are controlled than if a single product is used. Also, when herbicides are used, the weed composition in a field will change. Weeds not previously causing economic damage may become a problem. If a weed that is not controlled becomes a problem, a different herbicide material is needed and tank-mixing attempts to address this problem. Some farmers also tank-mix herbicides with insecticides or fungicides to save time and fuel by making only one trip over the field.

As part of USDA's 1982 Crop and Livestock Pesticide Use Survey, farmers were asked to identify tank-mix applications. Selected results from the survey follow.

Farmers reported using about 450 million pounds (a.i.) of herbicides on row and small grain crops in 1982, with 55 percent applied as herbicide-only tank-mixes and 44 percent as single-product applications (table 9). For row

Table 7--Quantity of active ingredients used on major field and forage crops, by region, 1976 and 1982

Region	Herbicides		Insecticides		Fungicides	
	1976	1982	1976	1982	1976	1982
	Million pounds				Thousand pounds	
Northeast	12.9	14.7	2.6	1.9	4	3
Appalachia	31.8	34.1	9.5	5.9	1,299	849
Southeast	18.5	22.9	30.1	13.5	4,799	4,331
Delta	33.9	41.2	33.7	11.6	172	923
Corn Belt	155.3	197.9	15.7	17.3	16	147
Lake States	44.0	63.0	5.2	3.8	2	80
Northern Plains	43.2	53.1	11.0	7.8	--	38
Southern Plains	14.4	17.6	12.9	7.1	1,801	213
West 1/	20.3	11.3	9.4	2.4	2	12
Total	374.3	455.8	130.1	71.3	8,095	6,596

1/ For 1976, this area includes the Mountain and Pacific ERS Production Regions. For 1982, the area includes only Arizona, Idaho, Montana, and Washington.

Table 8—Herbicide use on major field crops, by region, 1982 1/

Crop	Northeast	Appalachia	Southeast	Delta	Corn Belt	Lake States	Northern Plains	Southern Plains	West 2/	Total
	Thousand pounds (active ingredients)									
Corn	11,771	16,570	3,655	280	136,601	45,669	26,717	1,499	815	243,577
Cotton	—	811	1,377	9,586	222	—	--	5,176	1,115	18,287
Grain sorghum	—	491	178	1,081	2,345	—	7,949	3,695	*	15,739
Peanuts	—	1,141	3,304	—	—	--	--	484	--	4,92[illegible]
Soybeans	2,694	13,254	13,844	19,084	57,881	13,202	6,432	568	--	126,959
Tobacco	63	1,213	174	—	32	—	--	—	--	1,482
Wheat	45	517	185	189	62	2,690	7,654	610	6,117	18,069
Barley	—	11	—2/	--	—	654	1,340	--	2,405	4,410
Oats	101	2	8	*	36	643	607	73	67	1,537
Rice	—	—	--	10,530	321	—	--	3,238	--	14,089
Total	14,674	34,010	22,725	40,750	197,500	62,858	50,699	15,343	10,519	449,078

— = None reported.
* Less than 500 pounds

1/ Based on data obtained from USDA's 1982 Crop and Livestock Pesticide Usage Survey which included 33 States. 2/ Includes only Arizona, Idaho, Montana, and Washington.

crops alone, 42 percent of the herbicide materials were applied as single-product applications and 57 percent as tank-mixes. Tank-mixes accounted for 67 percent of the herbicides applied to peanuts and 63 percent of the applications of corn herbicides. In tobacco production, 70 percent of the herbicide materials were applied in single-product applications and 1 percent as herbicide-only tank-mixes. However, 10 percent of the tobacco herbicide materials were applied in tank-mixes with insecticides or nematicides, and another 18 percent with fungicides or insecticides. For small grains, a higher proportion of herbicides is applied in single-product applications.

Corn--Herbicide use on corn in 1982 was estimated at 244 million pounds (a.i.), up 16 percent from 1980 (table 10). Herbicide-only tank-mixes accounted for 63 percent of the total, compared with only 39 percent in 1980. All single-product applications declined between 1980 and 1982. Two-product tank-mixes dominated, but some farmers reported tank-mixes of three and four products. These multiple product tank-mixes usually contained glyphosate or paraquat and were used in no-till production systems. Metolachlor, either as a single-product or in tank-mixes, was reported used on 5.1 million acres in the 1980 survey, but by 1982, use had increased to 9.3 million acres.

Soybeans--Farmers reported using 127 million pounds (a.i.) of herbicides on soybeans in 1982, 10 percent more than 1980 (table 11). In 1982, single-product applications accounted

Table 9--Herbicide use on major field crops, 1982

Crop	Quantity (a.i.)	Proportion of quantity by: Single products	Proportion of quantity by: Herbicide-only tank-mixes 1/
	Million pounds	Percent	
Row:			
Corn	243.6	35	64
Cotton	18.3	72	28
Grain sorghum	15.7	53	47
Peanuts	4.9	33	67
Soybeans	127.0	49	51
Tobacco	1.5 2/	70	1
Total	411.0	42	57
Small grains:			
Barley and oats	5.9	82	18
Rice	14.1	58	42
Wheat	18.1	68	32
Total	38.1	67	33
Total	449.1	44	55

1/ Mixtures of two or more herbicide products.
2/ 18 percent of all herbicides were tank-mixed with insecticides and 10 percent with fungicides and insecticides.

for less than 50 percent of the total quantity of herbicides applied, down from 70 percent in 1980.

Based on acres treated, all single-product applications showed a decline between 1980 and 1982 except fluchloralin, which increased slightly. Two new materials, acifluorfen and metolachlor, were reported used on 2.7 and 3.2 million acres in 1982. The number of different tank-mix combinations increased substantially between 1980 and 1982. In 1980, four combinations accounted for about 65 percent of the herbicide tank-mix materials applied to soybeans. By 1982, the list had grown to 12 different combinations accounting for 85 percent of the tank-mix quantity. Acres treated with the four predominant tank-mixes reported in 1980 rose considerably by 1982. In addition, two new tank-mixes, acifluorfen + bentazon and metolachlor + metribuzin, were used extensively in 1982 on 1.8 and 2.6 million acres. Paraquat combined with other herbicides in tank-mixes was reported used on 1 million no-till acres.

Table 10--Corn herbicides

Herbicides	1980: Acres treated	1980: Pounds of active ingredients	1982: Acres treated	1982: Pounds of active ingredients
	Million			
Single applications:				
Alachlor	13.9	29.3	9.4	19.7
Atrazine	23.1	37.3	13.4	22.4
Butylate+	7.9	27.2	5.9	22.4
Cyanazine	6.1	10.6	2.8	4.9
Dicamba	4.2	1.5	3.4	.9
Metolachlor	3.1	5.5	1.5	3.2
2,4-D	9.6	5.0	6.3	3.3
Other	—	10.8	—	9.5
Total	—	127.2	—	86.2
Tank-mixes:				
Atrazine + alachlor	7.9	11.1 + 14.3	11.3	16.4 + 21.2
Atrazine + butylate+	3.8	4.9 + 11.7	6.5	8.7 + 23.7
Atrazine + cyanazine	1.5	1.7 + 1.9	2.0	2.7 + 3.6
Atrazine + metolachlor	2.0	3.1 + 3.5	6.3	8.7 + 10.7
Atrazine + simazine	1.0	1.2 + 1.2	.9	1.3 + 1.2
Atrazine + other	—	3.3 + 6.6	—	—
Cyanazine + alachlor	1.2	2.2 + 2.4	3.8	6.1 + 7.6
Cyanazine + butylate+	1.9	3.1 + 5.6	1.4	2.7 + 4.9
Cyanazine + metolachlor	—	—	.6	.9 + 1.2
Dicamba + 2,4-D	2.3	.8 + 1.0	4.7	1.0 + 1.6
Metolachlor + atrazine + simazine	—	—	1.7	3.2 + 2.6 + 1.3
Metolachlor + cyanazine + atrazine	—	—	.7	1.4 + .6 + .6
Other	—	2.1	—	8.9
Total	—	82.3	—	154.4
Total herbicides	—	209.5	—	243.6

Table 11--Soybean herbicides

Herbicides	1980 Acres treated	1980 Pounds of active ingredients	1982 Acres treated	1982 Pounds of active ingredients
		Million		
Single applications:				
Acifluorfen	—	—	2.7	.9
Alachlor	11.1	23.4	6.8	10.3
Bentazon	12.3	9.9	8.5	6.7
Chloramben	3.2	4.9	2.4	2.7
Fluchloralin	2.1	2.0	2.8	2.6
Glyphosate	2.6	2.3	1.8	2.2
Linuron	3.6	2.2	1.8	1.3
Metribuzin	9.6	4.7	5.1	2.2
Metolachlor	—	—	3.2	6.9
Trifluralin	24.1	21.0	22.2	20.4
Other	—	8.5	—	5.5
Total	—	78.9	—	61.7
Tank-mixes:				
Acifluorfen + bentazon	—	—	1.8	.3 + .7
Alachlor + metribuzin	2.5	5.5 + 1.4	4.0	6.9 + 1.7
Alachlor + linuron	2.1	4.1 + 1.4	4.5	8.1 + 3.2
Alachlor + naptalam + dinoseb	—	—	.8	1.5 + 1.3 + .6
Bentazon + 2,4-DB	—	—	.7	.4 + *
Chloramben + alachlor	—	—	.9	1.5 + 1.8
Chloramben + trifluralin	—	—	.5	.9 + .5
Dinoseb + naptalam	1.7	1.1 + 2.1	2.0	1.2 + 2.4
Metolachlor + metribuzin	—	—	2.6	4.2 + 1.6
Oryzalin + linuron	—	—	.5	.4 + .3
Paraquat + others	—	—	1.0	.4 + 1.7
Trifluralin + metribuzin	5.6	5.2 + 2.6	9.7	8.8 + 3.8
Other	—	12.1	—	11.1
Total	—	35.5	—	65.3
Total herbicides	—	114.4	—	127.0

* Less than 100,000 pounds.

Table 12--Grain sorghum herbicides

Herbicides	1980 Acres treated	1980 Pounds of active ingredients	1982 Acres treated	1982 Pounds of active ingredients
		Thousands		
Single applications:				
Atrazine	2,578	3,709	3,242	3,983
Dicamba	199	92	95	23
Glyphosate	55	110	493	457
Metolachlor	—	—	489	1,061
Propachlor	407	819	305	1,061
Propazine	1,190	1,239	1,063	997
2,4-D	898	571	1,002	446
Other	—	944	—	265
Total	—	7,484	—	8,293
Tank-mixes:				
Atrazine + propachlor	1,865	982 + 2,126	1,445	1,150 + 3,027
Atrazine + metolachlor	—	—	450	394 + 496
Atrazine + terbutryn	—	—	304	225 + 375
Atrazine + dicamba	—	—	196	254 + 64
Metolachlor + propazine	—	—	412	400 + 206
Propachlor + linuron	—	—	156	156 + 78
Dicamba + 2,4-D	—	—	182	13 + 24
Other	—	1,207	—	614
Total	—	4,315	—	7,446
Total herbicides	—	11,799	—	15,739

Grain sorghum--The quantity of herbicides used on grain sorghum rose 32 percent from 1980 to 1982 (table 12). Single-product applications accounted for about 65 percent of the quantity in 1980 and just over 50 percent in 1982. The acreage treated with most individual single-ingredient materials was about the same, but use of atrazine, glyphosate, and metolachlor increased substantially.

In both 1980 and 1982, atrazine + propachlor was the dominant tank-mix used on grain sorghum. However, by 1982, six other tank-mixes were reported on a fair number of acres. Atrazine + metolachlor and metolachlor + propazine were the two most common combinations.

Other row crops--For cotton, peanuts, and tobacco, only 1982 herbicide tank-mix data are reported. Tank-mixes were not used to a large extent by cotton farmers (table 13). In contrast with other major crops, cotton is treated with herbicides several times during the growing season. All of the tank-mixes reported contained MSMA or DSMA and were applied as postemergence directed sprays. In terms of acres treated, MSMA + fluometuron was the most commonly used tank-mix. Trifluralin, fluometuron, and dipropetryn were the predominant single-product applications.

Peanut farmers applied 4.9 million pounds (a.i.) of herbicides in 1982 (table 14). Tank-mixes accounted for about 65 percent of the total. Alachlor and benefin, either alone or in tank-mixes, are the two most commonly used herbicides in peanut production.

Tobacco growers applied 1.5 million pounds (a.i.) of herbicides, primarily as single-product applications (table 15). In tobacco production, herbicides, insecticides, and fungicides are sometimes applied together as tank-mixes. Application primarily involves the combining of preplant soil-incorporated herbicides with nematicides. Isopropalin was the most important herbicide used in tobacco production.

Small grain crops--Rice farmers used about 14 million pounds (a.i.) of herbicides in 1982 (table 16). Most were used in single-product applications. Propanil was the most commonly used herbicide either alone or in tank-mixes.

Table 13--Cotton herbicides, 1982

Herbicides	Acres treated	Times applied	Pounds of active ingredients
	Thousands	Number	Thousands
Single applications:			
Trifluralin	5,520	1.0	4,211
Fluometuron	2,239	1.1	1,640
Dipropetryn	1,212	1.0	493
Pendimethalin	957	1.0	621
Prometryn	894	1.3	898
MSMA	798	1.3	1,355
Glyphosate	520	1.5	1,325
Diuron	518	1.1	286
DSMA	518	1.1	762
Other	--	--	1,522
Total	--	--	13,113
Tank-mixes:			
MSMA + fluometuron	1,028	1.4	1,450 + 1,185
MSMA + dinoseb	247	3.7	469 + 649
MSMA + cyanazine	194	1.2	207 + 133
MSMA + others	125	1.1	177 + 78
DSMA + others	118	1.4	196 + 96
Other	--	--	534
Total	--	--	5,174
Total herbicides	--	--	18,287

Table 14--Peanut herbicides, 1982

Herbicides	Acres treated	Pounds of active ingredients
	Thousands	
Single applications:		
Alachlor	273	481
Benefin	356	482
2,4-DB	263	154
Vernolate	85	238
Trifluralin	78	42
Acifluorfen	65	22
Other	--	215
Total	--	1,634
Tank-mixes:		
Benefin + vernolate	214	312 + 459
Benefin + alachlor	54	78 + 205
Naptalam + dinoseb	149	298 + 149
Naptalam + dinoseb + alachlor	117	206 + 103 + 297
Metolachlor + benefin	57	112 + 82
Metolachlor + trifluralin	28	186 + 64
Other	--	744
Total	--	3,295
Total herbicides	--	4,929

Table 15--Tobacco herbicides, 1982

Herbicides	Acres treated	Pounds of active ingredients
	Thousands	
Single applications:		
Diphenamid	66	283
Isopropalin	125	187
Pendimethalin	86	86
Other	--	478
Total	--	1,034
Tank-mixes:		
Herbicides only	6	15
Isopropalin + insecticide	26	40
Pebulate + insecticide	25	82
Herbicide + insecticide	14	20
Isopropalin + other	66	100
Pendimethalin + other	24	22
Pebulate + other	19	57
Herbicide + other	24	112
Total	--	448
Total herbicides	--	1,482

Table 16--Rice herbicides, 1982

Herbicides	Acres treated	Pounds of active ingredients
	Thousands	
Single applications:		
Propanil	1,100	4,641
2,4-D	866	610
Molinate	830	2,182
2,4,5-T	263	195
Thiobencarb	119	390
Other	--	167
Total	--	8,185
Tank-mixes:		
Propanil + bifenox	551	1,662 + 561
Propanil + thiobencarb	294	857 + 880
Propanil + molinate	147	661 + 362
Propanil + others	166	546 + 309
Other	--	66
Total	--	5,904
Total herbicides	--	14,089

Farmers growing wheat, barley, and oats apply most of their herbicides as single-product applications (tables 17, 18). The most commonly used herbicide on these three crops is 2,4-D. Triallate or triallate + trifluralin also were reported for control of wild oats and foxtail, primarily in the Northern Plains. MCPA and MCPA tank-mixes are important in barley and oat production.

Regulatory Actions

Strychnine--The EPA administrative law judge has granted a 6-month extension in the strychnine hearings that were scheduled to start in Washington, D.C. on October 15, 1984. During the extension, interested parties will review and evaluate new research on the efficacy of control methods and their impact on nontarget wildlife species.

Dicofol--On October 10, 1984, EPA announced in the Federal Register (43:39820) its preliminary determination to cancel the registration of products containing dicofol and to prohibit their sale and distribution.

Dicofol is used primarily to control mite populations in citrus production and on cotton in Arizona, California, and New Mexico. It is also registered for use on alfalfa, clover for seed, berries, hops, figs, ornamentals, turf, mint, nuts, beans, cucumbers, squash, eggplant, melons, peppers, tomatoes, grapes, apples, pears, apricots, cherries, nectarines, peaches, and plums. Dicofol is used in many sections of the country.

EPA judged that the continued risks to wildlife from the chemical residual (DDTr) contained in dicofol would outweigh the

Table 17--Wheat herbicides, 1982

Herbicides	Acres treated	Pounds of active ingredients
	Thousands	
Single applications:		
2,4-D	18,233	8,033
MCPA	2,576	991
Triallate	1,389	1,553
Dicamba	768	201
Trifluralin	790	418
Diclofop methyl	697	637
Other	--	493
Total	--	12,326
Tank-mixes:		
Dicamba + 2,4-D	4,165	429 + 1,514
Bromoxynil + MCPA	1,361	412 + 431
Bromoxynil + others	641	208 + 417
Trifluralin + triallate	1,016	425 + 876
2,4-D + difenzoquat	236	176 + 163
MCPA + dicamba	262	109 + 26
Other	--	557
Total	--	5,743
Total herbicides	--	18,069

Table 18--Barley and oat herbicides, 1982

Herbicides	Acres treated	Pounds of active ingredients
	Thousands	
Single applications:		
Barley--		
2,4-D	3,366	1,591
MCPA	1,378	574
Triallate	769	1,066
Other	--	246
Total	--	3,477
Oats--		
2,4-D	1,551	737
MCPA	1,547	573
Other	--	73
Total	--	1,383
Tank-mixes:		
Barley--		
MCPA + bromoxynil	439	132 + 132
MCPA + others	300	116 + 97
Trifluralin + triallate	185	93 + 195
Dicamba + 2,4-D	136	22 + 48
Other	--	98
Total	--	933
Oats--		
2,4-D + dicamba	83	42 + 25
MCPA + dicamba	62	21 + 10
Other	--	56
Total	--	154
Total herbicides:		
Barley	--	4,410
Oats	--	1,537

admitted economic benefits of its continued use. EPA judged that other economically acceptable mite control materials are available.

The Federal Register notice and EPA's Position Document 2/3 were sent to the Secretary of Agriculture and the Scientific Advisory Panel for review and comment. EPA also invited comments from the public. After reviewing these comments and any other relevant information, EPA will prepare and publish Position Document 4 outlining its final regulatory position.

Linuron--EPA published in the Federal Register (49:37843) on September 28, 1984, a notice announcing the initiation of a Special Review for the herbicide linuron. EPA has determined that linuron is oncogenic (tumor producing) in rats and mice and may meet or exceed risk criteria. Registrants and other interested parties had 45 days to submit data to EPA rebutting the presumed risk of linuron. EPA is currently reviewing these comments and if the presumption of risk is not rebutted and the Agency cannot resolve the risk issues through voluntary action by registrants, a benefit-risk study will be conducted to evaluate the continued use of linuron and propose regulatory options.

Linuron is used widely to control selected broadleaf weeds and grasses in soybeans and to a lesser extent in cotton, corn, wheat, and potato production. It is also registered for selected vegetable crops and noncrop areas. In soybeans, linuron is used as a single-product application or in pre- or postemergence tank-mixes.

Aldicarb--on July 11, 1984, EPA published in the Federal Register (49:28320) a notice initiating a Special Review of the active ingredient aldicarb, an insecticide/nematicide used primarily in the production of cotton, peanuts, pecans, potatoes, and soybeans. EPA stated that aldicarb has a high acute oral toxicity, but that it does not cause adverse chronic health effects. Based on scientific studies, EPA concluded that aldicarb is mobile in the soil and is persistent under anaerobic conditions. Aldicarb has been identified in concentrations greater than the health advisory level of 10 parts per billion in well water in several States.

If the presumption of risk is not rebutted or if voluntary actions cannot be taken to reduce risk, a benefit-risk study will be conducted to evaluate the continued use of aldicarb and propose regulatory options.

Daminozide--EPA published in the Federal Register (49:29136) on July 18, 1984, a notice initiating a Special Review of the active ingredient daminozide, a growth regulator. EPA has concluded that daminozide and its hydrolysis product, UDMN, are oncogenic to laboratory animals. Both daminozide and UDMN have been found in raw and processed agricultural commodities and thus may present a risk to human health.

Daminozide is registered for use on a number of agricultural crops, but used primarily on apples and peanuts. Daminozide is used on apples to control timing of fruit maturity, preventing preharvest drop and improving red coloring. In addition, it controls vegetative growth (thus reducing pruning), promotes flower bud development, and increases fruit set. If daminozide use is restricted in apple production, the principal varieties affected would be Red Delicious and McIntosh.

In peanut production, daminozide promotes the development of shorter, more erect vines. This allows increased air circulation and sunlight penetration, which reduce disease and insect problems.

There are alternatives to daminozide in apple production but no alternatives for peanut production. However, one of the alternatives for apples, silvex, is currently in cancellation hearings.

The registrants and the public have commented on the risk presumption, and if it is not rebutted, a benefit-risk study will be initiated.

Corn and Soybean Production Losses from Potential Pesticide Regulatory Actions

by

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Abstract: Several corn and soybean pesticides are undergoing review that could result in the cancellation of this registration. Other pesticides will go through the same process. The estimates in this article indicate the potential impacts on average corn and soybean yields caused by withdrawing individual herbicide groups or all fungicides, insecticides, or nematicides used to control major plant pests. Estimates also show the production benefits of pesticide use. Because of the number of effective pesticides available to control major pests, removing a single pesticide from the market generally will result in only minor corn and soybean production losses. In some cases, however, eliminating a single herbicide (for example, atrazine, metribuzin, or bentazon) might cause production losses large enough to increase crop prices.

Keywords: Pesticide regulatory activity; production losses; corn; soybeans; pesticides.

Pesticide use is generally viewed as a yield-saving practice that promotes lower commodity prices and production costs than would otherwise be possible. Pesticides are widely used to reduce yield losses caused by injurious insects, diseases, nematodes, and weeds. However, some people consider certain pesticides inappropriate because of potential adverse impacts on environmental quality, consumer health, and worker safety. The risks and benefits of pesticides must be evaluated so informed decisions can be made about their use. Data on the relative effectiveness of alternative pest control practices are essential in estimating the benefits of pesticides. This article summarizes preliminary results of efforts to

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assess the effects of pesticide use on corn and soybeans in the major producing States.

A pesticide will be unavailable if its registration is cancelled or if the manufacturer voluntarily takes the material off the market. Several corn and soybean pesticides are under EPA regulatory review and could have their registrations modified or cancelled. Included are: captan, a seed treatment for corn and soybeans; linuron, a herbicide used in corn and soybean production; aldicarb, a soybean insecticide/nematicide; and alachlor, a corn and soybean herbicide. EPA is also calling for data on a large number of other corn and soybean pesticides in advance of its reassessment and reregistration activity. Based on internal review, EPA could determine that some of these materials require a formal "Special Review". The results could include reregistration, label modification, or cancellation.

This article estimates the production losses that may result from withdrawing all chemicals used to control specific insects or diseases, or by withdrawing an entire herbicide group from the market. The estimated losses also represent the production benefits realized from the use of these pesticides. The article also examines the implications of removing a small number of pesticides from the market.

The estimates of production losses were developed from data on the damage caused by various pests and the relative effectiveness of available controls. Research and extension personnel supplied the data under an activity referred to as the Pesticide Assessment by Commodity, which was initiated by the National Agricultural Pesticide Impact Assessment Program. The pesticide assessment for corn and soybeans considered major pests, regional variation in pest problems, pesticide use, pest management practices, pesticide efficacies, and yield reductions caused by removing currently registered pesticides from the market.

The experts based their decisions on survey data, experimental and field research trials, and field experience. They used a questionnaire to record their judgments about pest losses and pesticide efficacies, and to minimize overstatement of pesticide productivity. The information was collected between September 1982 and November 1983.

The reliance on expert opinion reflects a lack of sufficient experimental data covering the range of climatic, soil, and other factors that determine the extent and the severity of current pest-caused losses and changes caused by withdrawing major pesticides from the market.

The assessment focused on insect, disease, and weed problems in six U.S. regions that accounted for 97 percent of the corn and 98 percent of the soybean production during 1979-82:

Corn Belt:	Illinois, Indiana, Iowa, Missouri, Ohio.
Delta:	Arkansas, Kentucky, Louisiana, Mississippi, Tennessee.
Lake States:	Michigan, Minnesota, Wisconsin.
Northeast:	Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia.
Northern Plains:	Colorado, Kansas, Nebraska, North Dakota, South Dakota.
Southeast:	Alabama, Georgia, North Carolina, South Carolina.

The estimated losses describe production decreases that would result from withdrawing certain pesticides from the market, assuming planted acreages remain constant. Losses estimated for insects, diseases, nematodes, and weeds for the "no pesticide control" scenario are those that reflect the withdrawal of all pesticides used to control each specific pest. Estimates are not additive because coexisting pests were not considered in the estimation procedure except where groupings were identified.

While losses occur even at current pesticide use levels, they are not included in the estimates presented. The estimates of yield losses due to weeds are based on the assumption that the most economical, legally permissible control practice is used in each instance. Regional estimates are averages for substate areas weighted by their proportional crop acreages. These averages overstate losses in some areas of the multistate regions and understate losses in others. Even though average losses may be relatively small, farmers operating in particular areas or using a specific production practice may suffer significant losses.

Insecticides

Currently, there are a number of effective insecticides available for control of each major corn and soybean insect pest. So, withdrawal of one or two insecticides from the market probably would have limited initial impact on average crop yields, production costs, and commodity prices. However, under certain soil and climatic conditions, some farmers may not be able to find effective alternatives and could incur significant yield losses. If several insecticides currently used to control one or more major pests were removed from the market, more farmers may be unable to control insect problems, resulting in a substantial decrease in crop production and subsequent higher crop prices.

Corn--Corn rootworm larvae, the soil complex (seed corn maggot, seed corn beetle, wire worms, grubs, and other soil insects), cutworms, and European cornborer have a greater potential than other insects to reduce corn production if insecticides were removed from the market (table 19). A 9-percent yield loss averaged over all regions could occur if all insecticides used to control corn rootworm larvae and the soil complex were withdrawn. This loss is at least three times greater than for any other insect pest.

Corn rootworm larvae and the soil complex generally are controlled with carbofuran, chlorpyrifos, disulfoton, ethoprop, fonofos, isofenfos, phorate, or terbufos. Annually, 35-40 percent of the planted corn acreage is treated with these materials. These two pest categories have the greatest potential to reduce production in all the study regions except the Delta and Northeast.

If all insecticides used to control cutworms or European cornborers were withdrawn from the market, corn production losses could amount to about 3 percent initially (table 19). Roughly 5-10 percent of planted corn acreage is annually treated for each of these pests. Chlorpyrifos and fenvalerate are important materials used to control cutworms. Carbofuran and fonofos are used most frequently for cornborers, but permethrin and methomyl also are effective.

Table 19--Potential production losses if all pesticides used for a particular insect pest are cancelled, by crop, pest, and region 1/

Crop, pest	Corn Belt	Delta	Lake States	Northeast	Northern Plains	Southeast	All regions assessed 2/
				Percent			
Corn:							
Corn rootworm and soil complex	9.7	1.5	3.2	2.8	11.1	16.9	9.2
European cornborer	3.3	2.8	2.6	2.6	3.2	0.3	2.9
Cutworms	4.3	0.7	0.7	3.4	1.2	--	2.8
Stalkborer	1.3	--	--	0.2	--	--	0.7
True armyworm	0.5	3.1	0.5	2.3	0.1	0.3	0.7
Soybeans:							
Corn earworm	0.2	4.0	--	1.2	--	16.8	2.9
Soybean loopers	--	3.9	--	--	--	11.8	2.3
Velvetbean caterpillar	--	2.2	--	--	--	10.5	1.7
Stinkbug	--	3.0	--	0.2	--	6.8	1.5
Mexican bean beetle	1.0	--	--	2.5	--	0.1	0.6

-- = Insignificant production loss.

1/ Estimates of losses for different pests should not be summed. 2/ Weighted average based on the region's planted acreage.

Source: Pesticide Assessment by Commodity: Corn and Soybeans, NAPIAP, USDA.

Withdrawing insecticides used for cutworm control could cause important corn production losses in the Corn Belt, Northeast, and Northern Plains. Withdrawing insecticides used for cornborer control could cause substantial losses in all regions except the Southeast.

Stalkborers and true armyworms would cause total losses of less than 1 percent across all regions assessed, if all insecticides controlling either of them were cancelled (table 19). Stalkborer damage would be most severe in the Corn Belt, while damage from true armyworms would be greatest in the Delta and Northeast.

Soybeans--Corn earworms, soybean loopers, velvetbean caterpillars, and stinkbugs have greater potential than other insects to reduce soybean production if they are not controlled. The greatest initial losses would occur in the Delta and the Southeast where most soybean insecticides are used. Losses would be small in the Corn Belt, the major soybean region.

Without insecticides, yield losses could be [illegible] percent for corn earworm, 2 percent for soybean loopers, and 1-2 percent each for velvetbean caterpillars and stinkbugs (table 19). Losses from these four pests would be concentrated in the Delta and Southeast. Roughly 2-5 percent of the soybean planted acreage is treated annually for each of these four pests. Major pesticides used to control corn earworm include carbaryl, methomyl, methyl parathion, and permethrin, while acephate and chlorpyrifos are used less frequently. Methomyl, permethrin, and acephate are used for soybean loopers, whereas carbaryl, methomyl, and methyl parathion are used for stinkbugs. Methomyl, methyl parathion, and permethrin are frequently used for velvetbean caterpillar control.

The Mexican bean beetle would cause an initial average yield loss of less than 1 percent if all insecticides to control it were cancelled. This pest has greater potential to cause yield loss than the other four soybean pests in the Corn Belt and Northeast (table [illegible]). About 1 percent of the soybean planted acreage in the study area is treated for Mexican bean beetles, primarily with carbofuran.

Some insecticides are used for both corn and soybean pests. For example, carbofuran and fonofos are used for corn rootworm larvae and European cornborer control on corn, while carbofuran is also used to control Mexican bean beetles on soybeans. Permethrin, fenvalerate, and methomyl are used for a variety of pests on either crop. So, removing these insecticides from the market could result in substantial yield losses to both corn and soybeans, which are often raised on the same farm.

Fungicides and Nematicides

Three major pest groupings are considered in this section: seed rots and seedling blights; foliar diseases; and nematodes. The pesticide materials used are pest-group specific but can be used on both corn and soybeans. Withdrawing all materials used for a specific group could reduce both corn and soybean production, causing higher crop prices.

The major compounds used as seed treatments are captan, carboxin, and thiram. Almost all of the corn seed and one-third of the soybean seed are treated annually with one or more of these materials. Captan is applied to about 75 percent of all corn seed and 20 percent of all soybean seed. Cancelling all seed treatments could cause initial production losses of approximately 5 percent for corn and 2 percent for soybeans (table 20). All three major fungicides are equally effective in many, but not all, environmental situations, so the withdrawal of only one would affect total production only slightly. However, some farmers in some regions may not be able to find effective alternatives.

Foliar fungicides are applied annually on 5 percent or less of the soybean acreage and on a negligible amount of corn acreage. Foliar treatments (primarily benomyl) to soybeans are applied mostly in the Delta. Other effective, registered materials include chlorothalonil, thiabendazole, and thiophanate-methyl. Removal from the market of all foliar fungicides could cause average soybean yield losses of 2 percent and negligible corn losses (table 20).

About 3-4 percent of the acreage of each crop is treated annually for nematodes. Nematicide use is greatest in the Southeast.

Carbofuran and terbufos are commonly used corn nematicides, while aldicarb, carbofuran, and fenamiphos are commonly used soybean nematicides. The withdrawal of all nematicides could cause initial average yield losses of less than 1 percent for corn and 1-2 percent for soybeans (table 20). Over time, nematode populations could increase, resulting in greater losses. Removing only one nematicide from the market would probably have only a minor impact on corn and soybean production, but some farmers may suffer significant losses in situations where alternative nematicides perform poorly. Cancelling compounds registered as nematicides could increase nematode damage and also increase damage to corn from corn rootworm larvae and the soil complex, which are also controlled with carbofuran and terbufos.

Herbicides

There are a number of important herbicide groups consisting of two or more compounds that effectively control a wide range of weed species. However, different compounds do not control every weed species with equal effectiveness, nor do they perform equally well under different climate and soil conditions. So, cancelling the registered uses of individual corn or soybean herbicides would likely increase yield losses caused by some weeds on some locations, even though farmers would attempt to control those problems by changing production practices and using other herbicides. Removing all chemically related herbicides that are registered and used to control specific weed problems could result in substantial production losses and higher crop prices.

Withdrawing any one of several important herbicide groups would cause significant production losses. For corn, losses would be about 10 percent for withdrawal of triazines, 6 percent for acetanilides, 3 percent for thiocarbamates, and 1-2 percent for phenoxys or benzoics (table 21). For soybeans, losses would be about 4 percent for bentazon or dinitroanilines, 2-3 percent for acetanilides or triazines, and less than 2 percent for phenoxys or substituted ureas.

Removing any single herbicide from a group would not cause a greater production loss than withdrawing the entire group to which it belongs. The effectiveness of alternative controls determines how withdrawing one herbicide will affect yields. For example, the triazines used on corn include atrazine, cyanazine, and simazine. Atrazine is the most widely used. More than 70 percent of all U.S. corn acreage is treated with one or more triazines, with almost 60 percent receiving an atrazine treatment. Because atrazine offers control of both broadleaf weeds and grasses, removing it would dramatically change weed control

Table 20--Potential production losses if all pesticides used for a particular disease or nematode pest are cancelled, by crop, pest, and region 1/

Crop, pest	Corn Belt	Delta	Lake States	Northeast	Northern Plains	Southeast	All regions assessed 2/
				Percent			
Corn:							
Seed rots and seedling blights	4.4	6.3	5.2	10.8	11.0	1.7	5.3
Nematodes	0.7	--	0.1	0.8	--	3.7	0.7
Soybeans:							
Foliar diseases	0.2	7.6	--	--	--	--	1.9
Seed rots and seedling blights	1.0	4.2	0.3	0.3	2.5	0.3	1.7
Nematodes	0.7	2.4	--	2.4	--	4.4	1.4

-- = Insignificant production loss.

1/ Estimates of losses for different pests should not be summed. 2/ Weighted average based on the region's planted acreage.

Source: Pesticide Assessment by Commodity: Corn and Soybeans, NAPIAP, USDA.

Table 21--Potential production losses if a specific herbicide family is cancelled, by crop and region 1/

Crop, herbicide family	Corn Belt	Delta	Lake States	Northeast	Northern Plains	Southeast	All regions assessed 2/
	Percent						
Corn:							
Acetanilides	4.6	9.8	9.4	3.5	1.8	8.3	5.8
Benzoics	1.0	3.4	0.1	6.7	0.5	0.2	1.3
Phenoxys	2.0	2.9	0.4	1.9	0.5	1.9	1.6
Thiocarbamates	3.0	9.8	0.1	0.6	5.0	6.4	3.2
Triazines	8.2	16.2	11.3	26.5	1.1	10.1	10.1
No Chemical Control--							
Added cultivation	19.2	38.1	17.9	35.3	8.2	26.1	20.7
Current cultivation	50.8	66.7	27.8	60.0	18.2	49.7	45.4
Soybeans:							
Acetanilides	4.8	0.3	0.3	17.5	--	0.3	2.8
Bentazon	4.9	6.1	1.8	4.8	0.4	1.0	4.2
Dinitroanilines	4.9	2.3	2.8	0.9	10.1	0.5	3.8
Phenoxys	0.2	6.2	--	--	--	0.1	1.5
Substituted Ureas	0.3	0.3	0.1	10.9	0.1	--	0.5
Triazines	2.9	2.0	--	0.4	10.0	0.5	2.5
No Chemical Control--							
Added cultivation	34.5	42.0	24.9	15.1	13.1	25.7	32.8
Current cultivation	52.5	61.6	32.5	52.3	25.4	64.5	52.7

-- = Insignificant production loss.

1/ Estimates of losses from cancelling specific herbicides should not be summed. Losses assume that the best alternative herbicide or cultural practice is used. 2/ Weighted average based on the region's planted acreage.

Source: Pesticide Assessment by Commodity: Corn and Soybeans, NAPIAP, USDA.

practices in corn production and cause significant production losses. Two chemicals likely would be needed to replace atrazine, one for grasses and another for broadleaf weeds. Many experts noted that growers might need additional cultivations to compensate for the loss of atrazine. Simazine and cyanazine are not, in most States, effective alternatives to atrazine because they do not provide as effective control of several weed species, especially quackgrass. Also, the use of simazine can pose a soil residue problem under some situations.

Acetanilides (alachlor and metolachlor) present a different situation. Removing both acetanilides would cause substantial corn and soybean losses. However, in almost every State, alachlor and metolachlor generally were considered effective alternatives. Thus, initial production losses would be minor if only one were withdrawn, but there are situations where there would be no effective alternative, so yields would decrease. Withdrawing both chemicals, however, would generally result in poorer grass control. More than 50 percent of all corn acreage and over 40 percent of all soybean acreage is treated with an acetanilide each year.

Because some herbicide groups consist primarily of one chemical, withdrawing that chemical would cause losses comparable to those incurred by removing the entire group. Metribuzin is the only triazine used on soybeans, with 30–40 percent of the crop treated each year. Phenoxys are similar: 2,4-D is used on corn, and 2,4-DB on soybeans. Linuron is the most commonly used substituted urea applied to soybeans, dicamba is the principal benzoic applied to corn, and bentazon is the only one of its group applied to soybeans.

The herbicide group that would, if removed from the market, cause the greatest production loss in each region varies more for soybeans than for corn. The loss of triazines would cause the biggest drop in corn yields in all regions except the Northern Plains, where the withdrawal of thiocarbamates (butylate+ and EPTC+) would cause the greatest declines. Other chemicals do not offer the same control of shattercane, an important weed problem in this region. Each year, nearly 20 percent of all U.S. corn acreage is treated with a thiocarbamate.

Cancelling the registration of bentazon would cause the greatest soybean losses since this herbicide is most important in the Corn Belt, Delta, and the Southeast. However, cancelling either the dinitroanalines (trifluralin, pendimethalin), metribuzin, or acetanilides on soybeans could cause similar losses. The distribution of losses would be the main difference between these groups because dinitroanalines and metribuzin are important in the Northern Plains but less important in other regions.

Herbicides appear to benefit soybeans more than corn. In four of five regions, soybeans showed larger losses than corn without chemical control. Assuming farmers cultivate more, losses with no chemical control would be about 33 percent for soybeans and 21 percent for corn (table 21). The loss estimates show that herbicides and other farm production practices are interrelated. Every region showed substantially different yield losses sustained under "No Chemical Control" with current cultivation practices versus "No Chemical Control" with additional cultivations.

Without herbicides, farmers would have to cultivate more to maintain yields. The result would be poorer weed control, changing weed populations, and increased costs of production. In addition, soil erosion and sedimentation of waterways would increase. Removing all herbicides from the market would make corn and soybean production extremely difficult because the practice of using herbicides to reduce weed competition cannot be economically achieved by other means. Nearly 100 percent of all planted acreage has been treated with herbicides in recent years.

The selective cancellation of the registered use of individual herbicides would, only in a few cases, result in substantial corn or soybean yield losses. However, most regulatory actions resulting in the loss of registered uses could affect where and how these crops are grown and the control of individual weed species. For example, data from the Delta and the Southeast indicate that conservation or no-till production would not be possible without the use of paraquat, glyphosate, triazines, or acetanilides. Without these herbicides, most no-till and some reduced-tillage production in the United States would cease. Control of soil erosion also would be more difficult.

Many specialists indicated that herbicides allowed production to be economically viable in their States. Triazines are considered essential for corn production in the Delta. Personnel from Georgia attributed their corn output to available herbicides. Soybean production in many States requires herbicides. There are numerous production techniques that will moderate yield losses caused by the withdrawal of particular chemicals: Cultivation and rotations can be used, treatment time may be altered, and row spacing narrowed. However, these changes make production more risky, more difficult, and less profitable.

In almost every State, specialists asserted that there are relatively new chemicals that have not yet reached their market potential. Sethoxydim and fluazifop-butyl, new postemergence herbicides, are considered as effective as many currently used chemicals. As these and other new materials become more widely used, some herbicides now considered essential may lose market shares within a few years.

Potential Use and Implications of the Data

The data presented were assembled to provide a link between biologists' knowledge of pesticide productivity and economic modeling. The productivity relationships allow calculation of total pest losses from data that inherently vary across geographic areas and climatic conditions. Having these data available makes it possible to assess the impacts of many different pesticide regulatory options. Economic analyses of pesticide regulation can lead to forecasts of agricultural commodity supply and price changes as well as changes in farm income and its regional distribution. Changes in retail prices and consumer expenditures can also be forecast. Additionally, the data show where further research is needed in biological relations and their overall effects. The research will improve economic analyses and aid in sound policy decisionmaking.

The loss estimates provided by the scientists reflected expectations based on typical climatic conditions, cultural practices, and the current distribution of pest problems. Participants were not requested to provide estimates extending beyond a few growing seasons. Thus, there are two reasons why these data can not answer questions about long-run changes. First, since it is rare to find two pesticide active ingredients that offer identical control levels for exactly the same pests, a forced change in pesticide use would eventually alter pest populations. Over time, the pests that are problems would change. Second, the estimates reflect current technology. Corn and soybean pesticide markets are large enough that pesticide manufacturers will probably have economic incentives to develop new materials. A radical change in the way EPA regulates pesticides could undo those incentives, but more likely, new pesticides will be developed and marketed. The ability of undiscovered pesticides to control pests cannot be forecast.

1981 National Urban Pesticide Applicator Survey

by

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Abstract: Commercial urban applicators applied 47.1 million pounds of pesticide (active ingredients) to lawns, trees, and structures in 1981, according to a survey of 2,800 firms conducted by the Environmental Protection Agency. Slightly more than 50 percent of the pesticides used was applied to structures. Insecticides accounted for almost 80 percent of the total. Small firms with gross sales of between $25,000 and $100,000 dominate the industry.

Keywords: Pesticides; commercial urban applicators; insecticides.

Introduction

The commercial urban pest control industry has grown rapidly in recent years. Structural pest control is the mainstay of the industry, with most of the recent increase in pest control services for homeowners. Because these firms provide services in places where a large number of people work and live, it is important to ensure safe and effective pest control measures.

A study of pesticide use in three sectors of the commercial pest control industry--tree, lawn, and structural--was funded by the Environmental Protection Agency (EPA) and was jointly sponsored by the three trade associations representing the sectors and the Association of American Pesticide Control Officials. The survey was conducted by Research Triangle Institute, Raleigh, NC, under the technical direction of Dr. Douglas J. Drummond.

A total of 2,838 firms responded to the survey by providing data for 1981. They represented all regions of the country, and all firm sizes. The sample included firms belonging to the cooperating trade associations and other firms as well.

About one out of every three eligible businesses from individual State licensing lists was included in the sample. A business was eligible if it was on a State licensing list, provided commercial pest control services, and did not provide strictly agricultural pest control services. All States except North Dakota and Alaska participated. Sample selection was in accordance with a probability-based design permitting valid statistical inferences for each industry sector and geographical region. A mail questionnaire was used with a personal interview follow-up for nonrespondents.

Summary of Results

The structural pest control industry is characterized primarily by firms solely engaged in structural pest control and these firms account for about one-half of the firms surveyed (table 22). About one-third of the firms were engaged in more than one business area, that is, a combination of lawn, tree, or structural pest control.

An estimated 47 million pounds (a.i.) of pesticides were applied by urban pesticide applicators in 1981 (table 23). On an industrywide basis, most of the pesticide use was by firms engaged in structural pest control. These firms accounted for about three-fourths of total use of active ingredient covered in the study. There are considerable differences in the average amount of active ingredient used per firm among the industry categories. Firms specializing in tree pest control used only 1,900 pounds (a.i.) per year, while lawn alone and lawn and structural firms used more than twice that amount on average. This is not surprising because herbicide application rates are usually greater than those for insect or disease control.

Of the 47.1 million pounds (a.i.) of pesticides used, insecticides accounted for 79 percent (table 24). As expected, the structural pest control industry accounted for the majority of insecticides and used very little herbicide or fungicide materials. Insecticide use generally takes the form of termiticides, fumigants, and controls for cockroach and general household insects. The major termiticides reported were chlordane, heptachlor, and aldrin. The major fumigants were ethylene dichloride, sulfuryl fluoride, carbon tetrachloride, and methyl bromide. Methoxychlor, chlorpyrifos, and diazinon were the major insecticides reported for cockroach and general household insect control.

The most significant users of fungicides were the tree and lawn industry sectors. The major active ingredients reported were pentachlorophenol used as a wood preservative, and benomyl, captan, maneb, and PCNB used for ornamental and turf protection. Pentachlorophenol and copper naphthenate were important wood preservatives used by structural pest control firms.

As expected, the lawn care industry had the highest use of herbicides. The major herbicides used were bensulide, DCPA, and 2,4-D. Atrazine and diuron, which are important agricultural herbicides, were also reported as major lawn care herbicides for specific regions of the country.

Rodenticide use was reported predominately by the structural pest control industry, including single and multi-market firms. The major active ingredients were polybutene as a bird or rat repellent; zinc phosphide as a bait or tracking powder; and warfarin as an anti-coagulant bait.

The leading formulation type was wettable powder for fungicides and liquid concentrate for insecticides and herbicides (table 25). Ready-to-use formulations were the most common rodenticides used.

The industry was dominated by firms grossing between $25,000 and $100,000 in sales, which accounted for 60 percent of the total (table 26). Only 6 percent of pest control firms had gross sales of $500,000 or more per year.

Total employment of urban pest control firms was estimated at about 136,000, of which more than two-thirds were service technicians or technical managers (table 27). Firms engaged in structural pest control accounted for two-thirds of total employment (about 91,000).

The final detailed results of this survey are scheduled to be available in December 1984 through the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA, 22161.

Table 22--Number of firms* responding to the National Urban Pesticide Applicator Survey, 1981

Categories	Distribution of sample		Estimated distribution of population	
	Number	Percent	Number	Percent
Lawn	257	9.1	1,278	7.4
Tree	281	9.9	1,490	8.6
Lawn and tree	526	18.5	3,033	17.6
Structural	1,409	49.6	8,814	51.1
Structural and tree or lawn	365	12.9	2,621	15.2
Overall	2,838	100.0	17,236	100.0

* Some multi-location firms or firms that serve multiple States are represented more than once in these accounts.

Table 23--Quantities of pesticides used by urban pesticide applicators, by industry sector, U.S., 1981

Type of business	Estimated amount used by population	Average amount per firm
	Pounds active ingredients	
	Million	Thousand
Lawn	5.3	4.2
Tree	2.8	1.9
Lawn and tree	3.3	1.1
Structural	23.7	2.7
Structural and tree or lawn	12.0	4.6
Overall	47.1	2.7

Table 24--Quantities of pesticides used by urban pesticide applicators, by industry sector and pesticide class, U.S., 1981

Pesticide class	Industry sector					
	Lawn	Tree	Tree and lawn	Structural	Structural and tree or lawn	Overall
	Thousand pounds					
Fungicide	94	289	279	198	177	1,037
Herbicide	3,402	208	1,310	925	3,074	8,919
Insecticide	1,854	2,289	1,705	22,563	8,592	37,003
Rodenticide	0	0	1/	37	128	165
Total	5,350	2,786	3,294	23,723	11,971	47,124

1/ Less than 0.1 percent.

Table 25--Percent of pesticide usage (a.i.) by urban pesticide applicators, by formulation type, U.S., 1981

Formulation	Fungi-cide	Herbi-cide	Insecti-cide	Rodenti-cide
			Percent	
Dust	1.4	1/	0.6	4.5
Granular/ pelleted	4.5	9.3	1.9	0.9
Liquid concentrate	42.7	54.3	63.1	0.3
Pressurized	0	1/	12.5	7.0
Ready to use	3.7	0.1	19.3	87.3
Wettable powder	47.8	36.3	2.7	0

1/ Less than 0.1 percent.

Table 26--Pest control firms by gross sales and industry sector, U.S., 1981

Industry sector	Reporting aggregates with gross sales of --						
	Unknown	Less than $25,000	$25,000 $99,999	$100,000 $499,999	$500,000 $999,999	$1,000,000 $5,000,000	More than $5,000,000
				Percent			
Lawn	4.0	27.3	36.9	28.2	2.2	1.7	0.8
Tree	4.4	33.4	28.0	25.4	4.0	4.4	0.4
Lawn and tree	13.6	26.4	27.2	25.3	3.7	2.2	0.4
Structural	16.4	34.8	28.2	16.6	2.0	1.7	0.4
Structural and tree or lawn	14.5	19.5	30.4	25.9	5.1	3.0	1.6
Overall	13.8	30.3	28.9	21.2	3.0	2.2	0.6

Table 27--Number of employees of pest control firms by industry sector, U.S., 1981

Industry sector	Technical service	Sales and clerical	Total
		Number	
Lawn	7,002	2,386	9,388
Tree	8,907	4,564	13,471
Lawn and tree	16,637	5,527	22,164
Structural	45,186	21,218	66,404
Structural and tree or lawn	17,453	7,216	24,669
Overall	95,185	40,911	136,096

FARM MACHINERY

U.S. farmers are projected to purchase $7.37 billion of farm machinery in 1984, down about 3 percent from a depressed $7.62 billion in 1983. Fewer tractors and less harvesting equipment were purchased through October 1984 compared with the same 10 months a year earlier as financial conditions at the farm level continued to deteriorate and real interest rates remained near historically high levels. Annual unit purchases of two-wheel drive tractors with 40 or more horsepower (hp) and all four-wheel drive tractors are projected to fall 8 and 27 percent, respectively, below 1983. Purchases of various categories of grain and forage harvesting equipment are forecast to drop 9 to 22 percent.

The outlook for farm financial conditions in 1985 suggests little change from 1984. Depending on interest rates, total farm machinery expenditures currently are estimated between $7.3 and $7.8 billion. If real interest rates rise next year, total purchases of all over-40 hp tractors are projected to fall about 5 percent and purchases of most harvesting machinery items are expected to drop 3 to 7 percent below 1984. But, if real interest rates decline, total tractor purchases could increase 9 percent and various harvesting equipment purchases could rise from 1 to 24 percent.

Indices for September 30 inventories to January-September purchases for most farm machinery categories are at or near record levels, standing at 136 percent for tractors and ranging from 103 to 247 for various grain and forage harvesting equipment. Several of the major full-line manufacturers reduced production of tractors and combines during fourth-quarter 1984 to bring inventories in line with demand. If actual 1985 demand for farm machinery matches the current projection, further cutbacks and production capacity consolidation may occur.

Demand

Financial Conditions

U.S. expenditures for farm machinery in 1984 are expected to decline 3.3 percent to $7.37 billion, down from $7.62 billion a year earlier (table 28). This estimate was lowered substantially from the August projection of $8.1 billion, as domestic purchases of farm machinery fell to the lowest levels in over a decade and financial conditions in the farm sector failed to improve. Unit purchases in 1984 are projected to total 60,900 for over-40 hp two-wheel drive tractors, and 3,700 for four-wheel drive tractors, down 8 and 27 percent, respectively, from 1983. Purchases of various grain and forage harvesting equipment are forecast to drop between 9 and 22 percent as well.

The current situation affecting the financial well-being of the agricultural community is characterized by increased interdependency with national and international economic conditions. The effect of the U.S. monetary and fiscal environment on interest and inflation rates and their impact on the value of the dollar ultimately influence farm equity, capital costs, and export demand for U.S. commodities. These factors, in turn, determine the level of demand for farm machinery.

The 1970's brought relatively favorable farm financial conditions and dramatic increases in export demand for U.S. commodities, as cropland values (equity) rose sharply, real interest rates fell to low or negative levels, and the value of the dollar steadily declined. Farmers responded to these factors by increasing the size of their operations and purchasing additional, higher-powered farm machinery.

The current monetary and fiscal environment, starting in 1979, has caused real interest rates to rise sharply, leading to a record high dollar value in 1984. Because of these changes and depressed world economic conditions, total farm debt has increased to record levels, cropland values have steadily fallen, and export demand for U.S. commodities has declined. Current projections call for little or no improvement during 1985 in these factors affecting the ability of U.S. farmers to assume additional long-term debt.

Higher interest rates discourage capital purchases of farm machinery and cropland, while increasing operating expenses. Real interest expenses are projected to total about $10.12 billion in 1984, up 11.1 percent from

Table 28--U.S. farm machinery trends

Item	1980	1981	1982	1983	Projected 1984	Projected 1985
			Billion dollars			
Nominal expenditures:						
Tractors	3.68	3.74	2.88	2.77	2.68	2.66-2.87
Harvesting machinery	6.96	6.48	5.10	4.85	4.69	4.64-4.92
Total	10.64	10.22	7.98	7.62	7.37	7.30-7.79
			Thousand units			
Tractor purchases:						
Over 40 hp 2-wheel drive	108.4	94.1	70.4	66.3	60.9	57.8-65.1
All 4-wheel drive	10.9	9.7	6.8	5.1	3.7	3.5-5.0
Total	119.3	103.8	77.2	71.4	64.6	61.3-70.1
			Billion dollars 1/			
Factors affecting demand:						
Interest expenses	9.11	10.18	10.72	9.87	10.12	10.3-10.5
Total production expenses	72.27	70.15	67.42	62.85	64.09	62-63
Outstanding farm debt 2/	92.93	93.27	97.50	100.46	96.11	NA
Real estate assets 2/	423.66	424.52	395.83	357.27	342.21	NA
Net farm income	11.9	15.9	10.8	7.5	13-15	NA
Net cash income	21.1	17.9	17.8	18.6	16.2	NA
			Percent			
After-tax PCA interest rate 3/	0.36	1.45	4.94	4.66	5.62	4.48-5.98
Debt-asset ratio 2/	16.5	16.7	18.6	20.7	20.8	21.0

NA = not available.

1/ Deflated using the GNP implicit price deflator (1972 = 100). 2/ Computed based on nominal dollar balance sheet data, including farm households. 3/ Production Credit Association.

1980. The proportion of interest expenses to total production costs rose from 12.6 percent in 1980 to 15.8 percent this year as farmers incurred higher interest rates to finance annual operating expenditures, outstanding debt, and limited capital acquisitions. The real after-tax PCA interest rate is projected to average about 4.5 to 6 percent in 1985, compared to 5.6 percent in 1984. Real commercial rates also are forecast to fall in this range. As a result, capital costs for farmers will remain high next year.

The debt-asset ratio for January 1, 1985, is forecast to increase slightly from the January 1, 1984 estimate of 20.8. The rise is primarily because of continued high total farm debt and further declines in the value of farm real estate, which accounts for about 75 percent of total farm assets. Real total farm debt dropped to $96.1 billion this year from a record $100.5 billion in 1983. The real value of farm real estate totaled $342.2 billion in 1984, declining for the third straight year. The upward trend in the debt-asset ratio reflects continued deterioration in the financial condition of the farm sector.

Although real net farm income (net value of calendar-year production) is expected to increase from $7.5 billion in 1983 to between $13 and $15 billion in 1984, farm machinery demand has not been and is not expected to be affected significantly. Much of the increase in projected net farm income this year is due to a rise in the value of commodity inventories, which fluctuates with changes in commodity prices. Total net cash income (actual calendar-year income received), on the other hand, is forecast to fall from $18.6 billion in 1983 to $16.2 billion this year as increases in production expenses exceed gains in gross cash receipts. Many farmers with increased cash are likely to reduce existing debt rather than purchase new farm machinery.

The dramatic rise in U.S. agricultural exports during the 1970's stopped in recent years as depressed economic conditions overseas and the high value of the dollar in world money markets reduced demand for U.S. commodities. During the past decade, farmers responded to rising exports by expanding their productive capacity. Many farmers decided to work larger acreages and purchased additional farm machinery. Increased productive capacity was financed by higher-valued cropland (increased equity), which since 1981 has fallen steadily in real terms. The drop in the value of cropland in part resulted from the effects of the rising value of the dollar. Reduced export demand and record crop surpluses also held down commodity prices and farm income in the early 1980's, which further depressed demand for farm machinery. The value of the dollar in 1985 is expected to remain near historically high levels; therefore, export demand and cropland values are not likely to rise.

Assuming that farm financial conditions will not improve next year, domestic demand for farm machinery in 1985 could decline from the depressed levels of the past 3 years. Depending on interest rates, expenditures for farm machinery are estimated to range from $7.3 to $7.8 billion. Unit purchases are projected between 57,800 and 65,100 for over-40 hp two-wheel drive tractors, and from 3,500 to 5,000 for all four-wheel drive tractors. Purchase patterns for grain and forage harvesting equipment next year are expected to follow a similar trend from 1984.

Prices

As 1984 progressed, farm machinery prices stabilized as declining domestic demand encouraged farm machinery manufacturers and dealers to hold down prices. The index of prices paid by U.S. farmers for tractors and self-propelled machinery rose 2.8 percent from September 1983 to September 1984, while the price index for other machinery items increased 5.2 percent (table 29). Farm machinery price indices continue to increase at a higher rate than the index for all production items, which rose less than 1 percent from September 1983 to September 1984.

USDA farm machinery price indices may overstate actual purchasing costs for some machinery items because they may not fully reflect sales incentive reductions. Farm machinery dealers continue to offer attractive sales incentives to encourage farmers to purchase new machinery. There currently is a broad range of dealer and factory incentives for farmers with different financial conditions. These incentives include price discounts, cash rebates, fixed finance rates below current commercial rates, delayed financing, deferred payments, and variable maturity periods. Another attractive incentive currently offered by many firms is multiyear warranty coverage for new machinery items.

Table 29--Indices of farm prices paid by U.S. farmers

Month	Tractors and self-propelled machinery		Other machinery		All farm production items	
	1983	1984	1983	1984	1983	1984
			1977 = 100			
January	168	177	165	174	150	156
March	172	180	168	177	152	157
June	176	182	173	182	153	157
September	177	182	174	183	154	155
			Percent increase from previous year			
January		5.4		5.5		4.0
March		4.7		5.4		3.3
June		3.4		5.2		2.6
September		2.8		5.2		0.6

Source: U.S. Department of Agriculture, Statistical Reporting Service.

Sales incentives have influenced farmers in relatively secure financial condition to purchase new machinery items, but they have not been sufficient to encourage farmers with substantial debt or cashflow problems. For many U.S. farmers, current financial conditions will prohibit capital purchases of new machinery in the near future. Lower interest rates, continued improvement in the world economy, and a more competitive dollar for a sustained period appear the ideal remedy for improving demand for new farm machinery.

Unit Purchases

A comparison of domestic farm machinery purchases during January-October 1984 with purchases during the same period in previous years shows that domestic demand for new farm machinery has steadily declined and that purchasing patterns have shifted among tractor categories. Comparisons are made between 1984 and two earlier distinct periods--1973-1979, when purchases were stable or increasing, and 1980-1983, when purchases steadily declined. For all farm machinery categories except the under-40 hp two-wheel drive tractors, January-October 1984 unit purchases were significantly below average purchases during 1973-79 and 1980-83 (table 30).

Counter to industry trends, demand is increasing for small tractors, which are manufactured overseas. Purchases of under-40 hp two-wheel drive tractors totaled about 44,620 units during January-October 1984, about 99 percent above the average 10-month purchases for 1973-79 and 14 percent above the 1980-83 average. Many of these purchases, however, were made for nonagricultural purposes or for uses other than production of field crops.

For higher-powered tractors, overall demand continued to trend downward. January-October purchases of over-40 hp two-wheel drive tractors in 1984 were slightly more than one-half and one-quarter, respectively, of the average for 1973-79 and 1980-83. Demand patterns within the over-40 hp two-wheel drive tractor category show that purchases of 90-140 hp units declined the most. Purchases during January-October 1984 in the 4 groups of tractors that comprise the 90-140 hp category ranged about 76 to 87 percent below the 1973-79 average and about 52 to 79 percent below the average for 1980-83. One exception is purchases of 120-130 hp tractors, which increased about 3[illegible] percent during 1984 from the 1980-83 average. Another exception outside this hp range is January-October 1984 purchases of

Table 30--Domestic farm machinery purchases 1/

Machinery category	January-October average		January-October	Change in 1984 from average for	
	1973-79	1980-83	1984	1973-79	1980-83
	Units			Percent	
Tractors:					
Two-wheel drive--					
Under 40 hp	22,471	39,282	44,617	98.6	13.6
Over 40 hp	114,814	73,406	53,365	-53.5	-27.3
Four-wheel drive	7,677	6,711	3,341	-56.5	-50.2
Harvesting machinery: 2/					
Self-propelled combines	27,932	16,382	8,754	-68.7	-46.6
Balers 3/	24,636	10,793	7,778	-68.4	-27.9
Forage harvesters 4/	12,297	5,761	3,053	-75.2	-47.0
Mower conditioners	23,262	15,532	12,222	-47.5	-21.3

1/ Sales of some machinery categories are not reported each year in the time series. Annual averages for each category were computed for the actual number of years in which data are reported. 2/ Annual averages for harvesting machinery are for 1972 through 1979. 3/ Balers producing bales less than 200 pounds. 4/ Shear bar type.

Source: Farm and Industrial Equipment Institute. October 1984 FED FLASH REPORT. FED-150-D10-P. November 13, 1984, and previous monthly reports.

140-150 hp two-wheel drive tractors, which decreased roughly 68 percent from the 1980-83 average.

Total purchases of four-wheel drive tractors for these respective annual comparisons were off 56 and 50 percent as well. Comparisons for the largest four-wheel drive tractors (250 and over hp) are quite different, however. Purchases in 1984 were about 13 percent above the 1973-79 average, but 21 percent below the 1980-83 average. This dichotomy is due in part to the fact that higher-powered four-wheel drive tractors were not marketed until 1977.

Unit purchases of grain and forage harvesting equipment during the first 10 months of 1984 dropped precipitously below the 1972-79 and 1980-83 averages. Declines from 1972-79 ranged from 47 percent for mower conditioners to 75 percent for forage harvesters. Compared with the average for 1980-83, purchases fell from 21 percent for mower conditioners to 47 percent for forage harvesters. Unit purchases of self-propelled combines, the biggest ticket item in the harvesting equipment group, fell about 69 and [illegible]7 percent below 1972-79 and 1980-83 annual averages.

For the past several years, U.S. farmers have steadily been buying fewer and smaller-powered tractors. Since 1979, when farm machinery expenditures were record-high, total power takeoff capacity for over-40 hp tractor purchases declined from 15.3 million hp to 6.64 million hp in 1984 (table 31). The weighted average per-unit capacity for these purchases also has steadily declined from a high of about 111 hp in both 1980 and 1981 to 102 hp in 1984. Given current financial conditions, farmers are expected to continue purchasing smaller-powered tractors in the near future.

Supplies

Domestic Situation

Retail supplies of all farm machinery items are projected to be excessive throughout fourth-quarter 1984 and into 1985. The current supply situation reflects the prolonged effects of growing inventories and declining demand. Although the industry has responded to this condition by drastically cutting production, demand for machinery continues to decline and inventory-to-purchase ratios for all categories continue to rise. Until demand increases or manufacturers can sufficiently reduce inventories through production cuts, farm machinery supplies will remain large.

A comparison of inventory-to-purchase indices for 1978 through 1984 best exemplifies the excessive supply of various machinery items. The ratio for over-40 hp tractors measured 136 in September 1984, over twice the average 1979 ratio of 66 (table 32). Historically, tractor purchases made in October through December have accounted for about 25 percent of annual purchases. Current retail supplies as measured in September 1984 are three times the normal and projected fourth-quarter 1984 demand for tractors.

Farmers who intend to purchase either self-propelled combines, balers (producing bales up to 200 lbs.), or shear-bar forage harvesters also face a very favorable supply situation. Inventories as a percent of purchases for these items totaled 209, 103, and 247, respectively, as of September 1984 (table 32). During the past 5 years, purchases of self-propelled combines and forage harvesters between July and October averaged 54 and 59 percent of annual purchases, respectively. Given the highly seasonal buying pattern of grain and forage harvesting equipment, manufacturers maintain higher

Table 31--PTO estimates for domestic purchases of over-40 horsepower tractors 1/

Year	Total horsepower		Weighted average horsepower	
	Million	Percent change	Per unit	Percent change
1973	15.34		97.9	
1974	14.43	-5.9	101.0	3.2
1975	14.67	1.7	105.8	4.8
1976	14.32	-2.4	104.3	-1.4
1977	13.71	-4.3	104.7	0.4
1978	15.11	10.2	108.3	3.4
1979	15.30	1.3	110.1	1.7
1980	13.22	-13.6	110.8	0.6
1981	11.51	-12.9	110.8	0
1982	8.37	-27.3	108.3	-2.3
1983	7.68	-8.2	107.6	-0.6
Projected 1984	6.64	-13.5	102.0	-5.2

1/ PTO = power takeoff.

Source: Estimated from data summarized in table 30.

Table 32--September inventory to purchase ratios for selected farm machinery 1/

Machinery category	1978	1979	1980	1981	1982	1983	1984
				Percent			
Tractors:							
Two-wheel drive--							
40-99 hp	70	66	88	103	99	92	105
Over 100 hp	61	63	69	108	163	170	189
Total	66	65	80	105	126	123	137
Four-wheel drive	89	79	101	108	124	137	130
Total	67	66	82	105	126	124	136
Harvesting machinery:							
Self-propelled combines	78	77	103	118	198	182	209
Balers 2/	71	80	111	106	146	78	103
Forage harvesters 3/	196	177	195	206	263	232	247

1/ September 30 inventories for manufacturers, wholesalers, and dealers divided by January to September purchases. 2/ Producing bales up to 200 pounds. 3/ Shear bar type.

Source: Farm and Industrial Equipment Institute. September 1984 U.S. Retail Sales of Wheel Tractors and Selected Farm Machinery. 20-70-150-D9-P. November 12, 1984, and previous monthly reports.

inventory levels relative to purchases during the harvest season compared with the annual average. For instance, in September 1982, the ratio of inventories to purchases for self-propelled combines was 198, while the annual ratio measured only 100. However, depressed demand for self-propelled combines, balers, and forage harvesters through October 1984 indicate there will be above-normal supplies for the foreseeable future.

Foreign Trade

For the first 6 months of 1984, the United States registered a positive farm equipment trade balance of $302 million (table 33). Exports and imports both rose over year-earlier totals by 23 and 38 percent, respectively. Canada remained the most important U.S. trade partner. The U.S. trade balance with Canada improved from $214 million in January-June 1983 to $237 million during first-half 1984.

Canada and Australia continue to be the most important U.S. export markets for farm machinery. Exports to Canada and Australia for the first half of 1984 rose by approximately 26 and 400 percent, respectively, from a year earlier. Higher-powered farm machines produced in the United States are suitable for farming in Australia and Canada, unlike in many other countries that require smaller equipment. Roughly one-half of the value of exports to Canada and Australia is accounted for by large tractors and tractor parts. Given the very select foreign market for U.S. farm equipment, especially high-powered tractors and combines, the strong value of the dollar relative to foreign currencies has not been a strong deterrent to U.S. exports of farm equipment.

Conversely, the strong dollar abroad has had more of an impact on the overall rise in U.S. farm equipment imports. Imports from Canada, the United Kingdom, Italy, and Japan are up from 42 to 77 percent. U.S. farm machinery firms are contracting with private manufacturers and foreign subsidiaries to have them produce small- to medium-sized tractors for sale in the United States. In particular, most under-40 hp tractors are made under contract with Japanese firms and 40-99 hp tractors are made primarily by Western European subsidiaries of U.S. companies. Western European firms have a larger domestic market for 40-99 hp tractors than do U.S. firms and are able to produce these units at a lower cost. Tractors with less than 40 hp account for about 61 percent of the value of all U.S. farm machinery imports from Japan. Also, 40-99 hp tractors comprise approximately 55 and 46 percent of the total value of farm equipment imported by the United States from the United Kingdom and West Germany, respectively.

Table 33--Farm equipment trade situation 1/

Trade, country	1981	1982	1983	January-June 1983	January-June 1984
	Million dollars				
Exports:					
Canada	1,378	997	852	426	537
Australia	200	218	98	27	108
Mexico	260	125	46	15	40
Saudi Arabia	64	147	308	133	95
France	96	118	98	57	51
Total	1,998	1,605	1,402	658	831
Other	944	773	612	313	366
Total	2,942	2,378	2,014	971	1,197
Imports:					
Canada	706	487	454	212	300
Japan	202	181	205	95	158
United Kingdom	154	94	164	81	119
West Germany	197	169	248	127	112
Italy	101	95	99	44	78
Total	1,360	1,026	1,170	559	767
Other	190	154	177	91	128
Total	1,550	1,180	1,347	650	895
Trade balance	1,392	1,198	667	321	302

1/ Includes finished machinery items, nonassembled machinery, and parts.

Source: U.S. Department of Commerce. Trade Development, Office of Special Industrial Machinery.

Industry Profile

The U.S. farm machinery industry faces unprecedented financial problems as demand for its products falls for the fifth consecutive year. Adverse economic conditions since 1980 have taken many farmers totally out of the market for new farm machinery. For these farmers, the holding of currently-owned machinery for a longer time, machinery leasing, and purchases of used machinery are the only affordable means of satisfying their farm machinery needs.

Also, unlike other farm inputs (e.g. fertilizer, pesticides, and seed) that are relatively price inelastic at the farm demand level and are usually purchased with short-term operating capital, most farm machinery purchases are financed for more than 3 years. Because of different demand criteria for inputs and existing financial conditions, many farmers cannot assume additional long-term debt. As a consequence, the farm machinery industry is more vulnerable to the adverse economic conditions affecting agriculture than are other farm input industries.

In response to current conditions, domestic farm machinery manufacturers are taking short- and long-term steps to reduce operating costs and overhead. As gross receipts declined for most machinery manufacturers (some haven't shown a net profit for several years), efforts to reduce costs have allowed firms to remain in operation. Still, the major problem threatening the financial well-being of most full-line firms is manufacturing capacity levels that far exceed any foreseeable market demand.

Utilization rates reported in Stark's Off-Highway Ledger (Vol. 3, No. 23, November 19, 1984) show that North American tractor and combine producers are operating at 22.5 and 14.5 percent of total capacity, respectively, in an attempt to lower inventories and costs. Even at these low levels, inventory to purchase ratios reported earlier show that farm machinery supplies will remain excessive for the near term. To further avoid inventory buildups and associated finance costs, firms accounting for one-third of total North American tractor production temporarily stopped producing tractors during fourth-quarter 1984. Likewise, manufacturers who produce over 90 percent of all combines announced plans to temporarily close plants in late 1984. Some of these plants will not reopen until demand reduces inventories.

Although production cuts are the main way most farm machinery manufacturers are reducing costs, other steps include contractual arrangements with overseas subsidiaries and independent manufacturers to produce all or portions of some farm machinery items, scaled down product lines, and personnel reductions through early-retirement incentives.

Faced with a continued depressed market for farm machinery in 1985, some independent firms and parent companies have decided to concentrate long-term efforts in other markets. Yet, other firms have announced plans to market new tractors. Given excessive machinery inventories, plant closings and production cuts in 1984, and depressed demand expected next year, some firms may permanently consolidate production in a dramatic fashion or drop out of the market altogether.

FERTILIZER

Outlook for 1984/85

Preliminary data for the 1983/84 fertilizer year ending July 1, 1984, indicate that domestic agricultural consumption of fertilizer nutrients recovered substantially from the PIK-reduced level of 1982/83. Fertilizer use in 1983/84 rose 21 percent from a year earlier to near 22 million tons. Nitrogen use increased to about 11.1 million tons, phosphate 4.9 million, and potash 5.8 million tons.

In 1984/85, nutrient consumption is expected to advance about 2 percent, due to a slight increase in crop acreage and fertilizer application rates. Expected fertilizer consumption is forecast at 11.2 million tons of nitrogen, 5 million tons of phosphate, and 5.9 million tons of potash.

Fertilizer prices could advance again this year, but below the 7-percent rise in 1983/84. Overall prices in spring 1985 probably will be up less than 5 percent from a year earlier.

U.S. nitrogen production should increase in 1984/85. Stabilizing natural gas prices are helping to hold down production costs and maintain the competitive position of the domestic nitrogen fertilizer industry. Increased U.S. production should keep nitrogen imports close to year-earlier levels. Nitrogen exports also are expected to remain close to 1983/84 levels.

U.S. phosphate fertilizer production is forecast to rise about 4 percent in response to greater demand here and abroad. Exports could be up nearly 5 percent in 1984/85 as the world phosphate market continues to recover from depressed 1981/82 levels.

Larger potash supplies to meet expanded use in 1984/85 will come from increased production and imports. U.S. production could be up more than 10 percent, while imports are likely to be up less than 5 percent.

Review of 1983/84 Supplies

An additional 1 million tons of nitrogen from domestic production and another 1.2 million tons from increased imports were instrumental in satisfying expanded U.S. needs for nitrogen fertilizer in 1983/84 (table 34). Increased demand, coupled with higher prices, caused U.S. nitrogen production to increase about 10 percent.

Phosphate fertilizer production rose 14 percent in 1983/84 as U.S. producers responded to increased domestic and export demand. An additional 1.3 million tons of phosphate production was about equally divided between increased domestic use and expanded export requirements.

With domestic potash production down 10 percent, a 17-percent rise in potash imports was needed to meet increased U.S. requirements.

Trade

During 1983/84, U.S. imports of plant nutrients climbed some 27 percent in volume to 9.4 million tons, and 22 percent in value to $1.6 billion. Export volume and value each rose about 6 percent to 6.9 million tons valued at $2.3 billion.

On a nutrient basis, imports of all nitrogen products in 1983/84 increased around 45 percent from 2.8 to 4 million tons, as anhydrous ammonia imports jumped 52 percent and urea imports gained 21 percent (table 34). U.S. nitrogen exports increased 3 percent because diammonium phosphate exports recovered in the second half of the year.

After declining in 1981/82, phosphate exports rebounded, showing a year-over-year gain of about 10 percent in 1983/84. Exports of phosphoric acid and ammonium phosphate were up, more than offsetting declines in normal and triple superphosphate exports.

Potash imports increased 17 percent last year after declining in the 2 previous years. Potassium chloride, at 8.5 million short tons, was the largest nutrient import item.

Prices

Farm fertilizer prices in May 1984 averaged about 6 to 7 percent above a year earlier but declined more than 4 percent by October. Anhydrous ammonia and diammonium phosphate prices slipped about 8 percent from May, while prices of triple superphosphate and potash fell 9 percent (table 35). Mixed fertilizer prices averaged 1 to 8 percent lower. However, prices of urea, ammonium nitrate, and nitrogen solutions remained close to May levels.

Table 34--U.S. fertilizer supplies 1/

Item	1982/ 83	1983/ 84	Change
	Million short tons		Pct.
Beginning inventories: 2/			
Nitrogen (N)	2.07	2.00	-3
Phosphate (P_2O_5) 3/	.68	.67	-1
Potash (K_2O)	.57	.46	-19
Production:			
Nitrogen	11.29	12.36	+10
Phosphate 3/	9.25	10.55	+14
Potash	1.81	1.62	-10
Imports:			
Nitrogen	2.77	4.02	+45
Phosphate 3/	.11	.10	-10
Potash	4.51	5.29	+29
Exports:			
Nitrogen	2.00	2.05	+3
Phosphate 3/	3.92	4.33	+10
Potash	.62	.53	-15
Domestic supply: 4/			
Nitrogen	14.13	16.33	+16
Phosphate 3/	6.12	6.99	+14
Potash	6.27	6.84	+9

1/ Data for July through June for fertilizer year starting July 1. 2/ As of July 1. 3/ Does not include phosphate rock. 4/ Includes requirements for industrial uses.

Table 35--Average U.S. farm prices for selected fertilizer material 1/

Year	Anhydrous ammonia (82%)	Triple superphosphate (44-46%)	Diammonium phosphate (18-46-0%)	Potash (60%)	Mixed fertilizer (6-24-24%)
	Dollars per short ton				
1981: May	247	249	283	155	226
1982: May	255	228	262	155	219
1983: May	237	214	249	143	206
1984: May	280	231	271	147	217
October	259	210	250	134	205

1/ Based on a survey of fertilizer dealers conducted by the Statistical Reporting Service, USDA.

IOS-6

ENERGY

U.S. Energy Outlook

Spurred by rapid economic growth, U.S. energy use in 1984 is expected to rise 5.9 percent from 1983 to 74.8 quadrillion Btu. Energy consumption in 1985 is forecast at 76.1 quadrillion Btu, up less than 2 percent. The increases follow 4 years of decline: In 1983, use dropped more than 10 percent below the 1979 peak to 71 quadrillion Btu.

Improvement in fuel-efficient technology and energy conservation has caused the energy intensity of U.S. economic activity to decline. In 1973, energy intensity per dollar of real (1972 dollars) gross national product was 59,200 Btu. By 1983 it had dropped to 46,000 Btu per dollar of real gross national product and is projected at 45,400 Btu this year. Further gains in efficiency are anticipated in 1985, with intensity forecast at 45,000 Btu.

U.S. energy production in 1984 is projected to rise 6.7 percent from last year, while net energy imports are likely to climb 17 percent, accounting for 13 percent of the total U.S. energy supplied. More moderate gains are expected in 1985, with U.S. production up an estimated 1.8 percent, and imports up 2.2 percent. Net imports' share of the total energy supply probably will remain at 13 percent.

U.S. Petroleum Outlook

Total U.S. petroleum demand in 1984 apparently will increase for the first time since 1978, with consumption projected to rise by more than 4 percent from 1983. So far, 1984 has seen very rapid growth as the economic recovery continues. The outlook for 1985 is for continued growth, but at a much lower rate. As economic growth slows, U.S. petroleum demand is projected to be flat.

In 1984, increased U.S. energy requirements are likely to be met by greater imports, with domestic crude oil production increasing only 1.3 percent over last year (table 36). Net U.S. petroleum imports are estimated up more than 17 percent from 1983, accounting for about 31 percent of the total petroleum supply. In 1985, the share of net imports to total supply may remain at the 1984 level. Domestic crude oil production is expected to increase only slightly (0.4 percent).

Table 36--U.S. petroleum supply-demand balance

Item	1982	1983	1984-P	198[illegible]
	Million barrels per day			
Demand:				
Gasoline	6.54	6.62	6.78	6.78
Diesel fuel	2.67	2.69	2.87	2.79
Residual fuel	1.72	1.42	1.43	1.37
Other	4.37	4.50	4.80	4.93
Total	15.30	15.23	15.88	15.87
Supply:				
Production	10.78	10.79	10.93	10.97
Net imports (excludes SPR)	4.13	4.08	4.80	4.87
Net stock withdrawals	0.32	.25	-.06	.04
Total primary supply	15.23	15.12	15.67	15.87
	Percentage change from previous year			
Production		0.1	1.3	0.4
Demand		-0.5	4.3	-0.1
Net imports		-1.2	17.6	1.5
Net imports as share of U.S. supply		27.0	30.6	30.7

P = Projections.
SPR = Strategic Petroleum Reserves.

Source: U.S. Department of Energy, Energy Information Administration. Short-Term Energy Outlook. DOE/EIA - 0202 (84/3/Q), September 198[illegible]

World Petroleum Outlook

World economic growth is expected to continue through 1985, but at a lower rate than in first-half 1984. For 1984, total petroleum demand in market economies is estimated up about 1 million barrels per day with two-thirds of the increase occurring in the United States.

The official Organization of Petroleum Exporting Countries (OPEC) crude oil prices have remained at about $29 per barrel since March 1983. Spot prices recently have dropped considerably below the official prices because of world oversupply and sluggish demand. Great Britain and Norway recently lowered prices of their crude to $28.65 and $28.50, respectively. In response, OPEC decided to cut production by 9 percent, or 1.5 million barrels per day to hold the official price at $29. The oversupply situation is likely to keep downward pressure on world oil prices through the remainder of the year and through 1985 unless OPEC succeeds in curtailing production. In fact, the U.S. Secretary of Energy has stated that oil prices are not likely to stay much above $25 per barrel over the next few years .

The continuing Iran-Iraq conflict presents the possibility of an oil supply disruption in the Persian Gulf, as evidenced by recent attacks on oil tankers. The conflict is a continuing source of uncertainty and represents a threat to the stability of the world oil market. During 1984, an estimated 8 to 10 million barrels of oil per day will pass through the Strait of Hormuz. Although direct U.S. dependence on Persian Gulf oil is relatively low, oil is fungible and prices are relatively uniform throughout the world. Therefore, an oil cutoff from the Persian Gulf area could lead to higher U.S. oil prices.

Farm Energy Use and Expenditures

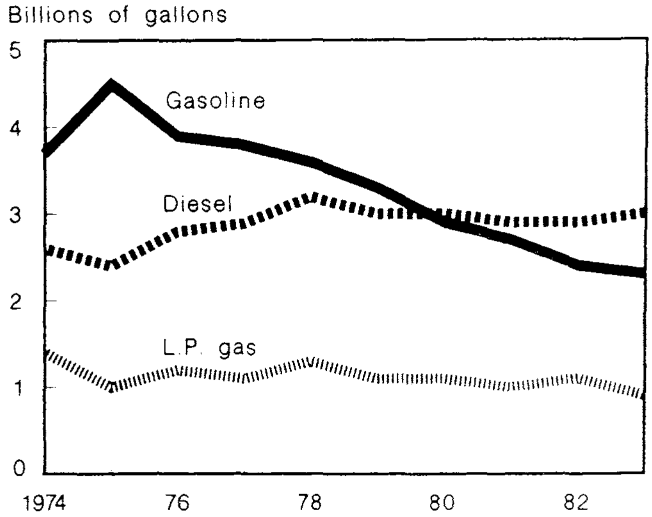
Agriculture accounts for less than 3 percent of total U.S. energy use, but energy is a very critical farm input. Farm energy use in 1984 is expected to rise 7 percent from last year as most of the acreage diverted in 1983 under the payment-in-kind (PIK) and other acreage reduction programs was returned to production and as harvest fuel needs rebounded from last year's drought-reduced requirements.

Farm use of gasoline in 1983 declined more than 4 percent from a year earlier, whereas diesel fuel increased more than 3 percent. Since 1980, farmers have used more diesel fuel than gasoline, largely because of the continued switch to diesel-powered machinery from older gasoline-powered machinery. LP gas use declined 18 percent in 1983, primarily due to reduced crop drying because of the PIK program and drought (figure 1).

Farmers' expenditures for fuels and energy in 1982 and 1983 were $9.8 and $9.6 billion, respectively. However, expenditures this year are projected to be higher, reversing a downward trend since 1981 when farm fuel and energy outlays peaked at $10.2 billion.

While total energy use is increasing this year, per acre use will likely decrease as efficiency gains continue. In spite of some

Farm Fuel Use



recent easing of energy prices, the energy price index level has remained higher than the general price level. Farmers continue to adopt energy conserving practices in tillage, irrigation, crop drying, and other farm activities.

Prices

Farm prices of gasoline, diesel, and LP gas are expected to be mostly unchanged for the remainder of 1984 and during 1985. Supplies should be ample assuming no major disruptions. For the first 9 months of 1984, farmers paid an average of $1.16 per gallon for bulk-delivered gasoline, $1.00 per gallon for diesel, and $0.76 per gallon for LP gas (table 37). Average farm gasoline and diesel fuel prices are down substantially from their 1981 peaks of $1.29 for bulk delivered gasoline and $1.16 for diesel fuel.

Unusually cold weather early in the winter of 1983/84 increased demand and put some upward pressure on fuel oil and distillate prices. In the first quarter of 1984, farmers paid $1.02 per gallon for diesel, 2 cents above the 1983 average. Farm gasoline prices for the remainder of 1984 are expected to average $1.15 per gallon, whereas LP gas prices may average about $0.76. Electricity prices to nonindustrial consumers are expected to average about 4 percent higher than last year.

Contrary to earlier forecasts, natural gas prices are not likely to increase significantly when partial deregulation takes effect on January 1, 1985, under the Natural Gas Policy Act. There are two reasons for this reversal: First, because of recent market conditions, most of the expected increases in natural gas prices from deregulation have already occurred. Second, natural gas prices are strongly influenced by world oil prices because of the strong substitution potential between oil and gas in the industrial and electricity market. Most industries and utilities can burn oil or gas, and since oil prices are not likely to rise, they will act as a lid on natural gas prices. This suggests farmers need not expect significant increases in fertilizer prices due to natural gas deregulation.

Table 37--Average U.S. farm gasoline, diesel fuel and LP gas prices

Period	Gasoline 1/	Diesel fuel	LP gas
	Dollars per gallon		
1977	.57	.45	.39
1978	.60	.46	.40
1979	.80	.68	.44
1980	1.15	.99	.62
1981	1.29	1.16	.70
1982	1.23	1.11	.71
1983	1.18	1.00	.77
1984			
I	1.16	1.02	.77
II	1.17	1.00	.76
III	1.15	0.99	.75
IV 2/	1.15	1.01	.76

1/ Bulk delivered regular. 2/ Projected using third-quarter farm prices as reported in Agricultural Prices, SRS, USDA and percentage changes projected by Department of Energy, Energy Information Administration for gasoline and number 2 heating fuel (for diesel and LP gas).

Source: U.S. Department of Energy, Energy Information Administration. Short-Term Energy Outlook. DOE/EIA - 0202 (84/3Q), September 1984.

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