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FARMERS' EXPENDITURES FOR CUSTOM PESTICIDE SERVICE IN 1964

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AGRICULTURAL ECONOMIC REPORT NO. 146

ECONOMIC RESEARCH SERVICE

U.S. DEPARTMENT OF AGRICULTURE

PREFACE

In 1964, the Congress authorized an expanded program of research on the use of pesticides in agriculture. One phase of this program was a periodic farm survey to obtain information on the use of pesticides in different areas and on different crops and classes of livestock. These data would provide a basis for estimating the costs and benefits of pesticides, and would serve as a measure of changes in pesticide use.

To meet this need for information, the Economic Research Service (ERS) undertook a nationwide sample survey of farmers in early 1965 to measure the extent of pesticide use by farmers during 1964. Personnel in the Statistical Reporting Service (SRS), Agricultural Research Service (ARS), and the Agricultural Stabilization and Conservation Service (ASCS) assisted in carrying out the study.

This report is on the first national survey of farmers' expenditures for pesticides. Although publication was delayed because of problems in computer compilations, the data will serve as important benchmarks.

The Standards and Research Division of SRS designed the nationwide sample from which farmers were selected for interview. The Data Collection Branch of SRS assisted in developing the final format of the questionnaire and supervised the collection of data through their State statistics offices throughout the country. The Washington Data Processing Center of SRS developed the automatic data processing system and program specifications and provided technical assistance in editing and tabulating the data.

Personnel in the Crops Research, Entomology Research, and Pesticide Regulation Divisions of ARS and in the Defense Activities Staff of ASCS assisted in designing the questionnaire and provided technical information relating to pesticides.

Special acknowledgment is made to Velmar W. Davis, Chief, Production Resources Branch, Farm Production Economics Division, ERS, for his work in initiating the pesticide research program, and developing the benchmark survey on which this report is based.

We are greatly indebted to the thousands of farmers who voluntarily provided the data. Without their interest and cooperation, this publication would not be possible.

This is one of a series of reports based on the survey. Other reports include Farmers' Expenditures for Pesticides in 1964; Quantities of Pesticides Used by Farmers in 1964; and Farmers' Pesticide Expenditures for Crops, Livestock, and Other Selected Uses in 1964 (Agr. Econ. Rpts. 106, 131, and 145, respectively).

CONTENTS

Page

Summary---------- iv

Methodology---------- 1

Expenditures for Custom Pesticide Services---------- 2
Custom pesticide services used on crops---------- 3
Costs per acre for custom services---------- 4
Equipment used for applying custom pesticides---------- 4
Forms of pesticide materials used---------- 5
Forms of pesticide applied by types of equipment---------- 6
Custom pesticide services used on livestock---------- 6

Tables---------- 8

Appendix.--Crops included in grouped categories---------- 24

Washington, D.C. 20250 October 1968

SUMMARY

Farmers use custom pesticide services extensively. In the 48 contiguous States, they spent about $173 million for custom pesticide services, including the cost of application and materials, in 1964. This amounted to an average of about $55 for each farmer. Nearly $172 million was spent to control crop pests and slightly less than $2 million to control livestock pests. The cost of custom-applied pesticide materials used on crops and livestock was $115 million or one-fourth of all pesticides used by farmers in 1964.

About one-third of the farmers using pesticides on crops in 1964 used some custom services and 27 percent of total farm expenditures for crop pesticide materials was for materials applied by custom operators. Only 5 percent of the livestock pesticide materials were custom applied.

Of the $172 million that farmers spent for custom pesticide services on crops, one-third--$59 million--was for application and two-thirds--$113 million--for materials. The cost of applying the pesticides varied from 19 percent of the total custom cost for vegetables other than potatoes to 75 percent for hay and pasture.

Cotton was the major crop on which custom pesticide services were used. Growers spent $65 million for custom services on cotton, an average of $857 for each farm using such services. Forty-three percent of the farmers using pesticides on cotton used some custom services.

The crop categories with the highest average cost per farm for custom pesticide applications and materials were certain fruits and nuts ($1,661) and potatoes ($1,490).

While only 22 percent of the corn growers using pesticides had them custom applied, more farmers reported using custom services to treat corn than any other crop. Custom expenditures for corn were about $11 million in total and averaged only $77 per farm where used.

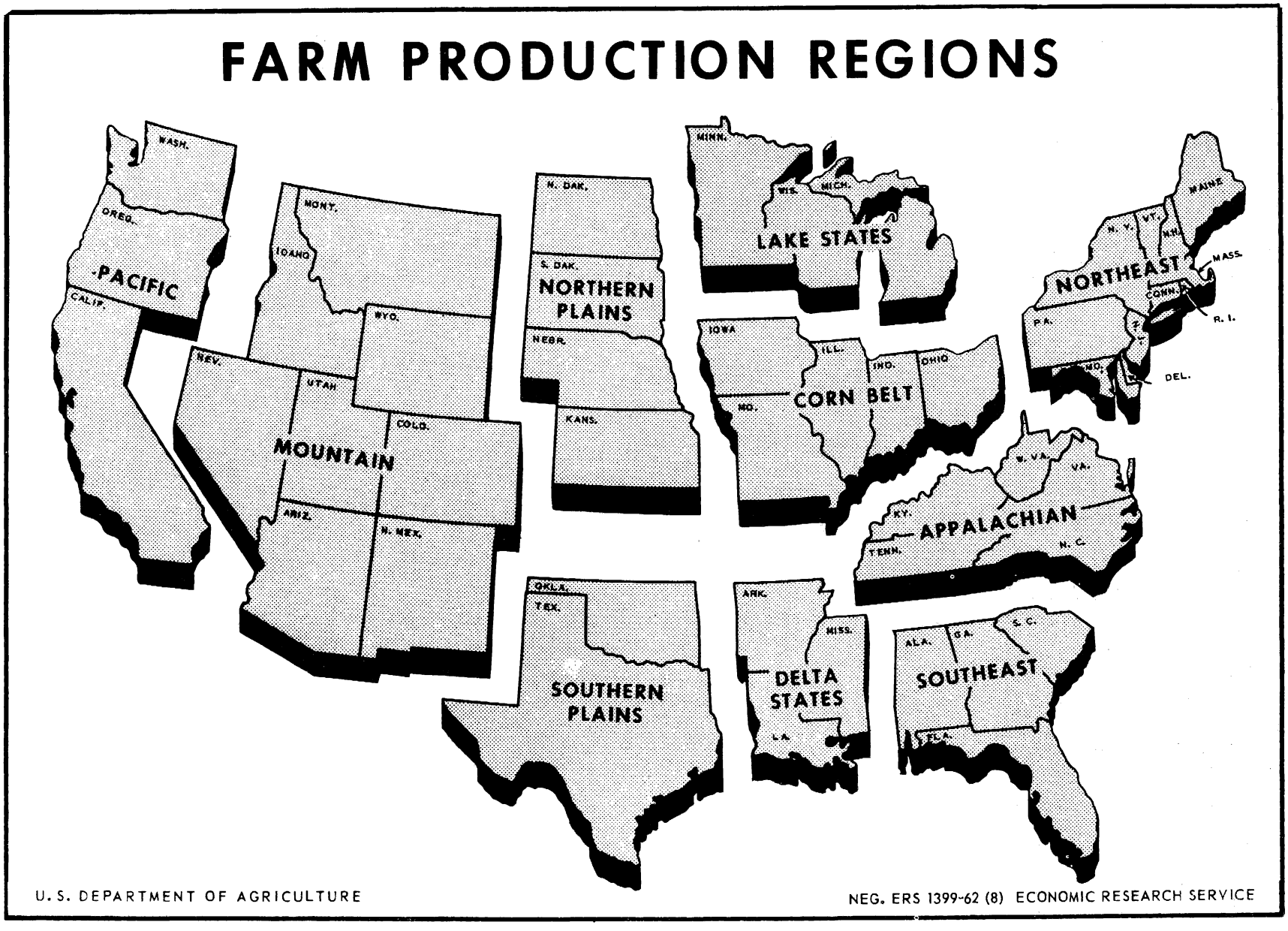
Sprays were the predominant form of materials used by custom operators. They accounted for 88 percent of all the custom pesticide materials used on crops. Dusts accounted for 10 percent and granular and other materials for about 1 percent each.

The combined cost of spray (liquid) materials and custom application of sprays in 1964 ranged from $1.60 per acre for application with fixed wing aircraft on wheat, sorghum, and summer fallow to almost $70 an acre for sprays applied to tobacco with ground equipment. The high cost for custom treatment of tobacco was primarily due to soil sterilization of tobacco beds. Charges for spray materials alone ranged from $0.40 an acre for hay and pasture to $65.70 for tobacco. Application charges ranged from $0.90 to $6.60 per acre, depending on the crop and the type of equipment used.

Fixed wing aircraft accounted for nearly 70 percent of the farmers' custom expenditures for application and materials. Ground equipment accounted for 30 percent and helicopters 1 percent.

Aircraft accounted for a much larger proportion of application costs than of the costs of materials. This was due largely to the fact that aircraft were used primarily for relatively light application on field crops, and therefore covered a wider area with the same amount of material than ground equipment, which was generally used for fruits and vegetables.

Farmers generally did not use custom pesticide services to treat livestock. They only spent a total of about $1.7 million for custom-applied pesticides on livestock in 1964. This amounted to 5 percent of all the pesticides used on livestock. Thirty-seven percent of the farmers using custom services on livestock treated dairy cattle. However, the amount spent for custom-applied pesticides by the average dairy farmer was low compared to other livestock producers.


FARM PRODUCTION REGIONS
WASH.
OREG.
CALIF.
PACIFIC
MONT.
IDAHO
WYO.
NEV.
UTAH
COLO.
ARIZ.
N. MEX.
MOUNTAIN
N. DAK.
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NEBR.
KANS.
NORTHERN PLAINS
MINN.
WIS.
MICH.
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Figure 1

FARMERS' EXPENDITURES FOR CUSTOM PESTICIDE SERVICE IN 1964

by

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Custom pesticide services are a significant farm expense item. Over one-fourth of the pesticides used on farms in 1964 were applied by custom operators. Farmers spent over $173 million on custom pesticide applications and materials in 1964. This report explores the nature and extent of custom pesticide services used by farmers on crops and livestock in various regions of the 48 contiguous States. Custom services may vary from applying a herbicide-fertilizer combination with ground equipment on corn to applying low-volume insecticides on cotton from airplanes.

Some of the major reasons farmers use custom pesticide application services are: (1) Technical knowledge, skill, and costly specialized application equipment are needed for proper application, (2) farm labor may not be available at the critical time, and (3) dealers may offer the service at little or no charge when the farmer buys their materials.

METHODOLOGY

This report is based on a personal-interview survey of 10,800 farms in 417 counties throughout the 48 States.

The survey included farms with gross sales from agricultural products of $5,000 or more annually in all ERS production regions1/ of the 48 States, except 12 Southern States, where it included farms with gross sales of $2,500 or more per year. These 12 States are in three regions--Appalachian, Southeast, and the Delta. The kinds of farms included in the sample accounted for about 90 percent of the sales of farm products. The survey included nearly 1 percent of these farms, and was designed to allow expansion of the data to regional and 48-State totals.

In this report, totals have been adjusted to represent all farms in each region and in the 48 States. The sample data relating to crops were expanded to 1964 Census of Agriculture totals for each region for all farms on the basis of acres of each crop grown on the sample farms relative to total acreage of the crop in the region. For example, 247,700 acres of corn reported grown by farmers surveyed in the Corn Belt were expanded to 31,125,000 acres of corn grown by all farmers in the Corn Belt in 1964 as reported by the Census of Agriculture. It was assumed that small farmers not included in the sample used custom pesticide services at the same rates as farmers that were sampled.

1/ The map on the facing page shows the States in the ERS production regions.

Livestock data were expanded in a similar way. In each region, the total number of commercial farms reporting a class of livestock (based on the 1964 Census of Agriculture) was divided by the number of sample farms in the region reporting that class of livestock. This ratio of total farms with livestock to sample farms was used to expand the sample data on custom pesticide usage to total usage for the region.

This report discusses custom services related to the use of pesticides on crops and livestock, including insecticides, herbicides, fungicides, miticides, nematocides, rodenticides, soil fumigants, defoliants, and desiccants. Disinfectants and any kind of medicine taken internally by livestock are not included. Neither does the report include custom services employed in treating seed, stored crops, storage buildings, farmyards, gardens, idle cropland, fence rows, irrigation ditches, road banks, or any other noncropland. Custom pesticide services that were part of an organized local, State, or Federal pest control program not paid for directly by the farmer are not covered in this report.

EXPENDITURES FOR CUSTOM PESTICIDE SERVICES

Due to the technical knowledge and specialized equipment required for proper application of agricultural chemicals, farmers use custom services extensively. Farmers spent over $173 million for custom pesticide applications and materials in 1964. This amounted to an average of about $55 for each farmer in the 48 contiguous States. Of this, as shown in the tabulation below, nearly $172 million was spent to treat crops and less than $2 million to treat livestock.

	Pesticide applications	Pesticide materials	Total
	$1,000	$1,000	$1,000
Crops	58,921	112,878	171,799
Livestock	1/	1,690	1,690
Crops and livestock 2/	58,921	114,568	173,489

1/ Application costs for livestock were not obtained in this survey. However, they are estimated at close to an additional $1 million.

2/ Does not include the cost of applying pesticides on livestock or livestock buildings or any expenditures for custom pesticide services other than for crop and livestock uses.

The cost of custom-applied pesticide materials (not including applications) amounted to nearly $115 million or 25 percent of all pesticide materials used by farmers in 1964.

A comparison with an earlier report2/ indicates that the proportion of pesticides, as measured by expenditures, applied by custom operators was the same in 1964 as the proportion of all acres treated by custom operators in 1958. About 27 percent of the pesticides applied to crops

2/ Strickler, Paul E., Extent of Spraying and Dusting on Farms, 1958 With Comparisons, U.S. Dept. Agr. Statis. Bul. 314, May 1962.

in 1964 were custom applied, ranging from 5 percent of all pesticides used on apples to 80 percent of those used on grains other than corn, wheat, and sorghum (table 1). Farmers generally did not use custom services to treat livestock because of the need for frequent application and the low cost of the equipment used. Only 5 percent of all livestock pesticide materials were custom applied.

Custom Pesticide Services Used on Crops

Nearly $172 million was spent for custom services to control crop pests or an average of $372 per farm included in the survey. Of the total amount farmers spent for custom services on crops, one-third ($59 million) was for application and two-thirds ($113 million) was for materials.

Nearly one-third of the farmers who used pesticides on crops had some custom applied (table 2). Seventy-five percent of the citrus growers, but only 13 percent of the apple growers, used these services. The cost of applying the pesticides varied from 19 percent of the total custom cost for vegetables other than potatoes to 75 percent for hay and pasture. This difference is primarily due to the large amounts of relatively high-cost pesticides required for vegetables compared with the small amount of lower cost materials used on hay and pasture.

Cotton was the leading crop on which custom pesticide services were used in 1964. This crop accounted for over one-third of the total spent by all farmers for custom pesticide applications and materials. On the average, cotton growers who used custom services spent $857 per farm on custom services for cotton.

Generally, expenditures for fruit and vegetable custom pesticide application and materials were higher than for most other crops. Where custom services were used, the expenditure per farm on Irish potatoes was $1,490, on citrus and apples about $750, and on miscellaneous fruits and nuts $1,661. The large expenditures for these crops are largely due to the need for repeated applications and the high cost of some pesticides used.

Custom pesticide services were used most frequently to treat corn. However, the average expenditure per farm for custom services of $77, including application and the materials, was among the lowest for any crop.

Farmers in the Western and Southern regions, except for the Southeast, were more likely to use custom services than those in other areas, and also, had the highest expenditures per farm. The largest amounts spent for custom pesticide applications and materials, both as totals and per farm, were in the Pacific, Delta, and Southern Plains regions (table 3). Farmers in these regions accounted for over 60 percent of all custom pesticide expenditures in the 48 States and spent over $1,000 per farm for custom application and materials. The large amounts spent on custom services in these areas can be attributed primarily to the large acreages of cotton, fruits, vegetables, and specialty crops.

The use of custom pesticide services does not appear to be influenced greatly by size of farm (table 4). About 30 percent of the farmers who used pesticides also used custom pesticide services in all of the groupings, below $40,000, of farms according to gross sales. Forty-three percent of the farmers with sales of $40,000 or more used custom services.

Expenditures for custom pesticide services, however, were closely related to sales. Farms with annual sales of $40,000 or more accounted for slightly less than half of the agricultural sales and had a little over half of the total expenditures for custom pesticide services. As would be expected, the amount spent per farm for custom services went up appreciably as sales increased. Farmers with sales of $5,000 to $10,000 spent $140 per farm for custom services while those with sales of over $40,000 spent over $1,800 (table 4).

Costs per acre for custom services

The average cost of custom spraying services, including materials and application, ranged from $1.60 per acre for materials applied with fixed wing aircraft on wheat, sorghum, and summer fallow to almost $70 per acre for sprays applied to tobacco with ground equipment (table 5). The high cost of tobacco treatment was largely due to the use of soil sterilants on tobacco beds.

Comparisons of the actual costs of application with costs of materials between areas or crops are not easily made. Some operators may apply the materials at little or no cost and charge more for the pesticide while others may do the reverse. Therefore, the charge for application needs to be considered in conjunction with the charge made for the pesticides.

The cost of applying the pesticide sprays ranged from $0.90 an acre for cotton, wheat, other grain, and summer fallow when ground equipment was used, and for soybeans when aircraft was used, to $6.60 an acre for sprays applied to citrus and apples with ground equipment. Material costs ranged from $0.40 an acre for sprays applied with fixed wing aircraft to hay and pasture to $65.70 for sprays applied with ground equipment on tobacco. The low cost for hay and pasture is primarily due to the extensive use of the relatively inexpensive material, 2,4-D, while the high cost for tobacco reflects seed bed treatment.

Expenditures per acre for dusts, granules, and other types of materials in addition to sprays by major crop groupings are shown in tables 6, 7, and 8. With ground equipment, the per acre cost for sprays was generally higher than for dusts. When air equipment was used, the reverse was usually true.

Regionally, the highest per acre costs for pesticide services were frequently in the Lake States and Pacific regions, probably because of the large acreages of fruits and specialized crops in these areas (table 9). The lower cost of sprays in the Delta, Corn Belt, and Northern Plains may be largely attributed to the predominance of grains and other field crops in these areas.

Equipment used for applying custom pesticides

Equipment used for custom application was classified into three general types: ground, fixed wing aircraft, and helicopter. Most of the custom pesticides were applied by fixed wing aircraft. They accounted for 69 percent of the farmers' custom pesticide expenditures for applications and materials in 1964 (table 10). Ground equipment accounted for 30 percent. Helicopters were only a minor factor and accounted for 1 percent.

Fixed wing aircraft seem to be particulary important in applying pesticides to most field crops, which are generally treated only once or twice during the growing season. About 90 percent of the custom pesticide expenditures for small grains and soybeans were used for treatment by fixed wing aircraft. Ground rigs are not particularly adaptable to use on these crops during the growing season.

Ground equipment was most often used to apply custom pesticides on fruits and vegetables and also on corn and tobacco. This type of equipment is well suited for use on fruits, vegetables, and tobacco because they require relatively large amounts of pesticides, and fruits and tobacco are frequently grown in small plots on hilly or rolling land.

Fixed wing aircraft accounted for over 80 percent of the cost of applying custom pesticides, but only 61 percent of the materials were applied by them. On the other hand, ground equipment, which accounted for only about 14 percent of the cost of applying dusts and sprays, applied 36 percent of the materials. The major reason for the relatively higher application cost with airplanes was that they were usually used on crops where large areas were covered with relatively small amounts of material. The crops on which ground equipment was most often used frequently require large amounts of material to treat a given area.

Over 90 percent of the amount spent for custom pesticide application and materials in the Delta and Southern Plains regions was for services of fixed wing aircraft (table 11). On the other hand, less than 40 percent of the custom pesticide business in the Northeast, Lake States, and Appalachian regions was accounted for by fixed wing aircraft.

Some of the differences in the type of equipment used can be attributed to the size of the area to be treated and the topography. For example, crops in the Appalachian region are difficult to treat with airplanes because frequently the fields there are small and widely dispersed. Tobacco, a major crop in the Appalachian area, is often grown in such small plots that treatment by aircraft would be difficult.

The large-scale irrigated cotton farming areas of the Delta area are particularly adaptable to aerial application. Aircraft are also preferred in the Plains, where small grains are grown on large level tracts of land. In the Corn Belt, where row crops predominate, ground equipment is used by custom operators to apply most of the pesticides.

Helicopters, although not used extensively in any area, were most important in the Northeast. These aircraft are capable of precision spraying on small fields close to populated areas. Ground equipment lends itself to the significant acreages of horticultural and specialty crops grown in the Northeast.

Forms of pesticide materials used

Pesticide materials were classified into the following types: dusts, sprays, granules, and other. Dusts are dry materials purchased at field strength and applied in the dry form. The use of this type of material is gradually diminishing relative to other forms. Sprays are applied in a liquid medium and are usually purchased either as emulsions or as wettable powders. In recent years, emulsions have become the most popular form for most pesticide products, due to the reduced dangers in mixing and the ease of combining such pesticides with water. Granules are dry

materials which have been aggregated into pellets. While the granular market is still relatively small, it is expanding rapidly.

All other pesticides were grouped into a category of "other." This group includes baits, strips, aerosols, rubs, etc.

Sprays were the predominant form of pesticides used in custom applications. They accounted for almost 90 percent of all expenditures for custom pesticide services used by farmers on crops (table 10). Sprays represented from 76 percent of the materials used on fruits and nuts (not including deciduous fruit) to nearly 100 percent of those used on small grains and sorghum.

Dusts accounted for 10 percent of the custom services and materials used on crops. Their use ranged from 1 percent on grains and hay to 24 percent for some fruits and nuts.

Granular pesticides, which accounted for only 1 percent of the expenditures for custom services by farmers, were used mostly on corn and other field crops. The remaining 1 percent of the custom pesticides were in forms other than dusts, sprays, or granules. These were used primarily on tobacco, alfalfa, and vegetables.

Geographically, sprays ranged from slightly over 50 percent of custom pesticide expenditures in the Southeast to 98 percent in the Southern Plains (table 11). Almost 50 percent of the pesticides used by custom applicators in the Southeast were dusts. Other areas using appreciable amounts of dusts were the Northeast, Lake States, and Mountain regions. Most of the granular materials were used in the Corn Belt as soil insecticides and herbicides.

Forms of pesticide applied by types of equipment

Sprays were by far the predominant pesticide form used in both aerial and ground applications for nearly all crops. Slightly over 60 percent of the total amount spent by farmers for custom services, including materials and applications, was for sprays applied by fixed wing aircraft (table 12). Twenty-six percent was for sprays applied with ground equipment.

Dusts accounted for 10 percent of the total amount spent for custom pesticide services. Of this, 8 percent was applied with air equipment and 2 percent with ground equipment. A slightly lower proportion of the aerial application costs was for dusts (table 13). A slightly larger proportion of the dust material was applied by aircraft (table 14). Aerial application of dusts was significant on soybeans and vegetables other than potatoes. Substantial amounts of dusts were also applied with ground equipment on some fruits and nuts.

Custom Pesticide Services Used on Livestock

Livestock were generally not treated by custom operators. Farmers spent only about $1.7 million for pesticide materials that were applied to livestock by custom operators in 1964 (table 15). This amounted to 5 percent of the total spent for livestock pesticide materials. In addition, only 5 percent of the farmers reporting the use of pesticides on livestock used custom services. Information was not obtained on the cost of applying the livestock pesticides.

In this report, livestock pesticides include only chemicals, primarily insecticides, that were applied externally to animals or to the premises. Livestock pesticides do not include disinfectants or any type of medicine taken internally.

Total custom expenditures for livestock pesticide materials were highest for beef cattle. The amount spent per farm for different classes of livestock ranged from an average of $15.20 for treating hogs to $47.40 for poultry.

Of the total amount spent for custom-applied livestock pesticide materials, 34 percent was for treating beef cattle, 27 percent for dairy cattle, and 22 percent for poultry (table 16).

Custom pesticide expenditures on poultry were most important in the Northeast, Delta, and Southeast. In the Appalachian, Northern Plains, Southern Plains, and Mountain regions, expenditures on beef were highest. In the Corn Belt, custom pesticide expenditures on hogs were highest, and in the Lake States, custom expenditures were highest on dairy cattle.

While expenditures on dairy cattle accounted for only 27 percent of all custom livestock pesticide costs, dairy producers accounted for 37 percent of all farmers using custom services on livestock. On the other hand, poultry producers accounted for 22 percent of the custom expenditures, but only 12 percent of the farmers using custom services.

Table 1.--Expenditures for custom-applied pesticide materials compared with total expenditures for pesticide materials used on crops and livestock, 48 contiguous States, 1964 1/

Category	Total expenditures for materials	Expenditures for custom applied materials 2/	
	$1,000	$1,000	Percent
Crops:			
Corn	71,803	8,856	12
Cotton	114,040	44,070	39
Wheat	9,487	5,264	55
Sorghum	2,682	754	28
Other grains 3/	19,796	15,746	80
Soybeans	18,352	4,750	26
Tobacco	30,025	2,385	8
Other field crops 3/	20,047	4,585	23
Alfalfa	4,023	1,337	33
Other hay and pasture 3/	6,510	1,041	16
Irish potatoes	10,691	2,014	19
Other vegetables 3/	33,368	11,878	36
Citrus	13,785	5,039	37
Apples	38,968	1,861	5
Other deciduous fruit 3/	14,610	984	7
Other fruits and nuts 3/	12,097	2,158	18
Summer fallow	3,377	156	5
All crops	423,661	112,878	27
Livestock: 4/			
Dairy	8,997	440	5
Beef	17,681	720	4
Hogs	2,726	172	6
Sheep	275	132	48
Poultry	1,614	226	14
All livestock	31,293	1,690	5
Crops and livestock	454,954	114,568	25

1/ Does not include any expenditures for custom applied pesticide materials for noncrop and nonlivestock uses.
2/ Does not include cost of applying pesticides.
3/ Crops included in this category are listed in the appendix.
4/ Does not include the cost for applying pesticides on livestock or livestock buildings.

Table 2.--Extent and cost of custom pesticide application on crops, by crop category, 48 contiguous States, 1964

Category	Farms reporting pesticide use 1/	Farms reporting custom application service 2/	Total custom expenditure for--3/			Expenditures per farm reporting custom pesticide services for--4/		
			Applying pesticides	Applied pesticide materials	Total	Applying pesticides	Applied pesticide materials	Total
	Percent	Percent	$1,000	$1,000	$1,000	Dollars	Dollars	Dollars
Corn	56	22	2,310	8,856	11,166	17	60	77
Cotton	73	43	20,545	44,070	64,615	302	555	857
Wheat	20	55	7,886	5,264	13,150	104	58	162
Sorghum	26	25	958	754	1,712	68	47	115
Other grains 5/	18	35	5,929	15,746	21,675	92	212	304
Soybeans	19	25	2,981	4,750	7,731	143	198	341
Tobacco	94	22	611	2,385	2,996	13	56	69
Other field crops 5/	44	35	3,001	4,585	7,586	114	147	261
Alfalfa	7	24	1,248	1,337	2,585	102	93	195
Other hay and pasture 5/	7	15	3,063	1,041	4,104	128	45	173
Irish potatoes	85	18	2,947	2,014	4,961	940	550	1,490
Other vegetables 5/	64	37	2,825	11,878	14,703	145	520	665
Citrus	96	75	1,947	5,039	6,986	264	490	754
Apples	89	13	590	1,861	2,451	145	602	747
Other deciduous fruit 5/	95	16	293	984	1,277	47	140	187
Other fruits and nuts 5/	80	29	1,608	2,158	3,766	134	1,527	1,661
Summer fallow	13	19	179	156	335	36	30	66
All crops	73	32	58,921	112,878	171,799	152	220	372

1/ Survey farms using pesticides on specified crops as a percentage of survey farms growing the crop.
2/ Survey farms reporting custom application services as a percentage of farms reporting pesticide use.
3/ Estimated expenditures for all farms in the 48 States.
4/ Expenditures per farm included in the survey. Includes farms with sales of agricultural products of $5,000 or more in all areas of the United States except the South. In the South (Appalachian, Southeast, and Delta States), includes farms with sales of $2,500 or more.
5/ Crops included in this category are listed in the appendix.

Table 3.--Extent and cost of custom pesticide application on crops, by regions, 48 contiguous States, 1964

Region	Farms reporting pesticide use 1/	Farms reporting custom application service 2/	Total custom expenditure for--3/			Expenditures per farm reporting custom pesticides services for--4/		
			Applying pesticides	Applied pesticide materials	Total	Applying pesticides	Applied pesticide materials	Total
	Percent	Percent	$1,000	$1,000	$1,000	Dollars	Dollars	Dollars
Northeast	65	29	1,306	2,424	3,730	55	102	157
Lake States	70	36	1,646	4,663	6,309	34	96	130
Corn Belt	79	21	2,778	5,988	8,766	43	93	136
Northern Plains	71	29	5,020	3,087	8,107	118	73	191
Appalachian	89	28	1,450	5,283	6,733	35	128	163
Southeast	77	30	3,286	10,954	14,240	107	357	464
Delta States	68	62	13,226	20,873	34,099	431	680	1,111
Southern Plains	46	53	10,418	20,691	31,109	344	683	1,027
Mountain	54	54	6,042	10,469	16,511	264	457	721
Pacific	70	54	13,749	28,446	42,195	440	911	1,351
All regions	73	32	58,921	112,878	171,799	152	220	372

1/ Survey farms using pesticides on any crop as a percentage of survey farms growing crops.
2/ Survey farms reporting custom application services as a percentage of farms reporting pesticide use on any crop.
3/ Estimated expenditures for all farms in the 48 States.
4/ Expenditures per farm included in the survey. Includes farms with sales of agricultural products of $5,000 or more in all areas of the United States except the South. In the South (Appalachian, Southeast, and Delta States), includes farms with sales of $2,500 or more.

Table 4.--Extent and cost of custom pesticide application on crops, by gross sales, 48 contiguous States, 1964

Gross sales of farms	Farms reporting pesticide use 1/	Farms reporting custom application services 2/	Total custom expenditure for--3/			Expenditures per farm reporting custom pesticide services for--4/		
			Applying pesticides	Applied pesticide materials	Total	Applying pesticides	Applied pesticide materials	Total
	Percent	Percent	$1,000	$1,000	$1,000	Dollars	Dollars	Dollars
Less than $5,000----	5/	5/	3,026	8,141	11,167	5/	5/	5/
$5,000-$9,999-------	65	32	5,198	10,264	15,462	50	90	140
$10,000-$19,999-----	73	31	8,272	15,186	23,458	68	123	191
$20,000-$39,999-----	80	30	9,950	19,062	29,012	141	268	409
$40,000 or more-----	76	43	32,475	60,225	92,700	648	1,189	1,837
All classes-------	73	4/32	58,921	112,878	171,799	152	220	372

1/ Survey farms using pesticides on any crop as a percentage of survey farms growing crops.
2/ Survey farms reporting custom application services as a percentage of farms reporting pesticide use on any crop.
3/ Estimated expenditures for all farms in the 48 States.
4/ Includes farms with sales of agricultural products of $5,000 or more in all areas of the United States except the South. In the South (Appalachian, Southeast, and Delta States), includes farms with sales of $2,500 or more.
5/ Information not available for all farmers in this class.

Table 5.--Expenditures per acre for custom pesticide spraying service for selected crops applied by ground equipment and fixed wing aircraft, 48 contiguous States, 1964 1/

Category	Application cost		Materials cost		Application and materials cost	
	Ground equipment	Fixed wing aircraft	Ground equipment	Fixed wing aircraft	Ground equipment	Fixed wing aircraft
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Corn	1.20	1.40	3.00	1.30	4.20	2.70
Cotton	.90	1.00	8.00	1.60	8.90	2.60
Wheat	.90	1.00	1.70	.60	2.60	1.60
Sorghum	1.00	1.10	2.80	.50	3.80	1.60
Other grains 2/	.90	1.40	2.10	3.80	3.00	5.20
Soybeans	1.00	.90	3.40	1.10	4.40	2.00
Tobacco 3/	3.20	2.60	65.70	3.10	68.90	5.70
Other field crops 2/	1.30	1.80	10.10	1.30	11.40	3.10
Alfalfa	1.60	1.30	2.20	.90	3.80	2.20
Other hay and pasture 2/	1.10	1.30	1.50	.40	2.60	1.70
Irish potatoes	2.70	2.70	8.60	1.70	11.30	4.40
Other vegetables 2/	3.00	2.60	22.60	3.80	25.60	6.40
Citrus	6.60	1.60	14.90	3.30	21.50	4.90
Apples	6.60	4.00	15.40	2.10	22.00	6.10
Other fruits and nuts 2/	4.10	2.60	9.50	.80	13.60	3.40
Summer fallow	.90	1.00	2.30	.60	3.20	1.60
All crops	2.60	1.20	13.70	1.50	16.30	2.70

1/ Includes only custom rates for liquid materials applied by custom applicators.
2/ Crops included in this category are listed in the appendix.
3/ Includes soil sterilants on tobacco beds.

Table 6.--Expenditure per acre for custom pesticide application and materials for selected crop groupings, by form of pesticide applied with specified types of equipment, 48 contiguous States, 1964

Category	Ground equipment				Aircraft			
					Fixed wing		Helicopter	
	Dust	Spray	Granular	Other	Dust	Spray	Dust	Spray
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Grains 1/	2.80	4.80	2.80	---	4.00	2.60	---	2.50
Other field crops 2/	4.30	3/29.70	12.90	4/	5.80	3.80	---	2.30
Hay and pasture 5/	---	3.20	5.20	1.90	3.20	1.80	---	6.70
Vegetables 6/	12.30	19.50	---	23.30	6.10	5.40	---	14.30
Citrus fruits	8.30	21.50	---	---	---	4.90	---	4/
Other fruits 7/	4.90	19.70	---	---	8.20	6.50	9.00	4/
All crops	4.50	16.30	3.30	18.20	5.80	2.70	9.00	2.70

1/ Includes corn, sorghum, soybeans, wheat, and other grain listed in the appendix.
2/ Includes tobacco, cotton, and other field crops listed in the appendix.
3/ Includes soil sterilants used on tobacco.
4/ Less than 10,000 acres treated.
5/ Includes all pasture, alfalfa, other hay and forage, and summer fallow.
6/ Includes potatoes and other vegetables listed in the appendix.
7/ Includes apples and the other deciduous fruits, and the other fruits and nuts groupings in the appendix.

Table 7.--Expenditures per acre for custom pesticide application (not including materials) for selected crop groupings, by form of pesticide applied with specified types of equipment, 48 contiguous States, 1964

Category	Ground equipment				Aircraft			
					Fixed wing		Helicopter	
	Dust	Spray	Granular	Other	Dust	Spray	Dust	Spray
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Grains 1/	1.20	1.00	1.00	---	1.50	1.10	---	1.50
Other field crops 2/	.90	3/1.80	2.40	4/	1.60	1.80	---	1.40
Hay and pasture 5/	---	1.20	1.50	1.00	2.00	1.20	---	4.50
Vegetables 6/	2.40	3.90	---	2.30	1.90	2.60	---	4.40
Citrus fruits	5.80	6.60	---	---	---	1.60	---	4/
Other fruits 7/	2.70	5.40	---	---	3.40	3.20	3.80	4/
All crops	1.40	2.60	1.10	2.00	1.50	1.20	3.80	1.70

1/ Includes corn, sorghum, soybeans, wheat, and other grain listed in the appendix.
2/ Includes tobacco, cotton, and other field crops listed in the appendix.
3/ Includes soil sterilants used on tobacco.
4/ Less than 10,000 acres treated.
5/ Includes all pasture, alfalfa, other hay and forage, and summer fallow.
6/ Includes potatoes and other vegetables listed in the appendix.
7/ Includes apples and the other deciduous fruits, and the other fruits and nuts groupings in the appendix.

Table 8.--Expenditures per acre for pesticide materials (not including application cost) applied by custom operators for selected crop groupings, by form of pesticide applied with specified types of equipment, 48 contiguous States, 1964

Category	Ground equipment				Aircraft			
					Fixed wing		Helicopter	
	Dust	Spray	Granular	Other	Dust	Spray	Dust	Spray
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Grains 1/	1.60	3.80	1.80	---	2.50	1.50	---	1.00
Other field crops 2/	3.40	3/27.90	10.50	4/	4.20	2.00	---	.90
Hay and pasture 5/	---	2.00	3.70	.90	1.20	.60	---	2.20
Vegetables 6/	9.90	15.60	---	21.00	4.20	2.80	---	9.90
Citrus fruits	2.50	14.90	---	---	---	3.30	---	4/
Other fruits 7/	2.20	14.30	---	---	4.80	3.30	5.20	4/
All crops	3.10	13.70	2.20	16.20	4.30	1.50	5.20	1.00

1/ Includes corn, sorghum, soybeans, wheat and other grain listed in the appendix.
2/ Includes tobacco, cotton, and other field crops listed in the appendix.
3/ Includes soil sterilants used on tobacco.
4/ Less than 10,000 acres treated.
5/ Includes all pasture, alfalfa, other hay and forage, and summer fallow.
6/ Includes potatoes and other vegetables listed in the appendix.
7/ Includes apples and the other deciduous fruits and the other fruits and nuts groupings in the appendix.

Table 9.--Expenditures per acre for custom pesticide application and materials for all crops, by regions and form of pesticide applied with specified types of equipment, 48 contiguous States, 1964

Region	Ground equipment				Aircraft			
					Fixed wing		Helicopter	
	Dust	Spray	Granular	Other	Dust	Spray	Dust	Spray
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Northeast	10.00	7.70	5.40	---	8.90	5.10	1/	1/
Lake States	5.40	23.80	2.20	---	7.00	2.30	---	---
Corn Belt	1/	8.10	3.00	---	2.40	2.40	---	3.20
Northern Plains	1.90	3.00	---	---	6.50	1.40	---	2.60
Appalachian	3.30	17.00	5.30	15.10	3.60	2.60	---	---
Southeast	3.20	15.90	---	---	7.00	2.70	1/	1/
Delta States	6.20	2.90	---	---	3.50	2.20	---	2.50
Southern Plains	---	6.20	---	---	7.80	3.10	---	---
Mountain	---	4.10	7.90	---	7.00	4.30	---	1/
Pacific	5.90	20.20	---	22.50	6.40	6.90	---	7.50
All regions	4.50	16.30	3.30	18.20	5.80	2.70	9.00	2.70

1/ Insufficient data for calculation of an estimate.

Table 10.--Distribution of expenditures for custom pesticide application and materials on selected crop groupings, by form of pesticide applied and type of application equipment used, 48 contiguous States, 1964

Category	Form of pesticide				Type of application equipment		
	Dust	Spray	Granular	Other	Ground	Aircraft	
						Fixed wing	Helicopter
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Corn	6	89	5	---	83	17	---
Cotton	10	90	---	---	17	82	1
Wheat	1	99	---	---	9	85	6
Sorghum	1	99	---	---	31	69	---
Other grains 1/	1	99	---	---	6	92	2
Soybeans	23	77	2/	---	8	92	2/
Tobacco	8	89	2/	3	72	24	4
Other field crops 1/	17	81	2	---	40	59	1
Alfalfa	1	97	---	2	51	49	---
Other hay and forage 1/	1	97	1	1	16	78	6
Irish potatoes	13	87	---	---	12	88	---
Other vegetables 1/	16	80	---	4	62	35	3
Citrus	4	96	---	---	98	2	2/
Deciduous fruit 3/	9	91	---	---	80	11	9
Other fruits and nuts 1/	24	76	---	---	84	15	1
Summer fallow	---	100	---	---	34	66	---
All crops	10	88	1	1	30	69	1

1/ Crops included in this category are listed in the appendix.
2/ Less than 0.5 percent.
3/ Includes apples and other deciduous fruit listed in the appendix.

Table 11.--Distribution of expenditures for custom pesticide application and materials for all crops, by regions, form of pesticide applied, and type of application equipment used, 48 contiguous States, 1964

Region	Form of pesticide				Type of application equipment		
	Dust	Spray	Granular	Other	Ground	Aircraft	
						Fixed wing	Helicopter
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Northeast	23	77	1/	---	58	37	5
Lake States	14	85	1	---	59	39	2
Corn Belt	7	87	6	---	58	41	1
Northern Plains	4	96	---	---	15	85	1/
Appalachian	13	84	1	2	69	31	---
Southeast	46	54	---	---	37	61	2
Delta States	6	94	---	---	6	93	1
Southern Plains	2	98	---	---	7	93	---
Mountain	15	85	1/	1/	16	83	1
Pacific	7	91	---	2	54	43	3
All regions	10	88	1	1	30	69	1

1/ Less than 0.5 percent.

Table 12.--Distribution of expenditures for custom pesticide application and materials for selected crop groupings, by form of pesticide applied with specified types of equipment, 48 contiguous States, 1964

Category	Ground equipment				Aircraft			
					Fixed wing		Helicopter	
	Dust	Spray	Granular	Other	Dust	Spray	Dust	Spray
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Corn	4	74	5	---	2	15	---	---
Cotton	2	15	---	---	8	74	---	1
Wheat	---	9	---	---	1	84	---	6
Sorghum	---	31	---	---	1	68	---	---
Other grains 1/	2/	6	---	---	1	91	---	2
Soybeans	2/	7	2/	---	22	70	---	2/
Tobacco	4	65	2/	3	4	20	---	4
Other field crops 1/	9	29	2	---	8	51	---	1
Alfalfa	1	48	---	2	---	49	---	---
Other hay and forage 1/	---	14	1	1	1	77	---	6
Irish potatoes	5	7	---	---	8	80	---	---
Other vegetables 1/	2	56	---	4	14	21	---	3
Citrus	4	94	---	---	---	2	---	2/
Deciduous fruits 3/	2	78	---	---	1	10	6	3
Other fruits and nuts 1/	17	67	---	---	7	8	---	1
Summer fallow	---	34	---	---	---	66	---	---
All crops	2	26	1	1	8	61	1/	1

1/ Crops included in this category are listed in the appendix.
2/ Less than 0.5 percent.
3/ Includes apples and other deciduous fruit listed in the appendix.

Table 13.--Distribution of expenditures for custom pesticide application (not including materials) on selected crop groupings, by form of pesticide applied with specified types of equipment, 48 contiguous States, 1964

Category	Ground equipment				Aircraft			
					Fixed wing		Helicopter	
	Dust	Spray	Granular	Other	Dust	Spray	Dust	Spray
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Corn	7	42	9	---	5	37	---	---
Cotton	1	5	---	---	4	89	---	1
Wheat	---	5	---	---	1	88	---	6
Sorghum	---	14	---	---	1	85	---	---
Other grains 1/	2/	6	---	---	1	89	---	4
Soybeans	2/	4	2/	---	14	81	---	1
Tobacco	7	18	2/	4	7	50	---	14
Other field crops 1/	5	8	2	---	9	75	---	1
Alfalfa	1	41	---	2/	---	58	---	---
Other hay and forage 1/	---	8	1	1	1	83	---	6
Irish potatoes	3	3	---	---	11	83	---	---
Other vegetables 1/	1	33	---	1	11	43	---	11
Citrus	9	88	---	---	---	2	---	1
Deciduous fruits 3/	3	36	---	---	2	37	12	10
Other fruits and nuts 1/	30	44	---	---	10	15	---	1
Summer fallow	---	19	---	---	---	81	---	---
All crops	2	12	1	1/	6	76	1/	3

1/ Crops included in this category are listed in the appendix.
2/ Less than 0.5 percent.
3/ Includes apples and other deciduous fruit listed in the appendix.

Table 14.--Distribution of expenditures for pesticide materials (not including application cost) on selected crop groupings, by form of pesticide applied with specified types of equipment, 48 contiguous States, 1964

Category	Ground equipment				Aircraft			
					Fixed wing		Helicopter	
	Dust	Spray	Granular	Other	Dust	Spray	Dust	Spray
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Corn	2	83	4	---	2	9	---	---
Cotton	3	19	---	---	9	68	---	1
Wheat	---	15	---	---	2	78	---	5
Sorghum	---	52	---	---	1/	48	---	---
Other grains 2/	1/	6	---	---	1/	93	---	1
Soybeans	1/	10	1/	---	27	63	---	1/
Tobacco	3	78	1/	2	3	13	---	1
Other field crops 2/	11	42	2	---	8	37	---	1/
Alfalfa	1	55	---	4	---	40	---	---
Other hay and forage 2/	---	29	1	1	2	60	---	7
Irish potatoes	8	13	---	---	3	76	---	---
Other vegetables 2/	2	61	---	5	15	16	---	1
Citrus	2	96	---	---	---	2	---	1/
Deciduous fruits 3/	1	93	---	---	1/	2	4	1
Other fruits and nuts 2/	7	82	---	---	6	3	---	2
Summer fallow	---	52	---	---	---	48	---	---
All crops	2	34	1	1	9	52	1/	1

1/ Less than 0.5 percent.
2/ Crops included in this category are listed in the appendix.
3/ Includes apples and other deciduous fruit listed in the appendix.

Table 15.--Extent and cost of custom applied pesticide materials for selected classes of livestock, 48 contiguous States, 1964

Class of livestock	Farms reporting pesticide use 1/	Farms reporting custom application service 2/	Total expenditure for custom applied pesticide materials 3/	Expenditures per farm 4/
	Percent	Percent	$1,000	Dollars
Dairy	82	5	440	16.00
Beef	46	3	720	22.70
Hogs	50	1	172	15.20
Sheep	17	5	132	34.80
Poultry	26	1	226	47.40
All classes	72	5	1,690	24.80

1/ Survey farms using pesticides on specified livestock as a percentage of survey farms raising that livestock.

2/ Survey farms reporting custom application services as a percentage of farms reporting pesticide use.

3/ Estimated expenditures for all farms in the 48 States.

4/ Expenditures per farm included in the survey reporting custom pesticide service. Includes farms with sales of agricultural products of $5,000 or more in all areas of the United States except the South. In the South (Appalachian, Southeast, and Delta States), includes farms with sales of $2,500 or more.

Table 16.--Distribution of the use of custom applied pesticide materials among regions, by selected classes of livestock, 48 contiguous States, 1964

Region	Distribution of expenditures for custom applied materials						Distribution of farmers reporting the use of custom applied materials					
	Dairy	Beef	Hogs	Sheep	Poultry	Total	Dairy	Beef	Hogs	Sheep	Poultry	Total
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Northeast	35	---	---	1	64	100	79	---	---	2	19	100
Lake States	88	6	4	1/	2	100	81	5	7	1	6	100
Corn Belt	22	23	34	14	7	100	29	30	12	24	5	100
Northern Plains	4	87	1	6	2	100	10	70	5	9	6	100
Appalachian	---	66	4	25	5	100	---	14	43	29	14	100
Southeast	1	7	2	---	90	100	4	34	7	---	55	100
Delta States	9	1	---	---	90	100	22	11	---	---	67	100
Southern Plains	---	100	---	---	---	100	---	100	---	---	---	100
Mountain	14	73	1	12	---	100	3	80	3	14	---	100
Pacific	60	40	---	---	---	100	80	20	---	---	---	100
All regions	27	34	10	7	22	100	37	33	7	11	12	100

1/ Less than 0.5 percent.

Appendix.--Crops included in grouped categories

Other Deciduous Fruit
- Peaches
- Pears
- Cherries
- Apricots
- Plums
- Prunes
- Nectarines

Other Fruits and Nuts
- Grapes
- Avocados
- Figs
- Blackberries
- Blueberries
- Boysenberries
- Currants
- Gooseberries
- Loganberries
- Raspberries
- Strawberries
- Almonds
- Filberts
- Pecans
- Walnuts
- Olives
- Tung nuts

Other Grains
- Oats
- Mixed grains
- Barley
- Rye
- Rice

Other Hay and Pasture
- All hay, other than alfalfa
- All pasture and rangeland

Other Vegetables
- Sweetpotatoes
- Cabbage
- Carrots
- Celery
- Lettuce
- Onions
- Tomatoes
- Watermelons
- Sweet corn
- Snap beans
- Spinach
- Artichokes
- Asparagus
- Broccoli
- Cauliflower
- Cucumbers
- Beets
- Green peppers
- Green peas
- Cranberries
- Other vegetables

Other Field Crops
- Grass and hay seed
- Buckwheat
- Castorbeans
- Hops
- Lentils
- Millet
- Mung beans
- Peppermint
- Spearmint
- Rutabagas
- Sesame
- Spelt
- Sunflowers
- Velvetbean
- Dry beans
- Dry field peas
- Peanuts
- Sugarbeets
- Safflower
- Flax
- Popcorn
- Cowpeas
- Broomcorn
- Sugarcane

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