IMPACTS
OF THE ELIMINATION OF ORGANOPHOSPHATES AND CARBAMATES FROM CORN PRODUCTION

AFPC Policy Research Report 99-3

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Pesticides and registered trade names included in this report are not intended to be a complete listing. The trade names are included merely as some examples of the pesticides. They are not an endorsement of any particular chemical company's product or an indication that any such product is the exclusive trade name used for any particular purpose.

Changes in Regional Corn Yields

This report represents a review of possible options and effects if all OP&C (organophosphate and carbamate) insecticides are eliminated from use in US corn production. The objective of the survey is to provide a basis for discussion and guidance for pesticide policy decisions.

Corn Insects

Soil insects are present most years to affect planted seeds, new seedlings, and young corn plant roots. The most widespread insect in the US is the rootworm larva that feeds on corn roots. In the South, billbugs present a major problem to corn plants. Corn-soybean rotations are widely practiced to reduce the impact of rootworm larvae. In recent years, however, adult rootworm beetles have adapted to laying eggs in soybean fields. This practice influences infestation of rootworm larvae in the subsequent corn crop. OP insecticides are the dominant chemicals of choice for preventing rootworm larvae damage in corn. Rootworm larvae are estimated to cause a 10 percent crop loss in the United States even though many acres are currently treated for rootworms.

Insecticide Use on Corn

In the United States, approximately 80 million acres of corn have been planted in the past three years (1996, 1997, and 1998). About 30 percent of these acres (24 million) received an insecticide application.

Insecticide application for corn rootworm at planting occurred on 70 percent of those treated acres. Foliar application for cornborer and/or corn rootworm beetles occurred on 20-25 percent of the treated corn acres. The remaining 5-10 percent of the treated acres were soil or foliar applications for controlling cutworms, grubs, wireworms, seed corn maggots, seed corn beetles, stink bugs, bill bugs, and other seed, seedling, or foliage feeding insects.

Of those insecticides used on corn, 60-65 percent are OP&C. They are used because they provide the most effective and/or the most economical control of those insect infestations that impose a real risk to corn production.

Soil Applied Insecticides[1]

Three materials have had the most use for soil application at planting:

Chlorpyrifos (Lorsban), OP
Terbufos (Counter), OP
Tefluthrin (Force), Pyrethroid

[1]The list does not represent an all-inclusive list of insecticides used for corn insects.

Other organophosphates and carbamates used for soil insect control include:

Phorate (Thimet), OP
Tebupirimphos (Aztec), OP + Pyrethroid
Chloroethoxyfos (Fortress), OP
Ethoprop (MoCap), OP
Carbofuran (Furadan), C

Other soil-applied insecticides used for corn treatment are:

Cyfluthrin (Baythroid)
Cyhalothrin (Warrior)
Permethrin (Ambush, Pounce)
Fipronil (Regent)
Bifenthrin (Capture)

Insect infestation on corn plant leaves and stalks requires on-site management decisions to cope with the risk of yield losses. Infestation from insects that attack the above ground plant parts are unpredictable. Long term records can project probabilities of insect infestations and potential yield losses. An insect, for example, may cause yield losses one year out of every five on 30 percent of the corn acres and cause a 30 percent loss without treatment. This insect would result in an estimated yield loss of approximately 2 percent annually (2 x 0.3 x 0.3). Day-to-day weather will dictate if insect populations increase or decrease. See Appendix III, Table 6 for a list of alternative insecticides.

Yield loss estimates for corn are reported in Table 1. The detailed yield losses at the state level are presented in Appendix III, Table 4. The percent yield loss using best management practices without OP&C is elevated due largely to the higher cost of using less effective alternative chemicals.

These estimates are gathered from experienced entomologists who have knowledge of insect damage incidences over several years. Entomologists who work closely in the management control or in the pest management arena were considered to be the best judges of potential yield losses.

Northeast

Agronomic Component. A cooler, shorter growing season and the use of crop rotations contribute to a lower impact of insects on corn yields. The major threats for corn are soil insects. The impact without OP&C, according to this survey, is not judged to generate additional yield losses. Yield losses are estimated at 1 percent without the use of OP&C.

Economic Component. The least important corn producing region from a planted area perspective (share of 3.67 percent) is the Northeast region (New York and Pennsylvania). To avoid problems of the 1993 crop year, the data provided by the Agricultural and Food Policy Center at Texas A&M University (AFPC) used planted acre yields calculated over the 1994-97 period. However, the cost of production data were an update of the USDA cost of production estimates for 1996. The information on percent changes due to an OP&C reduction scenario provided by the plant scientists is used to project yield changes. Production was projected to decline from 69.51 bu/pl acre[2] to 68.82 bu/pl acre under best management practices without OP&C chemicals.

Southeast

Agronomic Component. Due to a longer growing season with more moisture, humidity, and warm temperatures; this region of the US exhibits the best environment for insect populations which threaten crop yields. It is also the region with a greater variety of insects that can potentially reduce corn yields. Insect damage causing a 30 percent yield loss without chemical treatment is a common occurrence. This survey indicates the importance of chemical insect control for this US region. The yield loss due to removal of OP&C is 5.38 percent.

Economic Component. The Southeast region with a share of 4.40 percent of total planted acres comprises Georgia, Kentucky, Louisiana, and North Carolina. As indicated, the planted acre yields were calculated over the 1994-97 period with an update of the USDA cost of production estimates in 1996. The information on percent changes due to the OP&C reduction scenario provided by the plant scientists is used to project the yield changes. Production was projected to decline from 97.67 bu/pl acre to 92.42 bu/pl acre under best management practices without OP&C chemicals.

North Central

Agronomic Component. Eliminating OP&C will impact this large corn-growing region of the US the least of all regions. It is a region, however, where soil insects attack seed, seedlings, and the roots of young plants. Rootworm larvae dominate to cause yield loss, and corn growers continue to apply soil insecticides at planting to reduce the potential risks which can occur annually. Rootworm larvae resistance to chemicals is a major concern and could be enhanced without the mode of action available from OP&C. Without OP&C, annual corn yields are estimated to decline 3.83 percent.

Economic Component. The North Central region comprises the Corn Belt and Lake States regions of the current USDA regional classification. This region is the most important of the corn producing regions from a yield perspective as well as from the proportion of US planted acres (65.80%). This region comprises Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio,

[2]Bu/pl acre = bushels per planted acre.

and Wisconsin. As indicated, the planted acre yields were calculated for the 1994-97 period along with updated cost of production estimates. The information on percent changes due to the OP&C reduction scenario provided by the plant scientists was used to project the yield changes. Production was projected to decline from 123.63 bu/pl acre to 118.89 bu/pl acre under best management practices without OP&C chemicals.

Plains States

Agronomic Component. With the use of best management practices without OP&C, corn yield loss is placed at 2.69 percent.

Economic Component. The Plains States region, Kansas, Nebraska, North Dakota, South Dakota, Texas, and Colorado, constitutes 26.13 percent of the planted acres in the US and is second in terms of production per acre. As indicated previously, the planted acre yields were calculated for the 1994-97 period with updated cost of production estimates. The information on percent changes due to various OP&C reduction scenarios provided by the plant scientists was used to project the yield changes. Production was projected to decline from 114.81 bu/pl acre to 111.72 bu/pl acre under best management practices without OP&C chemicals.

Changes in Regional Corn Production Costs

Alternative Chemical Costs

One must acknowledge that there will be economic shifts when insecticide products are changed. Reported costs ranged from $2 less per acre to as much as $15 more per acre depending upon resulting crop insect infestation and available pest management options. Some of the changes contributing to cost of production shifts can include one or more of the items on the following list.

- Potential higher cost of new chemicals,
- Refitting an application for a shift in liquid volume applied or in liquid pressure required,
- Refitting either planting equipment attachments or spray equipment with the above changes,
- Added regulation in storage, handling, record keeping, safety, etc.,
- Shifts to commercial application from private application,
- Shifts in cropping systems to management insect risks.

Due to the high, varied, real or potential cost shifts, the cost has been placed at $3 per acre greater in the northern climatic areas and at $5-10 per acre greater in the southern climatic regions. Considering the wide range in cost of $5-10/acre, this analysis has used $7.50 in all the calculations. The corn yield and cost of production changes without OP&C are detailed in Appendix III, Table 5.

Northeast

Total variable costs per acre in the Northeast were estimated to increase by 1.74 percent with a decrease (-1.00%) in yield per acre. The total variable cost per bushel increased 2.77 percent due to best management practices without OP&C.

Southeast

The Southeast was very sensitive to the OP&C withdrawal scenario. A nearly 10 percent increase in total variable cost per acre was observed without OP&C ($2.38/bu relative to the baseline variable total cost of $2.17/bu). The chemical cost per bushel increased almost three times as much as total variable costs ($0.33 - 0.43/bu).

North Central

The North Central region experienced a 3.98 percent increase in total variable cost per bushel without OP&C chemicals. However, the chemical cost per bushel increase was relatively low compared to other regions ($0.23 - 0.26/bu).

Plains States

The Plains States experienced a 4 percent increase in total variable cost per bushel without OP&C chemicals. However, the chemical cost per bushel increase was similar to that of the North Central region ($0.22 - 0.26/bu).

Commentary

Various survey or review approaches will result in some shifts in economic estimates or shifts in yield loss estimates. Those surveys can form an aggregate from which policy can proceed. Science becomes the cornerstone of sound policy. It forms an aggregated consensus from which science-based policy is possible.

From a collection of reports, contacts with experts, and world science publications, one can develop a realistic impact of eliminating all organophosphates and carbamates from corn production. One must be aware that trends already show the most toxic substances are being replaced by less toxic ones. Efforts are already taking place to add new insecticides which will be less threatening to the ecosystem. This process is natural and already underway in the marketplace.

Table 1. Percentage corn yield loss estimates without OP&C insecticides.

Regions	Percentage Yield Loss Without OP&C Insecticides
Northeast[1]	1.00
Southeast[2]	5.38
North Central[3]	3.83
Plains States[4]	2.69

[1] New York and Pennsylvania.
[2] Kentucky, North Carolina, Louisiana, and Georgia.
[3] Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, Ohio, and Missouri.
[4] South Dakota, Nebraska, Kansas, Texas, North Dakota, and Colorado.

Scientists Consulted:

B. Bender, Geneticist, Iowa State University
D. Boethal, Entomologist, Louisiana State University
D. Brassard, Office of Pest Management, US EPA
R. Higgins, Entomologist, Kansas State University
R. Hudson, Entomologist, Tifton Experiment Station, University of Georgia
K. Jarvi, Pesticide Management, University of Nebraska
B. Johnson, Entomologist, University of Wisconsin
J. Obermeyer, Entomologist, Purdue University
G. O'Connor, Entomologist, University of Connecticut
K. Ostlie, Entomologist, University of Minnesota
F. Pierce, Entomologist, Colorado State University
R. Pope, Entomologist, Iowa State University
R. H. Smith, Entomologist, Auburn University
K. Steffey, Entomologist, University of Illinois
J. Tollefson, Entomologist, Iowa State University
L. Townsend, Entomologist, University of Kentucky
T. Van Arsdale, National Council of Farm Cooperatives
J. VanDuyn, Entomologist, North Carolina State University
H. Wilson, Entomologist, Ohio State University
R. Wright, Entomologist, University of Nebraska

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Appendix I:
Production Data for Corn

Table 2. Corn production data.

	1993	1994	1995	1996	1997	Average	% of US
	Planted Acreage (000)						
North Central	45850	50100	45050	49000	49350	47870	62.42%
Plains States	17135	18675	16700	19050	19600	18232	23.77%
Southeast	3250	3270	2710	3415	3300	3189	4.16%
Northeast	2470	2510	2480	2600	2750	2562	3.34%
US Total	73325	79175	71245	79507	80227	76696	
	Production (000 bu)						
North Central	3391800	6948950	4985240	5935550	6119920	5476292	64.47%
Plains States	1497825	2251670	1641550	2314700	2329675	2007084	23.63%
Southeast	241280	330490	252725	349550	310270	296863	3.49%
Northeast	149820	192040	158130	194740	172915	173529	2.04%
US Total	6336470	10102735	7373876	9293435	9365574	8494418	
	Yield/planted acre (bu)						
North Central	74.0	138.7	110.7	121.1	124.0	123.6	
Northern Plains	87.4	120.6	98.3	121.5	118.9	114.8	
Southeast	74.2	101.1	93.3	102.4	94.0	97.7	
Northeast	60.7	76.5	63.8	74.9	62.9	69.5	
US Total	86.4	127.6	103.5	116.9	116.7	116.2	

Source: Table developed by Edward G. Smith, Agricultural and Food Policy Center, Texas A&M University, College Station, Texas, 1999.

Appendix II:
Budget Data for Corn

Table 3. Budget for producing corn with and without organophosphates and carbamates.

	United States[a]			Northeast			Southeast			North Central			Plains States		
	Baseline	No O&C	% Change	Baseline	No O&C	% Change	Baseline	No O&C	% Change	Baseline	No O&C	% Change	Baseline	No O&C	% Change
Yield (bu/pl acre)[b]	118.31	114.11	-3.55%	69.51	68.81	-1.00%	97.67	92.42	-5.38%	123.63	118.90	-3.83%	114.81	111.72	-2.69%
Variable Cash expenses ($ac.):[c]															
Chemicals	$27.56	$30.76	11.61%	$26.80	$29.80	11.19%	$32.24	$39.74	23.26%	$27.96	$30.96	10.73%	$25.80	$28.80	11.63%
Other variable cash expenses	$175.91	$175.91	0.00%	$145.35	$145.35	0.00%	$179.82	$179.82	0.00%	$158.85	$158.85	0.00%	$224.31	$224.31	0.00%
Total, variable cash expenses	$203.47	$206.67	1.57%	$172.15	$175.15	1.74%	$212.06	$219.56	3.54%	$186.81	$189.81	1.61%	$250.11	$253.11	1.20%
Variable Cash expenses ($bu.):[c]															
Chemicals	$0.23	$0.27	15.71%	$0.39	$0.43	12.32%	$0.33	$0.43	30.27%	$0.23	$0.26	15.14%	$0.22	$0.26	14.71%
Other variable cash expenses	$1.49	$1.54	3.68%	$2.09	$2.11	1.01%	$1.84	$1.95	5.69%	$1.28	$1.34	3.98%	$1.95	$2.01	2.76%
Total, variable cash expenses	$1.72	$1.81	5.31%	$2.48	$2.55	2.77%	$2.17	$2.38	9.42%	$1.51	$1.60	5.65%	$2.18	$2.27	4.00%

[a] Corn states included represent 94% of the acreage planted to corn for all purposes and production 1993-1997 period.

[b] Average yields calculated for the 1993-1997 crop years with the US average weighted by the regions included.

[c] Variable cash expenses including capital replacement from ERS/USDA budgets for 1996 adjusted to 1998 using USDA Baseline.

Source: Table developed by Edward G. Smith, Agricultural and Food Policy Center, Texas A&M University, College Station, Texas, 1999.

Appendix III:
Worksheets for Corn

Table 4. Corn yield loss estimates without OP&C use.

	State[1/]	Treatment method[2/]	Planted acres[3/]	Share of planted acres	% acres treated[4/]	% yield loss Best management practices without OP&C[4/]	% acres infected	Major pests
Northeast:					45.22	1.00	50.00	
	NY	1	1200	0.4364	30	1	50	
		2						
	PA	1	1550	0.5636	57	<1	50	
		2						
Share		0.0367	2750					
Southeast:					82.75	5.38	40.17	
	GA	1	550	0.1667				
		2			90	9		Stink Bug
	KY	1	1300	0.3939				
		2				1		Stalk Borer
	LA	1	500	0.1515	80	4	50	
		2						
	NC	1	950	0.2879	80	10	35	Wireworm, Billbug
		2						
Share		0.0440	3300					
North Central:					56.44	3.83	48.51	
	IL	1	11200	0.2270	88	2	50	Rootworm
		2			8	1.2	12	Aphid
	IN	1	6000	0.1216	89	8	50	
		2						
	IA	1	12200	0.2472	69	6	50	Rootworm
		2			20			Corn borer
	MI	1	2600	0.0527	15	1	50	
		2						
	MN	1	7000	0.1418	15	1	50	
		2						
	MO	1	2950	0.0598	25	1	25	Cutworm
		2						
	OH	1	3600	0.0729	15	<1	50	
		2						
	WI	1	3800	0.0770	40	5	50	
		2						
Share		0.6580	49350					
Plains States:					38.51	2.69	45.06	
	KS	1	2850	0.1454	50		40	
		2						
	NE	1	9000	0.4592	40	5	50	Rootworm
		2			20	<1		Corn borer
	ND	1	800	0.0408	7	1	10	
		2						
	SD	1	3800	0.1939	18	1	45	
		2						
	TX	1	2000	0.1020	69	1	50	Rootworm, Cutworm
		2						
	CO	1	1150	0.0587	35	1	35	
		2						Rootworm, Grub
Share		0.2613	19600					

1/ States with 500,000 acres or more are considered.
2/ 1 = Soil Applied at planting: Rootworm, Wire worms, White grubs, Cutworms, Billbugs.
2 = Foliar Applied: Aphid, Spider mites, Armyworm, Stalk borer, Flea Beetles, Stink bug.
3/ 1997 USDA Ag Chem Use Rept AgCh 1 (98) Acres x 1000.
4/ From USDA-NAPIAP Rept No 1-CA-95; and various state contacts.

Note: Assume costs of alternative insecticide to be $3 greater in northern states and $5-10 greater in southern states.

Table 5. Corn yield loss and cost of production changes without OP&C use.

	United States			Northeast			Southeast		
	Baseline	No OP&C	% Change	Baseline	No OP&C	% Change	Baseline	No OP&C	% Change
Yield (bu/pl acre)	118.3077	114.1103	-3.5095%	69.5100	68.8174	-0.9964%	97.6700	92.4218	-5.3734%
Cash expenses:									
Seed	24.7564	24.7564	0.0000%	23.2400	23.2400	0.0000%	21.5600	21.5600	0.0000%
Fertilizer, lime, and gypsum	57.6691	57.6691	0.0000%	50.6900	50.6900	0.0000%	68.4200	68.4200	0.0000%
Chemicals	27.5606	28.7618	4.3825%	26.8000	29.8000	11.1940%	32.2400	39.7400	23.2630%
Custom operations[1/]	10.0661	10.0661	0.0000%	9.2900	9.2900	0.0000%	4.3500	4.3500	0.0000%
Fuel, lube, and repairs	39.3847	39.3847	0.0000%	27.6100	27.6100	0.0000%	35.9100	35.9100	0.0000%
Hired labor	8.6269	8.6269	0.0000%	13.8400	13.8400	0.0000%	18.6300	18.6300	0.0000%
Other variable cash expenses [2/]	0.5175	0.5175	0.0000%	0.0000	0.0000	0.0000%	0.0000	0.0000	0.0000%
Total, variable cash expenses	168.5814	169.7826	0.6372%	151.4700	154.4700	1.9806%	181.1100	188.6100	4.1411%
Capital replacement	34.8855	34.8855	0.0000%	20.6800	20.6800	0.0000%	30.9500	30.9500	0.0000%
Total	203.4669	204.6681	0.5236%	172.1500	175.1500	1.7427%	212.0600	219.5600	3.5367%

[1/] Cost of custom operations, technical services and commercial drying.
[2/] Cost of purchased irrigation water.

	United States[1/]			Northeast			Southeast		
	Baseline	No OP&C	% Change	Baseline	No OP&C	% Change	Baseline	No OP&C	% Change
Yield (bu/pl acre)	118.3077	114.1103	-3.5095%	69.5100	68.8174	-0.9964%	97.6700	92.4218	-5.3734%
Variable cash expenses ($/ac)[2/]:									
Chemicals	27.5606	28.7618	4.3825%	26.8000	29.8000	11.1940%	32.2400	39.7400	23.2630%
Other variable cash expenses	175.9063	175.9063	0.0000%	145.3500	145.3500	0.0000%	179.8200	179.8200	0.0000%
Total, variable cash expenses	203.4669	204.6681	0.5236%	172.1500	175.1500	1.7427%	212.0600	219.5600	3.5367%
Variable cash expenses ($/bu)[2/]:									
Chemicals	0.2330	0.2521	8.1708%	0.3856	0.4330	12.3131%	0.3301	0.4300	30.2626%
Other variable cash expenses	1.4869	1.5415	3.6440%	2.0911	2.1121	1.0064%	1.8411	1.9456	5.6785%
Total, variable cash expenses	1.7198	1.7936	4.1855%	2.4766	2.5451	2.7666%	2.1712	2.3756	9.4161%

[1/] Corn states included represent 94% of the acreage planted to corn for all purposes and production 1993-1997 period.
[2/] Variable cash expenses including capital replacement from ERS/USDA budgets for 1996 adjusted to 1998 using USDA baseline.

Note: Economic Research Service, USDA budgets for 1996 adjusted to 1998 using the USDA 1998 baseline.

Table 5 (continued). Corn yield loss and cost of production changes without OP&C use.

	North Central			Plains States		
	Baseline	No OP&C	% Change	Baseline	No OP&C	% Change
Yield (bu/pl acre)	123.6300	118.8936	-3.8311%	114.8100	111.7189	-2.6923%
Cash expenses:						
Seed	24.4400	24.4400	0.0000%	26.3600	26.3600	0.0000%
Fertilizer, lime, and gypsum	57.5700	57.5700	0.0000%	57.0300	57.0300	0.0000%
Chemicals	27.9600	27.9600	0.0000%	25.8000	28.8000	11.6279%
Custom operations[1/]	9.3600	9.3600	0.0000%	13.0300	13.0300	0.0000%
Fuel, lube, and repairs	30.8200	30.8200	0.0000%	64.1400	64.1400	0.0000%
Hired labor	6.9600	6.9600	0.0000%	10.5200	10.5200	0.0000%
Other variable cash expenses [2/]	0.0000	0.0000	0.0000%	2.0400	2.0400	0.0000%
Total, variable cash expenses	157.1100	157.1100	0.0000%	198.9200	201.9200	1.5081%
Capital replacement	29.7000	29.7000	0.0000%	51.1900	51.1900	0.0000%
Total	186.8100	186.8100	0.0000%	250.1100	253.1100	1.1995%

[1/] Cost of custom operations, technical services and commercial drying.
[2/] Cost of purchased irrigation water.

	United States[1/]			Southeast		
	Baseline	No OP&C	% Change	Baseline	No OP&C	% Change
Yield (bu/pl acre)	123.6300	118.8936	-3.8311%	114.8100	111.7189	-2.6923%
Variable cash expenses ($/ac)[2/]:						
Chemicals	27.9600	27.9600	0.0000%	25.8000	28.8000	11.6279%
Other variable cash expenses	158.8500	158.8500	0.0000%	224.3100	224.3100	0.0000%
Total, variable cash expenses	186.8100	186.8100	0.0000%	250.1100	253.1100	1.1995%
Variable cash expenses ($/bu)[2/]:						
Chemicals	0.2262	0.2352	3.9838%	0.2247	0.2578	14.7164%
Other variable cash expenses	1.2849	1.3361	3.9838%	1.9537	2.0078	2.7668%
Total, variable cash expenses	1.5110	1.5712	3.9838%	2.1785	2.2656	3.9995%

[1/] Corn states included represent 94% of the acreage planted to corn for all purposes and production 1993-1997 period.
[2/] Variable cash expenses including capital replacement from ERS/USDA budgets for 1996 adjusted to 1998 using USDA baseline.

Note: Economic Research Service, USDA budgets for 1996 adjusted to 1998 using the USDA 1998 baseline.

Table 6. Current and alternative corn insecticides for insect management.

Pest	Current Organophosphate/ Carbamate Treatment	Alternative Treatment
Rootworm (Larvae and adults)	Chlorpyrifos (Lorsban) Terbufos (Counter) Phorate (Thimet) Chlorethoxyfos (Fortress) Ethoprop (Mocap) Disulfoton (Di-Syston) Isofenphos (Oftenol) Tebupirimphos (Aztec)[1] Carbofuran (Furadan) Carbaryl (Sevin) Dimethoate (Cygon) Malathion (Fyfanon) Methomyl (Lannate)	Cyhalothrin (Warrior, Karate) Permethrin (Ambush, Pounce) Esfenvalerate (Asana-XL) Tefluthrin (Force) Fipronil (Regent)
Cutworm Wireworm Billbugs Grubs	Terbufos (Counter) Chlorpyrifos (Lorsban) Carbofuran (Furadan) Diazinon[2] Methyl Parathion (Penncap-M)	Tefluthrin (Force) Permethrin (Ambush, Pounce) Cyhalothrin (Warrior, Karate) Esfenvalerate (Asana-XL) Fipronil (Regent)
European Corn Borer	Chlorpyrifos (Lorsban) Carbofuran (Furadan) Diazinon[2] Carbaryl (Sevin) Methomyl (Lannate)	Permethrin (Ambush, Pounce) Cyhalothrin (Warrior, Karate) Esfenvalerate (Asana-XL) Fipronil (Regent)
Stink Bug	Ethyl Parathion (Parathion) Methyl Parathion (Penncap-M) Pyrethrin + Piperonyl (Pyrenone)	Permethrin (Ambush, Pounce)

[1] Organophosphate and pyrethroid.
[2] Diazinon has several trade names.

Note: More than 20 insects are capable of becoming a threat to corn yields. Emergency treatments will always be a necessity where high populations of insects develop and attack the corn plant. Only the more prevalent insect pests are listed in the table above.

Additional Comments Offered by Contacts:

- The average percentage yield losses from insect pests are calculated by multiplying the pest infestations times crop yield loss per year. If, for example, a specific pest infests 30% of the planted acres once every 5 years, and the infestation requires treatment to avoid a 30% loss of crop yield; what is the average loss? A 30% loss on 30% of the planted acres is an average 10% loss on all acres. An infestation every 5 years will reflect an average annual yield loss of 2%.

- Persistent insect pests in corn do occur, but predicting whether or not their infestation will result in economic yield losses is difficult.

- Treatment of a crop for insect pests does not necessarily assure satisfactory pest control.

- Insect pests on crops are often influenced more by climate than by management practices. A combination of management practices associated with anticipated climatic conditions is the combination necessary for best insect and pest management.

- Selection of an insect pest control material is primarily associated with product efficacy, costs, and pest resistance development. Reasonable pest control requires at least 3 modes of actions on any given pest in order to slow development of pest resistance.

- The amount of active ingredients in insecticide use is on a downward trend in several states. Improvements are occurring in pest management decisions. Improved application methods and timing can reduce risk with less insecticide use. Improved decisions on whether or not to apply an insecticide have led to lower insecticide use.

- Banning organophosphate and carbamate insecticides for soil applications on corn and soybeans appears to be beyond the scope and intent of the legislation to protect food or water quality.

- The marketplace has already experienced a shift from the more toxic insecticide to the less toxic insecticides. New products placed on the market in the next five years will continue to improve without total banning of organophosphates and carbamates. More trends toward safer methods of growing food are expected.

- In some cases, alternative insecticides will not be in large enough supply for use in corn or soybeans. In these situations the organophosphate or the carbamate insecticide represents the only approach to chemical treatment.

- Removal of an entire class of chemical compounds (organophosphates, carbamates) leaves a narrower selection of pesticides, and one can expect pest resistance to develop in less time than currently is the case.

- Land in the Conservation Reserve Program is an improved habitat for population increase of white grubs and wireworms. When this land is returned to marketable crops, pesticides will be necessary to reduce crop production infestation risks.

- All policy directed at removal of any pesticide should be aimed at 1) a reasonable alternative to pest management and 2) a reasonable means of managing pest resistance.

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