

Use Trends of Biopesticides: Pounds Applied

[Text files](#) of data are available. The reported pounds applied of biopesticides. Biopesticides include naturally occurring substances that control pests (biochemical pesticides) and microorganisms that control pests (microbial pesticides). The definition may also include new technologies that do not easily fit into one of those two categories. Values greater than one are rounded. For more information, see Pesticide Use Annual Report Data Access, References, and Definitions [Guide](#).

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
(3s,6r)-3-methyl-6-isopropenyl-9-decen-1-yl acetate	< 1	0	< 1	12	148	65	57	65	61	178
(3s,6s)-3-methyl-6-isopropenyl-9-decen-1-yl acetate	< 1	0	< 1	12	148	65	57	65	61	178
(e)-4-tridecen-1-yl-acetate	23	0	0	0	< 1	< 1	< 1	0	0	0
(e)-5-decen-1-ol	1	25	16	98	7	51	53	29	4	4
(e)-5-decenyl acetate	4	22	134	99	63	746	840	463	26	28
(e,e)-8,10-dodecadien-1-ol	1,019	1,290	1,004	5,367	1,195	798	1,220	942	1,307	1,048
(e,e)-9,11-tetradecadien-1-yl acetate	2	3	1	12	2	< 1	< 1	< 1	< 1	< 1
(e,z)-7,9-dodecadienyl acetate	24	0	0	0	0	0	0	0	0	0
(s)-kinoprene	339	446	337	253	378	531	481	361	315	337
(s)-verbenone	0	781	633	28	5	26	12	14	4	28
(z)-11-hexadecen-1-yl acetate	0	0	< 1	98	34	30	92	294	335	253
(z)-11-hexadecenal	0	1	< 1	98	33	19	92	293	335	253
(z)-4-tridecen-1-yl-acetate	< 1	0	0	0	< 1	3	6	0	0	0
(z)-9-dodecenyl acetate	< 1	< 1	0	0	0	0	0	0	0	0

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
(z,e)-7,11-hexadecadie n-1-yl acetate	0	0	0	0	0	0	< 1	0	0	0
(z,z)-11,13-hexadecadi enal	619	969	1,072	1,086	1,404	1,846	1,511	1,644	2,264	3,748
(z,z)-3,13-octadecadien -1-ol acetate	0	< 1	142	0	0	0	0	0	0	0
(z,z)-7,11-hexadecadie n-1-yl acetate	0	0	0	0	0	0	< 1	0	0	0
1,4-dimethylnaphthale ne	1,085	891	660	133	836	379	274	411	1,520	485
1,7-dioxaspiro-(5,5)-un decane	< 1	< 1	0	0	0	0	0	0	0	0
1-methylcyclopropene	< 1	8	1	1	< 1	< 1	< 1	< 1	< 1	< 1
2,4-decadienoic acid, ethyl ester, (2e,4z)-	< 1	4	3	3	2	1	48	4	< 1	9
2-methyl-1-butanol	< 1	< 1	< 1	< 1	< 1	< 1	1	2	2	4
3,7-dimethyl-6-octen-1 -ol	42	49	72	95	98	70	62	60	42	22
3-decen-2-one	0	0	0	0	0	443	0	0	0	0
Acetic acid	62	20,808	9,111	5,364	4,248	1,508	2,017	286	699	547
Aggregated adjuvant data	609	214	1,472	1,363	574	533	3,075	477	248	420
Agrobacterium radiobacter strain: k1026	< 1	< 1	< 1	0	0	0	0	0	0	0
Agrobacterium radiobacter strain: k84	271	137	2,561	64	59	248	49	49	52	61
Albifimbria verrucariasolids and solubles strain: aarc-0255	17,675	30,810	26,033	22,923	23,021	21,639	22,057	11,418	13,030	2,029
Allyl isothiocyanate	0	0	< 1	0	0	< 1	0	0	0	0

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Aminoethoxyvinylglycine hydrochloride	1,757	2,011	1,380	1,296	2,532	2,984	3,003	2,289	1,967	986
Ammonium bicarbonate	34	42	0	0	0	0	< 1	0	0	< 1
Ammonium nitrate	88,037	91,580	89,253	86,913	78,362	84,593	80,390	73,447	64,464	60,034
Ammonium nonanoate	3,131	3,399	27,356	19,625	17,272	5,421	8,751	9,007	10,798	4,703
Aspergillus flavus strain: af-36	8	9	14	15	16	18	20	24	22	10
Aureobasidium pullulans subspecies pullulans dsm # 14940	458	356	1,095	2,493	3,956	2,794	2,355	2,220	1,652	829
Aureobasidium pullulans subspecies pullulans dsm # 14941	458	356	1,095	2,493	3,956	2,794	2,355	2,220	1,652	829
Azadirachtin	4,323	5,114	4,775	4,884	4,427	5,021	6,332	6,693	22,727	5,701
Bacillus altitudinis strain: qst 2808	7,957	8,124	7,890	9,248	7,552	7,734	10,181	8,823	8,176	6,886
Bacillus amyloliquefaciens strain: f727	0	0	0	0	0	0	32,134	17,773	30,001	62,012
Bacillus firmus strain: i-1582	42	190	170	212	160	33	28	7	21	0
Bacillus mycoides isolate j	0	0	0	1,085	568	531	423	178	220	252
Bacillus popilliae	< 1	< 1	< 1	0	< 1	0	0	0	0	0
Bacillus sphaericus 2362 serotype h5a5b strain: abts 1743	10,499	12,357	13,122	16,362	10,812	11,726	10,440	7,198	7,248	12,933
Bacillus subtilis subspecies subtilis strain: iab/bs03	0	0	0	0	5	48	18	166	53	84

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bacillus subtilis var. amyloliquefaciens strain fzb24	119	178	6	< 1	0	0	0	0	0	10
Bacillus thuringiensis (berliner)	< 1	< 1	4	3	2	< 1	2	2	2	3
Bacillus thuringiensis (berliner), subsp. aizawai, serotype h-7	333	184	73	118	48	548	43	82	40	26
Bacillus thuringiensis (berliner), subsp. kurstaki, serotype 3a,3b	39	18	34	73	91	23	4	3	3	2
Bacillus thuringiensis (berliner), subsp. kurstaki, strain sa-11	59,901	61,494	59,224	56,544	76,877	82,549	99,228	79,833	86,197	65,350
Bacillus thuringiensis (berliner), subsp. san diego	0	0	0	0	0	2	0	0	0	0
Bacillus thuringiensis subsp. aizawai strain: abts-1857	49,186	55,955	72,261	92,931	88,725	118,092	129,650	149,323	162,098	145,749
Bacillus thuringiensis subsp. aizawai strain: gc-91	18,776	16,788	18,908	34,178	45,073	54,344	58,215	58,296	66,033	35,144
Bacillus thuringiensis subsp. aizawai strain: sd-1372, lepidopteran active toxins	6	43	13	6	16	2	1	6	3	10
Bacillus thuringiensis subsp. israelensis strain: am 65-52	49,610	55,727	80,139	73,504	75,358	66,835	74,439	67,993	59,371	87,811

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bacillus thuringiensis subsp. kurstaki delta endotoxin protein (crya(c)), genetically engineered in kill pseudomonas fluorescens	< 1	0	< 1	0	5	0	< 1	< 1	0	0
Bacillus thuringiensis subsp. kurstaki strain: abts-351	111,930	95,901	118,627	135,306	121,707	160,898	132,220	127,467	113,301	128,883
Bacillus thuringiensis subsp. kurstaki strain: eg2438	0	0	0	0	0	0	0	0	0	0
Bacillus thuringiensis subsp. kurstaki strain: eg7826, genetically engineered	0	0	7	0	15	0	0	0	0	0
Bacillus thuringiensis subsp. kurstaki strain: eg7841 , genetically engineered	65	3	43	3	< 1	2,503	14,065	15,617	9,194	2,121
Bacillus thuringiensis subsp. kurstaki strain: m-200	0	< 1	0	< 1	< 1	< 1	0	0	0	0
Bacillus thuringiensis subsp. kurstaki strain: sa-12	28,471	28,042	25,543	42,089	42,831	34,280	43,948	38,982	38,656	29,687
Bacillus thuringiensis subspecies israelensis strain bmp 144	4,936	6,672	5,859	5,972	5,591	8,444	5,891	5,616	4,249	6,255
Bacillus thuringiensis subspecies kurstaki strain bmp 123	0	0	0	0	0	0	5	0	0	0
Bacillus thuringiensis, subsp. kurstaki, strain hd-1	1,928	1,860	186	111	13	24	16	28	19	20

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bacillus velensis strain: qst 713	20,969	20,922	21,167	21,952	21,291	25,554	19,083	16,998	15,682	13,738
Bacillus velezensis strain: d747	177,589	131,325	209,780	395,706	273,485	298,923	231,886	231,275	240,156	199,981
Bacillus velezensis strain: gb03	2	3	3	4	3	3	2	2	2	< 1
Bacillus velezensis strain: mbi 600	0	0	15	79	275	699	1,300	1,595	3,394	2,747
Bacteriophage active against pseudomonas syringae pathovar tomato	< 1	0	0	< 1	0	< 1	< 1	0	0	< 1
Bacteriophages active against xylella fastidiosa	0	0	0	0	0	0	< 1	< 1	< 1	< 1
Balsam fir oil	< 1	< 1	< 1	0	< 1	< 1	0	0	0	0
Beauveria bassiana hf23	0	0	37	55	67	72	78	83	39	53
Beauveria bassiana strain: ant-03	0	0	0	0	0	0	783	3,775	4,687	2,723
Beauveria bassiana strain: gha	2,749	3,514	2,850	5,690	7,346	6,773	7,139	7,754	9,054	11,189
Beauveria bassiana strain: ppri 5339	0	0	0	0	0	11	141	563	40	30
Beta-conglutin	0	6,762	6,099	7,383	4,314	2,968	4,819	6,915	11,816	25,661
Burkholderia rinojensis strain a396	2,829	58,593	53,655	115,528	216,932	423,880	567,552	570,420	597,723	526,001
Calcium acetate	0	0	0	0	< 1	0	0	0	0	< 1
Calcium salts of phosphorous acid	0	0	0	0	0	< 1	0	0	0	< 1
Canola oil	62	97	247	286	2,177	2,833	3,051	1,446	1,485	2,813
Capsicum oleoresin	27	92	125	203	635	409	419	287	255	465

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Castor oil	8	< 1	4	0	3	0	15	< 1	8	0
Cerevisane (cell walls of saccharomyces cerevisiae strain las117)	0	0	0	0	0	0	0	0	173	3,611
Chromobacterium subtsugae strain: praa4-1	46,419	46,121	31,460	36,396	42,933	39,074	37,390	28,700	34,626	35,381
Cinnamaldehyde	0	0	0	59	< 1	0	4,032	3,173	1,567	3,756
Citric acid	114,940	126,198	142,124	136,402	152,412	166,166	178,096	192,395	213,553	192,691
Clarified hydrophobic extract of neem oil	197,351	222,940	166,397	173,115	138,383	143,585	240,622	103,441	316,691	77,821
Clove oil	0	0	0	0	0	0	62	0	0	0
Coniothyrium minitans strain: con/m/91-08	641	786	657	667	424	216	543	489	871	435
Corn syrup	3,344	4,342	4,850	14,882	22,773	18,305	16,166	14,012	19,580	13,275
Cottonseed oil	132,464	87,451	55,082	45,678	35,072	39,589	16,873	21,715	10,959	3,201
Coyote urine	9	6	3	6	3	3	3	2	27	< 1
Cydia pomonella granulosus virus	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cytokinin (as kinetin)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Diallyl disulfide	0	0	103	94	0	0	26	0	0	1
Dihydro-5-heptyl-2(3h)-furanone	0	0	0	0	0	< 1	0	0	0	0
Dihydro-5-pentyl-2(3h)-furanone	0	0	0	0	0	< 1	0	0	0	0
Dysphania ambrosioides	17,504	12,828	10,207	8,598	387	186	85	146	23	652
E-11-tetradecen-1-yl acetate	48	65	27	288	39	8	12	2	5	3
E-8-dodecenyl acetate	240	633	393	1,716	271	326	537	219	225	262

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Essential oils	< 1	2	1	< 1	< 1	< 1	< 1	< 1	< 1	0
Ethylene	1,333	1,683	1,299	1,248	953	1,022	1,206	828	1,531	396
Eugenol	< 1	< 1	1	< 1	< 1	0	0	0	< 1	0
Farnesol	17	20	29	38	39	28	25	24	17	9
Ferric sodium edta	6,790	8,000	12,449	12,329	8,118	8,747	5,866	4,313	4,153	6,276
Formic acid	341	2,606	1,243	984	1,647	352	6,569	220	236	450
Fox urine	4	3	1	4	2	1	2	< 1	8	< 1
Gamma aminobutyric acid	15	15	0	0	0	0	0	0	0	0
Garlic	1,392	667	849	529	1,127	1,098	1,556	1,141	736	1,516
Geraniol	42	49	72	95	98	70	62	60	42	22
German cockroach pheromone	< 1	0	< 1	< 1	< 1	< 1	0	0	0	< 1
Gibberellins	27,422	27,409	23,144	27,104	28,675	25,413	29,073	19,000	18,465	15,734
Gibberellins, potassium salt	0	0	0	1	0	0	0	0	0	0
Glutamic acid	15	15	0	0	0	0	0	0	0	0
Gs-omega/kappa-hxtx-hv1a, versitide peptide	0	0	< 1	0	3	22	1,423	3,890	11,986	8,387
Harpin protein	< 1	0	< 1	< 1	0	0	0	< 1	< 1	3
Heptyl butyrate	6	4	3	13	4	28	12	6	9	15
Hydrogen peroxide	49,826	74,428	130,417	312,188	359,155	461,229	570,933	575,887	821,967	659,087
Hydroprene	5,734	6,456	3,920	3,155	2,935	4,250	2,826	1,818	8,497	4,052
Hypocrea (teleomorph)	2	2	9	4	< 1	32	24	50	81	164
Hypocrea atroviridis	2	2	9	4	< 1	32	24	50	81	164
Iba	14	13	10	19	17	29	38	50	35	60
Indole	0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Iron hedta	120	91	170	213	113	157	185	209	185	6,398
Iron phosphate	2,007	2,071	2,250	3,482	2,837	3,208	3,543	2,682	3,640	3,018

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Isaria fumosorosea apopka strain: 97	5,951	5,638	8,947	8,659	5,100	8,433	8,853	5,969	1,303	1,860
Isaria fumosorosea strain: fe 9901	0	0	0	0	0	0	0	20	455	817
Kaolin	2,854,542	3,411,740	3,591,384	3,193,218	3,272,397	2,723,609	2,958,027	2,618,288	2,863,194	3,290,868
Kinoprene	5	0	0	< 1	0	0	0	< 1	< 1	0
Lactic acid	0	0	3	12	0	15	19	23	15	14
Lactose	5,957	7,421	8,350	8,868	7,943	8,175	7,391	7,563	6,836	8,144
Laminarin	0	0	0	0	0	0	25	196	228	136
Lauryl alcohol	293	501	319	2,566	309	230	437	261	358	224
Lavandulyl senecioate	3,166	507	1,035	1,312	2,282	4,190	3,328	2,744	3,168	76,267
Limonene	67,831	72,742	67,404	92,244	106,815	56,860	57,305	46,877	33,424	39,233
Linalool	62	93	15	11	2	< 1	< 1	< 1	< 1	< 1
Margosa oil	22,585	26,062	32,493	25,061	13,758	44,396	39,020	51,558	70,183	65,251
Metarhizium robertsii strain: f52	121	20	54	2	1	< 1	< 1	0	0	47
Methoprene	5	41	54	65	16	10	56	15	972	10
Methyl anthranilate	634	672	789	1,118	958	1,208	1,396	1,581	1,537	1,453
Methyl eugenol	0	0	126	386	1,149	1,138	561	691	1,221	1,966
Methyl nonyl ketone	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0	0	0
Methyl salicylate	0	0	0	< 1	< 1	0	0	< 1	0	45
Muscalure	17	23	30	44	60	20	14	15	10	8
Muscodor albus strain: sa13	0	0	0	0	0	0	270	0	0	0
Myristyl alcohol	60	102	65	520	63	47	89	53	73	46
N6-benzyl adenine	184	230	221	161	214	587	415	274	1,310	206
Natamycin	< 1	< 1	< 1	< 1	0	96	288	6	44	731
Nerolidol	42	49	72	95	98	70	62	60	42	22
Nitrogen, liquified	6	0	0	0	0	0	0	0	0	29

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Nonanoic acid	17,531	14,482	13,301	14,610	12,755	12,442	13,810	10,368	10,753	8,379
Nonanoic acid, other related	923	762	700	769	671	654	727	544	565	436
Nosema locustae spores	< 1	< 1	< 1	< 1	< 1	0	< 1	< 1	0	0
Oil of anise	< 1	< 1	< 1	< 1	< 1	< 1	0	0	0	0
Oil of black pepper	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Oil of cedarwood	0	< 1	< 1	0	0	0	0	0	0	0
Oil of citronella	1	5	< 1	< 1	< 1	1	1	< 1	< 1	< 1
Oil of jojoba	376	44	19	2	0	0	0	0	0	0
Oil of orange	0	0	0	0	0	0	0	0	0	0
Oxypurinol	< 1	0	0	0	0	0	< 1	0	0	0
Phenylethyl propionate	712	185	96	140	34	20	15	42	8	48
Phosphoric acid, monopotassium salt	374	9,585	15,002	11,445	10,125	3,350	275	0	0	0
Piperine	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Polyhedral occlusion bodies (obs') of helioverpa zea (corn earworm) nucleopolyhedrovirus strain: aba-npv-u	2	4	20	41	41	22	33	46	47	45
Polyoxin d, zinc salt	7,412	8,613	10,321	10,657	11,460	13,187	11,817	9,511	8,706	13,358
Potassium bicarbonate	223,547	318,270	462,904	489,086	350,416	470,622	317,391	196,530	230,909	429,696
Potassium phosphite	708,940	667,368	955,031	1,167,494	1,205,805	1,653,083	1,409,672	1,261,964	1,180,365	1,305,483
Potassium silicate	23,582	36,616	25,901	33,039	13,814	27,998	51,209	26,758	21,798	18,388
Potassium sorbate	0	0	0	0	0	0	3	0	0	0
Propyleneglycol monolaurate	44	0	0	0	0	0	0	0	0	0

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Pseudomonas chlororaphis subsp. aurantiaca strain: afs009	0	0	0	0	0	0	3,387	8,474	34,556	40,257
Pseudomonas fluorescens, strain a506	270	87	123	111	113	66	38	39	19	148
Purpureocillium lilacinum strain 251	5,031	6,408	6,273	5,474	3,817	2,939	3,417	3,390	3,327	1,529
Putrescent whole egg solids	< 1	1	6	5	6	2	6	8	1	11
Quillaja	775	829	1,027	1,385	1,452	1,636	1,260	1,095	552	492
Reynoutria sachalinensis (giant knotweed) plant extract	16,105	18,364	23,508	23,644	20,231	23,705	25,946	20,178	15,311	17,069
S-abscisic acid	2,382	2,114	2,192	2,220	1,861	1,856	1,222	1,590	1,220	1,102
S-methoprene	6,331	4,183	4,489	4,176	4,872	12,538	5,902	4,576	5,849	5,977
Sawdust	0	0	1	0	0	0	< 1	13	7	38
Silver nitrate	0	0	< 1	< 1	0	< 1	< 1	1	1	2
Sodium bicarbonate	479	420	13,604	3,679	3	0	0	0	0	0
Sodium chloride	211	216	128	81	110	147	82	158	195	74
Sodium lauryl sulfate	0	1,749	507	1,200	1,334	1,148	1,223	1,235	1,471	1,480
Sodium percarbonate	463,448	244,233	261,347	165,621	329,330	276,555	277,981	278,934	294,908	367,206
Sorbitol octanoate	0	0	0	< 1	0	0	0	< 1	0	0
Soybean oil	59,297	69,771	84,295	80,999	82,753	70,341	70,941	67,348	69,366	90,129
Streptomyces lydicus strain: wyec 108	3	3	4	3	2	4	2	2	2	1
Streptomyces griseoviridis strain k61	11	18	5	4	2	< 1	< 1	< 1	< 1	5
Sucrose octanoate	98	203	29	7	0	0	0	0	0	0
Sugar	16	60	667	4	20	775	120	69	4	6

Chemical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Swinglea glutinosa extract	0	0	0	0	0	0	4	18,709	13,306	10,254
Tea tree oil	0	0	0	0	0	0	0	9	4	5
Thyme oil	1,150	258	125	193	32	18	12	60	4	10
Thymol	314	278	570	564	679	162	455	196	392	134
Trichoderma harzianum rifai strain krl-ag2	86	65	112	64	86	95	80	116	164	157
Trichoderma virens strain: gl-21	2,989	4,586	4,395	2,829	2,707	1,395	136	11	< 1	216
Trimethylamine	0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Ulocladium oudemansii (u3 strain)	792	516	155	34	2,131	1,444	836	595	375	373
Vegetable oil	270,634	485,845	519,572	669,038	829,980	674,254	587,369	459,269	524,559	528,577
Xanthine	< 1	0	0	0	0	0	< 1	0	0	0
Yeast	0	86	14	4	12	< 1	< 1	30	< 1	18
Yucca, extract	5,652	2,565	3,130	2,173	5,733	6,806	4,935	6,510	15,308	2,847
Z,e-9,12-tetradecadien-1-yl acetate	122	20	10	21	62	159	20	70	91	56
Z-11-tetradecen-1-yl acetate	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Z-8-dodecenol	41	84	60	202	47	52	93	38	39	43
Z-8-dodecenyl acetate	3,490	4,330	4,348	6,514	4,166	4,096	8,201	3,402	3,410	3,557
Total	6,060,697	6,778,136	7,576,858	7,980,650	8,251,007	8,467,208	8,576,425	7,623,889	8,484,749	8,823,191