

WTFRC APPLE PESTICIDE RESIDUE STUDIES 2011-2024

Since 2011, the Washington Tree Fruit Research Commission has conducted annual field studies to evaluate the harvest residues of numerous insecticides, acaricides, fungicides, and bioregulators commonly used in commercial apple production in WA. To provide a comprehensive overview of all measured residues, the table below summarizes all results regardless of application rates and timings or supplemental treatments such as overhead cooling,



application of sunburn protectants, or simulated packing line washing, scrubbing, and waxing of fruit; values in **bold red font** highlight those residue levels which **exceed current maximum residue levels** (MRLs) for apples in some key export markets. Please note that



the table does not include MRLs for India, which are currently set at 0.01 ppm for most chemicals. For more details regarding application protocols or results from specific years, please review annual reports of these studies at www.treefruitresearch.org. For more information on MRLs or other regulatory issues, please consult the Northwest Horticultural Council at www.nwhort.org.

STUDY DETAILS

- All trials conducted on 'Pacific' Gala / M.9 Nic.29 trained to central leader/spindle on 3' x 10' spacing
- Applications made with 2 x 25 gal Rears Pak-Blast sprayer calibrated to 100 gal water + 8 oz Regulaid / acre
- Spray protocols included both standard (applications at typical commercial rates and timings) and aggressive (applications at maximum rates and minimum retreatment and pre-harvest intervals) programs

MAJOR FINDINGS

- Many residues reported as potentially problematic in earlier annual reports would now be considered acceptable due to the relaxation of some MRLs in some markets
- Higher residue levels were consistently measured with higher application rates and shorter pre-harvest intervals
- Residues of some pesticides decreased on fruit which received a simulated packing treatment, but results were too inconsistent and unpredictable to consider it a reliable method for reducing residue levels
- Sunburn protection programs with Raynox or Eclipse did not significantly affect measured pesticide residues
- Routine application of overhead cooling did not significantly impact pesticide residue levels
- Carrier volume (100 gal water/acre vs. 200 gal water/acre) effects on residue levels were inconsistent and inconclusive

Minimum, maximum, and median residues vs. MRLs of common pesticides applied to 'Gala'/M.9 Nic. 29 apples near Rock Island, WA. WTFRC 2011-2024.

Chemical name	Trade name	# years evaluated	# samples analyzed	Minimum residue	Maximum residue	Median residue	US MRL ¹	Lowest export MRL ¹
				ppm	ppm	ppm	ppm	ppm
Abamectin	AgriMek SC	4	20	0	0	0.000	0.02	0.01 (many)
Acequinocyl	Kanemite	4	20	0	0.032	0.000	0.4	0.01 (CHN, THA)
Acetamiprid	Assail 70WP	6	48	0	0.31	0.068	1	0.8 (many)
Afidopyropen	Versys	4	20	0	0	0.000	0.02	0.02 (many)
Benzovindiflupyr	Aprovia	4	16	0	0.043	0.023	0.2	0.2 (many)
Bifenazate	Acramite	8	79	0	0.43	0.029	0.7	0.2 (CHN)
Boscalid	Pristine	4	32	0.049	0.86	0.130	3	2 (many)
Buprofezin	Tourismo/Centaur	9	66	0	1.9	0.034	3	1 (TWN)
Captan	Captec 4L	2	8	0.15	1.1	0.555	25	5 (CAN)
Carbaryl (summer)	Carbaryl 4L	1	4	0.62	3.1	1.355	12	0.01 (THA)
Carbaryl (thinning)	Carbaryl 4L	2	16	0	0	0.000	12	0.01 (THA)
Chlorantraniliprole	Altacor/Altacor eVo	7	44	0	0.34	0.035	1.2	0.4 (many)
Cytraniliprole	Exirel	6	60	0.021	0.6	0.105	1.5	0.5 (TWN)
Cyclaniliprole	Verdepryn	4	16	0	0.16	0.057	0.3	0.2 (many)
Cyflufenamid	Torino	4	20	0	0.043	0.017	0.06	0.01 (THA)
Cyflumetofen	Nealta	6	48	0	0.25	0.035	0.3	0.3 (CAN, MEX)
Cyfluthrin	Baythroid XL	3	12	0	0	0.000	0.5	0.1 (many)
Cyprodinil	Inspire Super	11	96	0	0.19	0.041	1.7	0.05 (IDN)

Chemical name	Trade name	# years evaluated	# samples analyzed	Minimum residue	Maximum residue	Median residue	US MRL ¹	Lowest export MRL ¹
				ppm	ppm	ppm	ppm	ppm
Diazinon	Diazinon 50W	7	52	0	0.12	0.019	0.5	0.1 (CAN)
Difenoconazole	Inspire Super	11	92	0	0.11	0.021	5	0.5 (CHN)
Emamectin benzoate	Proclaim	3	40	0	0	0.000	0.02	0.02 (many)
Endosulfan*	Thionex 50W	4	32	0	0.99	0.000	na	na
Ethephon (fall)	Ethephon 2SL	1	2	0.72	0.9	0.810	5	0.1 (CAN)
Ethephon (summer)	Ethephon 2SL	3	12	0	0.57	0.260	5	0.1 (CAN)
Ethephon (spring)	Ethephon 2SL	2	6	0	0.14	0.000	5	0.1 (CAN)
Etoxazole	Zeal	7	72	0	0.13	0.017	0.2	0.07 (many)
Fenazaquin	Magister	2	8	0.30	0.52	0.385	0.6	0.3 (many)
Fenbutatin	Vendex 50WP	1	4	0.83	1.1	0.970	15	2 (TWN)
Fenpropathrin	Danitol	11	94	0	0.65	0.175	5	0.01 (THA)
Flonicamid	Beleaf 50SG	3	12	0.024	0.37	0.043	0.2	0.2 (many)
Flubendiamide	Tourismo	4	42	0	0.31	0.040	1.5	0.8 (many)
Fluopyram	Luna Sensation	3	38	0	0.083	0.000	0.8	0.5 (many)
Flupyradifurone	Sivanto prime	3	12	0.089	0.39	0.170	0.7	0.5 (TWN)
Flutianil	Gatten	6	32	0	0.031	0.000	0.15	0.15 (many)
Flutriafol	Topguard	6	64	0	0.13	0.028	0.4	0.3 (many)
Fluxapyroxad	Merivon	5	52	0	0.51	0.048	0.8	0.8 (CAN, MEX)
Formetanate	Carzol SP	1	4	0	0	0.000	na	na
Hexythiazox	Onager	3	40	0.012	0.089	0.022	0.4	0.4 (many)
Imidacloprid	Nuprid 2SC	4	32	0	0.053	0.000	0.5	0.5 (many)
Indoxacarb	Avaunt	3	12	0.066	0.29	0.110	1	0.1 (CAN)
Ipflufenquin	AXIOS	2	8	0.024	0.062	0.042	0.15	0.01 (THA)
Isofetamid	Kenja 400SC	4	24	0	0.16	0.018	0.6	0.6 (many)
Lambda-cyhalothrin	Warrrior II	7	54	0	0.053	0.000	0.3	0.2 (many)
Mancozeb	Penncozeb 75DF	1	4	0	1.8	0.750	0.6	0.6 (MEX)
Mefentrifluconazole	Cevya	4	16	0.057	0.37	0.140	1.5	0.9 (TWN)
Methoxyfenozide	Intrepid	4	32	0	0.21	0.030	2	1.5 (CAN, TWN)
Metrafenone	Vivando	2	28	0	0	0.000	1.5	1 (many)
Myclobutanil	Rally 40WSP	7	68	0	0.73	0.099	0.5	0.5 (many)
Novaluron	Rimon	4	34	0.09	0.63	0.325	3	2 (CAN, TWN)
Penthiopyrad	Fontelis	4	42	0	0.034	0.017	0.5	0.4 (many)
Phosmet	Imidan 70-W	6	32	1.1	6.1	2.700	10	2 (TWN)
Pydiflumetofen	Miravis	4	16	0.011	0.071	0.030	0.2	0.2 (many)
Pyraclostrobin	Pristine/Merivon	9	84	0	0.47	0.045	1.5	0.5 (many)
Pyridaben	Nexter	3	40	0	0.044	0.029	0.75	0.01 (THA)
Spinetoram	Delegate WG	9	74	0	0.084	0.011	0.2	0.05 (many)
Spinosad	Entrust	7	64	0	0.11	0.024	0.2	0.1 (many)
Spiridoclofen	Envidor 2SC	4	52	0	0.35	0.042	0.8	0.5 (China)
Spirotetramat	Ultor	4	52	0	0.19	0.020	0.7	0.7 (many)
Sulfoxaflor	Transform	3	12	0.051	0.17	0.097	0.5	0.3 (many)
Thiacloprid	Calypso	1	8	0.081	0.15	0.091	0.3	0.3 (CAN, THA)
Thiophanate-methyl**	Topsin 4.5FL	7	62	0	0.83	0.086	2	2 (MEX)
Tolfenpyrad	Bexar	7	40	0.096	1.1	0.345	1	0.01 (TWN, THA)
Trifloxystrobin	Luna Sensation	5	46	0	0.033	0.000	0.7	0.5 (CAN)
Triflumizole	Procare 480SC	5	46	0	0.049	0.000	0.5	0.01 (THA)
Zeta-cypermethrin	Mustang Maxx	1	4	0.061	0.11	0.087	2	0.7 (many)
Ziram***	Ziram 76DF	7	68	0	2.8	0.510	7	0.1 (CAN)

¹ Top markets for WA apples excluding India; 11 Oct 2024. <https://nwhort.org/export-manual/comparisonmrls/apple-mrls/>, <https://bcglobal.bryantchristie.com/>

* Endosulfan values reported are sum totals of Endosulfan I, Endosulfan II, and Endosulfan sulfate residues

** Thiophanate-methyl values reported are sum totals of thiophanate-methyl and carbenzadim residues

*** Dithiocarbamate residues cannot be directly measured; total Ziram values are estimates based on analysis of the degradation product CS₂



Results of these unreplicated trials are shared for informational purposes only and should not be construed as endorsements of any product, reflections of their efficacy against any insect, acarid, or fungal pest, or a guarantee of similar results regarding residues for any user. Apple growers should consult their university extension staff, crop advisors, and warehouse representatives to develop responsible pest control programs.