**Supplementary Table S2.** Overview of all authorized AS in EU for organic farming, their pesticide type and their ecotoxicological endpoints (for birds: acute LD50 and chronic NOEL, for honeybees: contact and oral acute LD50, for earthworms: acute LC50 and chronic NOEC). In the columns „classified as” to the right of each ecotoxicological endpoint l.t. stands for “low toxic”, m.t. for “moderately toxic”, h.t. for “highly-toxic”.

| **Authorized substances for ORGANIC FARMING** | | |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Active substance | Pesticide type | Birds –  Acute LD50  (mg kg bw-1) | Classified as (PPDB) | Birds –  Chronic NOEL  (mg kg bw-1 d-1) | Classified as (PPDB) | Honeybees - Contact acute 48hr LD50  (µg bee-1) | Classified as (PPDB) | Honeybees - Oral acute 48hr LD50  (µg bee-1) | Classified as (PPDB) | Earthworms - Acute 14d LC50 (mg kg soil-1) | Classified as (PPDB) | Earthworms - Chronic NOEC, reproduction  (mg kg soil-1) | Classified as (PPDB) |
| (E)-11-Tetradecen-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (E)-5-Decen-1-ol | Insecticides | 2050 | **l.t.** |  |  |  |  | 85 | **m.t.** |  |  |  |  |
| (E)-5-Decen-1-yl acetate | Insecticides | 5000 | **l.t.** |  |  |  |  | 85 | **m.t.** |  |  |  |  |
| (E)-8-Dodecen-1-yl acetate | Insecticides | 5000 | **l.t.** |  |  |  |  | 85 | **m.t.** |  |  |  |  |
| (E,E)-7,9-Dodecadien-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (E,E)-8,10-Dodecadien-1-ol | Insecticides | 2150 | **l.t.** |  |  |  |  | 85 | **m.t.** |  |  |  |  |
| (E,Z)-2,13-Octadecadien-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (E,Z)-7,9-Dodecadien-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z)-11-Hexadecen-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z)-11-Hexadecenal | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z)-11-Tetradecen-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z)-7-Tetradecenal | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z)-8-Dodecen-1-ol | Insecticides | 2050 | **l.t.** |  |  |  |  | 0.85 | **h.t.** |  |  |  |  |
| (Z)-8-Dodecen-1-yl acetate | Insecticides | 5050 | **l.t.** |  |  |  |  | 0.85 | **h.t.** |  |  |  |  |
| (Z)-9-Dodecen-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z)-9-Hexadecenal | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z)-9-Tetradecen-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z,E)-7,11-Hexadecadien-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z,E)-9,12-Tetradecadien-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| (Z,Z)-7,11-Hexadecadien-1-yl acetate | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| Adoxophyes orana GV strain BV-0001 | Insecticides |  |  |  |  |  |  |  |  | 1000 | **m.t.** |  |  |
| Kaolin | Insecticides 5000 | | **l.t.** | 2444 | **l.t.** | 100 | **m.t.** | 100 | **m.t.** | 2000 | **l.t.** |  |  |
| Ampelomyces quisqualis strain AQ10 | Fungicides | 1667 | **m.t.** |  |  |  |  |  |  |  |  |  |  |
| Aureobasidium pullulans (strains DSM 14940 and DSM 14941) | | 2000 | **m.t.** |  |  |  |  |  |  |  |  |  |  |
| Azadirachtin | Insecticides | 1000 | **m.t.** |  |  | 11.81 | **m.t.** | 8.1 | **m.t.** | 1000 | **m.t.** |  |  |
| Bacillus amyloliquefaciens AH2 | Fungicides |  |  |  |  | 4.30E+11 | **l.t.** | 20000000000 | **l.t.** | 1000 | **m.t.** |  |  |
| Bacillus amyloliquefaciens IT-45 | Fungicides |  |  |  |  | 200 | **l.t.** | 200 | **l.t.** |  |  |  |  |
| Bacillus amyloliquefaciens MBI 600 | Fungicides | 4000 | **l.t.** |  |  | 100 | **m.t.** | 11000000 | **l.t.** |  |  | 2.90E+12 | **l.t.** |
| Bacillus amyloliquefaciens str. QST 713 | Fungicides | |  |  |  |  |  | 180000000 | **l.t.** | 10000 | **l.t.** |  |  |
| Bacillus amyloliquefaciens strain FZB24 | Fungicides | 1000 | **m.t.** |  |  |  |  | 6000 | **l.t.** | 1000 | **m.t.** |  |  |
| Bacillus amyloliquefaciens subsp. plantarum D747 | Fungicides | 1200000000 | **l.t.** |  |  | 320 | **l.t.** |  |  | 1000 | **m.t.** |  |  |
| Bacillus firmus I-1582 | Others |  |  |  |  |  |  | 351000 | **l.t.** | 3510000000 | **l.t.** |  |  |
| Bacillus pumilus QST 2808 | Fungicides | 70000000000 | **l.t.** |  |  |  |  |  |  | 2.10E+12 | **l.t.** |  |  |
| Bacillus thuringiensis subsp. Aizawai strain GC-91 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** |  |  |  |  |  |  |
| Bacillus thuringiensis subsp. Aizawai strains ABTS-1857, GC-91 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** |  |  |  |  |  |  |
| Bacillus thuringiensis subsp. Israeliensis (serotype H-14) strain AM65-52 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** | 108 | **l.t.** |  |  |  |  |
| Bacillus thuringiensis subsp. Kurstaki strain ABTS 351 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** | 82 | **m.t.** |  |  |  |  |
| Bacillus thuringiensis subsp. Kurstaki strain EG 2348 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** | 82 | **m.t.** |  |  |  |  |
| Bacillus thuringiensis subsp. Kurstaki strain SA 11 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** | 82 | **m.t.** |  |  |  |  |
| Bacillus thuringiensis subsp. Kurstaki strain SA 12 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** | 82 | **m.t.** |  |  |  |  |
| Bacillus thuringiensis subsp. Kurstaki strains ABTS 351, PB 54, SA 11, SA12 and EG 2348 | Insecticides | 5000 | **l.t.** |  |  | 100 | **m.t.** | 82 | **m.t.** |  |  |  |  |
| Beauveria bassiana 203 | Insecticides |  |  |  |  | 1800000000 | **l.t.** | 1800000000 | **l.t.** |  |  |  |  |
| Beauveria bassiana IMI389521 | Insecticides |  |  |  |  |  |  | 185.7 | **l.t.** |  |  | 1000 | **l.t.** |
| Beauveria bassiana strain 147 | Insecticides |  |  |  |  |  |  | 185.7 | **l.t.** |  |  | 1000 | **l.t.** |
| Beauveria bassiana strain ATCC 74040 | Insecticides | 2667 | **l.t.** |  |  | 9285 | **l.t.** |  |  |  |  |  |  |
| Beauveria bassiana strain GHA | Insecticides | 2667 | **l.t.** |  |  | 9285 | **l.t.** |  |  |  |  |  |  |
| Beauveria bassiana strain NPP111B005 | Insecticides |  |  |  |  |  |  | 185.7 | **l.t.** |  |  | 1000 | **l.t.** |
| Beauveria bassiana strains ATCC 74040 and GHA | Insecticides | 2667 | **l.t.** |  |  | 9285 | **l.t.** |  |  |  |  |  |  |
| Bordeaux mixture | Fungicides | 616 | **m.t.** |  |  | 25.2 | **m.t.** | 23.3 | **m.t.** | 195.5 | **m.t.** |  |  |
| Calcium hydroxide | Insecticides | |  |  |  |  |  |  |  | 520 | **m.t.** |  |  |
| Cerevisane | Fungicides | 2500 | **l.t.** |  |  |  |  |  |  | 1000 | **m.t.** |  |  |
| Copper hydroxide | Fungicides | 223 | **m.t.** |  |  | 44.46 | **m.t.** | 49 | **m.t.** | 677 | **m.t.** | 15 | **m.t.** |
| Copper oxide | Fungicides | 1183 | **m.t.** |  |  | 22 | **m.t.** | 116 | **l.t.** | 862 | **m.t.** | 15 | **m.t.** |
| Copper oxychloride | Fungicides | 173 | **m.t.** |  |  | 44.3 | **m.t.** | 12.1 | **m.t.** | 489.6 | **m.t.** | 40.5 | **m.t.** |
| COS-OGA | Fungicides |  |  |  |  | 12.5 | **m.t.** | 10 | **m.t.** |  |  |  |  |
| Cydia pomonella Granulovirus (CpGV) | Insecticides | 10000 | **l.t.** |  |  | 100 | **m.t.** | 108.4 | **l.t.** | 1000 | **m.t.** | 1000 | **l.t.** |
| Ethylene | Plant growth regulators | |  |  |  |  |  |  |  | 60 | **m.t.** |  |  |
| Eugenol | Insecticides | 10000 | **l.t.** |  |  | 200 | **l.t.** |  |  | 1000 | **m.t.** |  |  |
| Extract from tea tree | Fungicides | 2000 | **m.t.** |  |  | 331 | **l.t.** | 66 | **m.t.** |  |  |  |  |
| Ferric phosphate | Others | 2000 | **m.t.** |  |  | 100 | **m.t.** | 109.9 | **l.t.** | 10 | **m.t.** | 6.7 | **m.t.** |
| Garlic extract | Insecticides | |  |  |  |  |  | 500 | **l.t.** |  |  |  |  |
| Geraniol | Fungicides | 10000 | **l.t.** |  |  | 200 | **l.t.** |  |  | 500 | **m.t.** |  |  |
| Helicoverpa armigera nucleopolyhedrovirus (HearNPV) | Insecticides |  |  |  |  |  |  | 5420 | **l.t.** |  |  |  |  |
| Hydrogen peroxide | Fungicides | 5000 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| Isaria fumosorosea Apopka strain 97 | Insecticides | 2500000000 | **l.t.** |  |  | 20 | **m.t.** |  |  |  |  |  |  |
| Kieselgur (diatomaceous earth) | Insecticides | 2000 | **m.t.** |  |  |  |  |  |  | 1000 | **m.t.** |  |  |
| Laminarin | Fungicides | 1700 | **m.t.** |  |  | 100 | **m.t.** | 118.64 | **l.t.** |  |  |  |  |
| Lauric acid (CAS 143-07-7) | Herbicides | 2510 | **l.t.** |  |  | 25 | **m.t.** |  |  | 105 | **m.t.** |  |  |
| Lime sulphur (calcium polysulphid) | Fungicides | |  |  |  | 593 | **l.t.** | 69.8 | **m.t.** | 1000 | **m.t.** |  |  |
| Maltodextrin | Insecticides | 2500 | **l.t.** |  |  | 200 | **l.t.** | 200 | **l.t.** | 500 | **m.t.** |  |  |
| Methyl decanoate (CAS 110-42-9) | Herbicides | 2510 | **l.t.** |  |  | 25 | **m.t.** |  |  | 105 | **m.t.** |  |  |
| Methyl octanoate (CAS 111-11-5) | Herbicides | 2510 | **l.t.** |  |  | 25 | **m.t.** |  |  | 105 | **m.t.** |  |  |
| Metschnikowia fructicola strain NRRL Y-27328 | Fungicides |  |  |  |  | 250 | **l.t.** | 279 | **l.t.** |  |  |  |  |
| Oleic acid (CAS 112-80-1) | Herbicides | 2510 | **l.t.** |  |  | 25 | **m.t.** |  |  | 105 | **m.t.** |  |  |
| Orange oil | Insecticides | |  |  |  |  |  | 100 | **m.t.** | 999.7 | **m.t.** |  |  |
| Paraffin oil/(CAS 64742-46-7) | Acaricides | 5000 | **l.t.** |  |  |  |  |  |  | 750 | **m.t.** |  |  |
| Paraffin oil/(CAS 72623-86-0) | Acaricides | 5000 | **l.t.** |  |  |  |  |  |  | 750 | **m.t.** |  |  |
| Paraffin oil/(CAS 8042-47-5) | Acaricides | |  |  |  | 100 | **m.t.** | 414 | **l.t.** | 375 | **m.t.** | 55.35 | **m.t.** |
| Paraffin oil/(CAS 97862-82-3) | Acaricides | 5000 | **l.t.** |  |  |  |  |  |  | 750 | **m.t.** |  |  |
| Pasteuria nishizawae Pn1 | Others | |  |  |  | 100 | **m.t.** | 100 | **m.t.** | 1000 | **m.t.** |  |  |
| Pelargonic acid (CAS 112-05-0) | Herbicides | 2450 | **l.t.** |  |  | 181.1 | **l.t.** | 122.1 | **l.t.** | 105 | **m.t.** | 250 | **l.t.** |
| Phlebiopsis gigantea strain FOC PG 410.3 | Fungicides |  |  |  |  | 100 | **m.t.** | 100 | **m.t.** |  |  |  |  |
| Phlebiopsis gigantea strain VRA 1835 | Fungicides |  |  |  |  | 100 | **m.t.** | 100 | **m.t.** |  |  |  |  |
| Phlebiopsis gigantea strain VRA 1984 | Fungicides |  |  |  |  | 100 | **m.t.** | 100 | **m.t.** |  |  |  |  |
| Plant oils / Citronella oil | Herbicides | 2250 | **l.t.** |  |  |  |  |  |  | 1000 | **m.t.** |  |  |
| Plant oils / Clove oil | Insecticides | |  |  |  |  |  |  |  | 1000 | **m.t.** | 1000 | **l.t.** |
| Plant oils / Rape seed oil | Insecticides | |  |  |  | 640 | **l.t.** | 2572 | **l.t.** |  |  | 3550 | **l.t.** |
| Plant oils / Spear mint oil | Plant growth regulators | |  |  |  | 200 | **l.t.** |  |  | 1000 | **m.t.** |  |  |
| Potassium hydrogen carbonate | Fungicides |  |  |  |  | 368 | **l.t.** | 24 | **m.t.** |  |  |  |  |
| Pseudomonas sp. Strain DSMZ 13134 | Plant growth regulators | |  |  |  |  |  |  |  | 1.06E+11 | **l.t.** |  |  |
| Purpureocillium lilacinum PL 11 | Insecticides | 58800000000 | **l.t.** |  |  | 500000 | **l.t.** |  |  |  |  |  |  |
| Purpureocillium lilacinum strain | Insecticides | 58800000000 | **l.t.** |  |  | 500000 | **l.t.** |  |  |  |  |  |  |
| Pyrethrins | Insecticides | 51151 | **l.t.** | 82 | **m.t.** | 0.013 | **h.t.** |  |  | 23.7 | **m.t.** | 0.25 | **m.t.** |
| Pythium oligandrum M1 | Fungicides |  |  |  |  | 491 | **l.t.** | 105 | **l.t.** |  |  |  |  |
| Sodium chloride | Herbicides | 3000 | **l.t.** |  |  |  |  |  |  | 2500 | **l.t.** |  |  |
| Sodium hydrogen carbonate (basic substance) | Fungicides | 8075 | **l.t.** |  |  | 559.1 | **l.t.** | 537.4 | **l.t.** |  |  |  |  |
| Spinosad | Insecticides | 2000 | **m.t.** | 68.35 | **m.t.** | 0.0036 | **h.t.** | 0.057 | **h.t.** | 458 | **m.t.** | 1.79 | **m.t.** |
| Spodoptera littoralis nucleopolyhedrovirus (SpliNPV) | Insecticides |  |  |  |  |  |  | 81200 | **l.t.** |  |  |  |  |
| Straight Chain Lepidopteran Pheromones | Insecticides | 2250 | **l.t.** |  |  |  |  |  |  |  |  |  |  |
| Streptomyces K61 (formerly S. griseoviridis) | Fungicides | 2500 | **l.t.** |  |  |  |  | 48 | **m.t.** | 1000 | **m.t.** | 1000 | **l.t.** |
| Streptomyces lydicus WYEC 108 | Fungicides |  |  |  |  | 100 | **m.t.** |  |  |  |  |  |  |
| Sulphur | Fungicides | 2000 | **m.t.** |  |  | 100 | **m.t.** | 106.8 | **l.t.** | 2000 | **l.t.** | 1000 | **l.t.** |
| Tetradecan-1-ol | Insecticides | 2050 | **l.t.** |  |  |  |  | 85 | **m.t.** | 1000 | **m.t.** |  |  |
| Thymol | Insecticides | 10000 | **l.t.** |  |  | 200 | **l.t.** |  |  | 500 | **m.t.** |  |  |
| Tribasic copper sulfate | Fungicides | 72.4 | **h.t.** |  |  | 23.5 | **m.t.** | 40 | **m.t.** | 155 | **m.t.** | 15 | **m.t.** |
| Trichoderma afroharzianum strain T-22 (Formerly Trichoderma harzianum strain T-22) | Fungicides | 2222 | **l.t.** |  |  | 10000000 | **l.t.** |  |  |  |  |  |  |
| Trichoderma asperellum (formerly T. harzianum) strain T25 | Fungicides |  |  | 2222 | **l.t.** | 100 | **m.t.** | 150 | **l.t.** |  |  |  |  |
| Trichoderma atroviride (formerly T. harzianum) strain T11 | Fungicides |  |  |  |  | 100 | **m.t.** | 150 | **l.t.** |  |  |  |  |
| Trichoderma atroviride strain SC1 | Fungicides | 2000 | **m.t.** |  |  | 1000000 | **l.t.** | 1130000 | **l.t.** |  |  |  |  |
| Trichoderma harzianum strains T-22 and ITEM 908 | Fungicides | 2222 | **l.t.** |  |  | 10000000 | **l.t.** |  |  |  |  |  |  |
| The following orgAS were excluded from the analysis: |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (E,Z)-3,8-Tetradecadien-1-yl acetate  (E,Z)-8-Dodecen-1-yl acetate  (E,Z)-9-Dodecen-1-yl acetate  (E,Z,Z)-3,8,11-Tetradecatrien-1-yl acetate  (Z)-11-Hexadecen-1-ol  (Z)-13-Octadecenal  (Z)-8-Tetradecen-1-ol  (Z)-8-Tetradecen-1-yl acetate  (Z,E)-9,11-tetradecadien-1-yl-acetate  Akanthomyces muscarius Ve6  Allium cepa L. bulb extract  Bacillus subtilis strain IAB/BS03  Bacillus thuringiensis subsp. Aizawai strain ABTS-1857  Bacillus thuringiensis subsp. Kurstaki strain PB 54  Beauveria bassiana PPRI 5339  Beer  Candida oleophila strain O  Capric acid (CAS 334-48-5)  Caprylic acid (CAS 124-07-2)  Carbon dioxide (active substance)  Chitosan  Chitosan hydrochloride  Paecilomyces fumosoroseus strain Fe9901 |  | Clonostachys rosea strain J1446  Coniothyrium minitans Strain CON/M/91-08  Cow Milk  Diammonium phosphate  Dodecyl acetate  E,Z-3,13-Octadecadienyl Acetate  Equisetum arvense L.  Fructose  Hydrolysed proteins  Lavandulyl senecioate  L-cysteine  Lecithins  Metarhizium brunneum strain Ma 43  Mild Pepino Mosaic Virus isolate VC 1  Mild Pepino Mosaic Virus isolate VX 1  Mustard seeds powder  n-hexadecanyl acetate  n-Tetradecylacetate  Onion oil  Pepino mosaic virus (PepMV) Chilean (CH2) strain  Pepino mosaic virus (PepMV) European (EU) strain  Pepino mosaic virus strain CH2 isolate 1906  Pseudomonas chlororaphis strain MA342 | | | |  | Quartz sand  Repellents by smell of animal or plant origin/ sheep fat  Rescalure  Saccharomyces cerevisiae strain LAS02  Salix spp. cortex  Spodoptera exigua multicapsid nucleopolyhedrovirus  Sucrose  Sunflower oil  Trichoderma asperellum  Trichoderma asperellum  Trichoderma asperellum strains ICC012, T25 and TV1  Trichoderma asperellum strain T34  Trichoderma atrobrunneum strain ITEM 908  Trichoderma atroviride strain IMI 206040  Trichoderma atroviride strain T11 and IMI 206040  Trichoderma atroviride strain I-1237  Trichoderma gamsii strain ICC080  Urtica spp.  Verticillium albo-atrum strain WCS850  Vinegar  Whey  Z,Z-3,13-Octadecadienyl Acetate  Zucchini yellow mosaic virus - weak strain | | | |  |  |  |