OHIO AGRICULTURAL EXPERIMENT STATION.

BULLETIN 102.

SEED AND SOIL TREATMENT AND SPRAY CALENDAR

FOR INSECT PESTS AND PLANT DISEASES.

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This Bulletin is designed to cover the needs of farmers and horticulturists. It was first prepared as a spray calendar at the request of the Ohio State Horticultural Society. Insecticides and Fungicides may often be combined in spraying, and, where Bordeaux mixture is used for fungous diseases this practice is recommended. Spraying young orchards with Bordeaux mixture from time of planting, and of stocks in nursery row, is strongly recommended to preserve healthy conditions.

FUNGICIDES.

1.

Bordeaux Mixture I.

Copper sulfate (blue vitriol) 4 pounds.
Quicklime (not air slaked) 4 pounds.
Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better, by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water. Slake the lime by addition of a small quantity of water, and when slaked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but stone lumps or sand is taken up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough agitation the mixture is ready to apply. The mixture must be made fresh before using, and any left over for a time, should be thrown out or fresh lime added.

2.

Bordeaux Mixture II.

Copper sulfate 2 pounds.
Quicklime, 2 pounds.
Water, to make 50 gallons.

For use on such trees as have foliage injured by Bordeaux I.

STOCK SOLUTION.

A solution of copper sulfate containing say one pound of sulfate to the gallon of water may be made up and permitted to stand indefinitely in a covered barrel if no lime is added. Such a solution is known as a stock solution and two or four gallons of this stock solution according to the strength desired, are taken for each 50 gallons of mixture to be made. For extensive spraying, a long trough or box of uniform width may be used in which to slake and keep the lime. The quicklime is weighed out according to the amount needed immediately, placed in the trough and slaked with a small quantity of water. The whole is evenly spread and covered as a putty, with water to exclude the air. This putty may be removed in calculated portions, placed in a tub and treated like the freshly slaked lime. By means of stock solution of copper sulfate and the lime in putty state, much valuable time is saved in filling the barrels or tanks used in spraying.

3.

Ammoniacal Solution of Copper Carbonate.

Copper carbonate, 6 ounces.
Ammonia, about 3 pints.
Water, 50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

Caution: Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

To make copper carbonate: Dissolve 10 pounds copper sulfate (blue vitriol) in 10 gallons of water, also 12 pounds carbonate of soda in same quantity of water. When cool, mix the two solutions slowly, stirring well. Allow the mixture to stand twelve hours and settle, after which pour off the liquid. Add the same quantity of water as before, stir and allow to stand the same length of time. Repeat the operation again, after which drain and dry the blue powder, which is copper carbonate.

4.

Copper Sulfate Solution.

Copper sulfate, 4 pounds.
Water, to make 50 gallons.

Dissolve the sulfate as directed in Bordeaux I.

Caution: This solution will injure foliage. It can be used only before the buds open.

5.

Potassium Sulfid Solution.

Potassium sulfid (liver of sulfur) 1 ounce.
Water, 3 to 4 gallons.

This solution will not remain unchanged. The potassium sulfid must be kept in a well stoppered bottle.

6.

Formalin.

For oats and wheat 1 lb. formalin to 50 gallons of water.
For potatoes ½ pint formalin to 15 gallons of water.

7

Corrosive Sublimate.

Corrosive sublimate, 2 ounces.
Water, 15½ gallons.
Label, **Poison**; used for potato scab and for disinfection.

To hasten solution, have druggist pulverize the sublimate.

INSECTICIDES.

8.

Kerosene Emulsion.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still boiling hot, remove from the fire and add two gallons of kerosene. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like the chinch bug, use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.) use 1 part emulsion to 15 or 20 parts water.

Kerosene emulsion kills by *contact* and therefore the application should be very thorough. It may be used against a great many differsnt pests, but is especially valuable for destroying those with sucking mouth-parts, for they cannot be killed with arsenical poisons.

9.

Paris Green.

In combination with Bordeaux mixture, Paris green may be used at the rate of 1 pound to 175 to 200 gallons.

When Bordeaux mixture is unnecessary, the Paris green may be used at the same rate, but 2 or 3 pounds of freshly slaked lime must be added to prevent burning of the foliage. Keep the mixture well stirred so that the poison will be distributed evenly.

In cases where successive sprayings are necessary, it is important to consider the accumulation of poison and use a slighly weaker mixture unless sufficient rain has fallen to wash off the poison thoroughly.

10.

London Purple.

If desirable London purple may be substituted for Paris green, but it has the disadvantage of being somewhat variable in composition and contains more soluble acid. For that reason it must be used somewhat weaker, or elsean abundance of lime provided, so as to prevent burning of foliage. It has the advantage of not settling as readily as Paris green.

11.

White Hellebore.

Hellebore is often employed in cases where arsenical poisons would be objectionable. Use one ounce to three gallons of water.

12.

Pyrethrum.

Pyrethrum is usually applied as a powder, with a bellows but may be used as a spray at the rate of one ounce to two gallons of water.

13.

Whale Oil Soap Solution.

Use from one to two pounds of the soap to one gallon of water. Be sure that the soap is thoroughly dissolved, and then apply in form of spray. 1 pound to gallon of water if used for peach leaf curl only.

14.

Arsenite of Soda.

Dissolve two pounds of commercial white arsenite and four pounds of carbonate of soda (washing soda) in two gallons of water and use one and one-half pints to a barrel of Bordeaux Mixture (50 gallons).

The easiest way to make the solution is to put both the white arsenite and carbonate of soda in a gallon of boiling water and keep boiling about fifteen minutes, or until a clear liquid is formed, and then dilute to two gallons.

SEED AND SOIL TREATMENT.

Seed or Plant.	For What Treated.	Treatment.	Method of Treatment.
Barley	Smuts	Modified hot water	Soak seed enclosed in sacks 4 hours in cold water, let stand wet 4 hours more and dip 5 minutes in hot water at 130 degrees F., or three degrees lower than for other hot water treatments.
Bean	Anthracnose	(See spray calendar.)	
	Weevil	Bisulfid of carbon	Submit to fumes for 24 hours in air-tight vessel.
Begonia	Nematodes	Heat soil with steam	Disinfect soil to be used by heating with steam as described under cucumbers.
Cabbage and Cauliflower	Club root	Quick lime on soil	Apply stone lime (quicklime) before planting, at rate of 80 bushels per acre and work into soil with tools.
	Maggot	Bisulfid of carbon	Make hole in soil near roots, pour in about a teaspoonful of bisulfid of carbon and fill hole with soil.
Cucumber	Nematodes in hot-house	Heat soil with steam	Heat earth before using in special box for 3 hours with 60 lbs. of steam or 4 hours with 40 lbs. See Bulletin 73.
Oats	Loose smut	Immerse seed in hot water. Soak seed in Potas. sulfid. Sprinkle seed with Formalin or copper sulfate	Immerse seed contained in open vessel for 10 minutes in hot water at 132-3 degrees F., for 7 minutes at 136 degrees F., or for 5 minutes at 140-2 degrees F., spread at once to dry. (2.) Soak seed in ¾ per cent. solution potassium sulfid for 24 hours with stirring, then dry. (3.) Sprinkle a pile of seed to saturate with formalin or copper sulfate, one gal. to bu. After 2 to 5 hrs. spread to dry. For latter use lime in drying. See Bulletin 97.
	Insects in stored grain	See wheat.	
Onion	Smut	Plant other crop. Use sets or transplanted seedlings	The soil once infected by spores of onion smut cannot easily be freed from them. Long planting in other crops or use of sets or transplants yields favorable results.
Potato	Scab	Soak uncut seed in corrosive sublimate or formalin	Soak seed for one hour in corrosive sublimate, or for 2 hours in formalin, then dry and plant on scab free soil.
Roses	Nematodes in hot-house	Heat soil with steam	Heat soil with steam as described above; thoroughly disintregated soil from sod one year or more old is less dangerous. Lime water stimulates affected plants but is not a remedy.
Sweet Potato	Bin rot	Use flowers of sulfur in soil	Make dope 1 part flowers of sulfur and 6 parts earth:—Drop handful and set plant through it.
	Soil rot	Use flowers of sulfur	(Same as above).
Tomato	Nematodes in hot-house	Heat soil with steam	As for roses and cucumbers above.
	Point rot in hot-house	Mulch or subwater	A supply of available water appears to be unfavorable to point rot of green tomatoes.
Turnip	Club root	Quick lime in soil	As for cabbage and cauliflower. Avoid succession of mustard crops.
Violet	Nematodes in hot-house	Heat soil by steam	The time for prevention is by soil treatment beforehand, as for cucumbers above.
Wheat	Loose smut	Modified hot water	Soak seed 4 hours in cold water, let stand 4 hours more in wet sacks, immerse 5 minutes in water at 133 degrees F. and dry.
	Stinking smut	Hot water, copper sulfate or formalin	Dip skimmed seed for 10 minutes in hot water at 133 degrees F. and dry on disinfected surface, or immerse 10 min. in blue stone, dry with air slaked lime by shoveling. Use 2 lbs. blue stone to 10 gals. water. Grain may be sprinkled with copper sulfate or formalin, as for oats. See Bulletin 97.
	Insects in stored grain	Bisulfid of carbon	Place one pound of bisulfid of carbon for each 2,000 lbs. of grain in grain in bins. Cover surface to hold the fumes which will spread through the mass, killing all insect life. Use in tight bins or buildings and do not use near fire of any description.

SPRAY CALENDAR.

What to Spray.	For What to Spray.	With What to Spray.	WHEN TO SPRAY. First Spraying.	Second Spraying.	Third Spraying.	Fourth Spraying.	Remarks and Cautions.
Apple	Bitter rot	Ammoniacal cop. carb	With first appearance of rot	Two weeks after first	Two weeks later	Not required if Bord. precedes	Follow by two or three sprayings with am. cop. carb.
	Scab	Bordeaux mixture I	As buds are swelling	Just before blossoms open	Just after blossoms drop	7 to 10 days later	These follow Bord. for scab; danger on fair skin'd apples.
	Sooty fungus	Bordeaux I	After blossoms drop	Two weeks later	These coincide with 3d and	4th for scab.	
	Bud moth	Arsenites in Bordeaux I	With opening of buds				
	Canker worm	Arsenites alone, 9 or 10	With first young worms	In 1 week if worms remain	Same as second		White skinned apples are injured by spraying after 3d.
	Codlin moth	Arsenites in Bordeaux I	As soon as blossoms fall	7 to 10 days later	These coincide with 3d and	4th for scab. Paris green alone on light apples.	
	San Jose scale	Whale oil soap solution	As soon as leaves drop in fall	Just before fol. starts in Spr			Two lbs. soap dissolved in 1 gallon water.
	Woolly aphis	Kerosene emulsion	When trees are not in full leaf	In fall			Don't use emul. when trees are in full leaf.
Aster	Blister Beetles	Whale oil soap	When beetles appear				Use 1 lb. soap to 6 gals. water.
Asparagus	Asparagus Beetle	Lime or Pyrethrum	Early spring				Do not use arsenites, except in late summer.
Bean	Anthracnose	Bordeaux I	Soak seed 1 to 2 h. in am. cop. car. five times strength of 3	Bord. on 2 to 3 in. plants	Bordeaux 10 days later	After blossoms	Repeat if needed.
Beet	Leaf spot	Bordeaux I	When plants are 5-6 in. high	Two weeks after first	Two weeks later		
Cabbage and Cauliflower	Cabbage worm	Pyrethrum	With first appearance of worms	Whenever worms observed			1 oz. to 3 gallons water, or dust 1 to 10 of flour.
	Club root	(See soil treatment.)					
Carnation	Leaf or calyx mould	Bordeaux I or ½ of 4	Upon appearance of fungus	Two weeks later	Two weeks later	Repeat if needed	Begin early before calyces are ruined.
	Leaf spot	Bordeaux I or ½ of 4	Upon appearance of fungus	Two weeks later	Two weeks later	Cover foliage well.	
Celery	Leaf spot or leaf blight	Bordeaux I	On young seedlings	Repeat on seedlings	Before or after transplanting	Two weeks later	Keep leaved well covered in plant bed.
Cherry Stocks	Leaf spot	Bordeaux II	When leaves are half grown	Two weeks later	Two weeks later	About two weeks later.	
Cherry	Leaf spot	Bordeaux II	When leaves are unfolding	Two weeks later	2 or 3 weeks after second		First after blossoming.
	Rot (?)	Bordeaux I and II	Before blossoming I	After bloss. drop II, on fruit	Two weeks later II on fruit	Two weeks later II or 3	Use 3 when fruit is large.
	Aphis	Whale oil soap	On first appearance of aphis				Difficult to reach aphis. Use 1 lb. soap to 6 gals. water.
	Cherry slug	Arsenites in Bord. II	When slugs appear	Repeat if slugs remain			Air slaked lime may be used.
	Curculio	Arsenites in Bord. I and II	Before blossoming in I	As blossoms dry up in II	One week later in II		Avoid strong solutions.
	San Jose scale	Whale oil soap solution	In fall as with the apple	As with the apple			
Cinerarias	Mildew	Bordeaux I or ½ of 4	When mildew appears	Two weeks later	Repeat if necessary.		
Chrysanthemum	Leaf spot	Bordeaux II or ½ of 4	July 1	Two weeks later	Repeat if necessary.		
Cucumber	Anthracnose	Bordeaux I	When plants begin to vine	Two weeks later	Two weeks later	Two weeks later	Repeat as necessary.
	Downy mildew	Bordeaux I	July 25 to August 1	Eight to ten days later	Eight to nine days later	Eight days later	Repeat at weekly intervals.
	Spot of fruit	Bordeaux I	After first blossoms	Ten days later	Two weeks after second	Two weeks after third	Apply to fruit carefully.
Currant	Leaf spot	Bordeaux I	As leaves are unfolding	Two weeks later	Two weeks later	Two or three weeks later	Fourth necessitates washing fruit.
	Plant bug	Kerosene emulsion	May	Early June if necessary			
	San Jose scale	Whale oil soap solution	As with the apple	In spring as with apple			
	Worm	White hellebore	When worms first appear	In 3 or 4 days repeat	Repeat as second.		
Gooseberry	Leaf spot	Bordeaux I	As currants with leaf spot	As currants with leaf spot	As currants with leaf spot	As currants with leaf spot	This remedy is very successful
	Mildew	Bordeaux I or 5	Before leaves open I	After blossoming I	Potass. sulfid 2 weeks later		Bord. coats fruit if used for 3d.
	Worm	White hellebore	As on currants.				
Grape	Anthracnose	Bordeaux I	Just before buds open	Just before blossoming	Just after fruit has set	Ten days later, Bordeaux	Don't spray after fruit is half grown.
	Berry moth	Arsenites, with Bordaux I		After fruit has set	Ten to fourteen days later		Do not spray with arsenites after July 1st.
	Downy and powdery mildew	Bordeaux I	Just before blossoming	After fruit has set	Ten to fourteen days later		Covered by spraying for anthracnose or rot.
	Rot	Bordeaux I and II	Just before buds open Bord. I	Just before blossoming I	Just after fruit has set I	Ten days later, Bordeaux	Follow by two or three sprayings with am. cop. carb.
	Leaf hopper	Kerosene emulsion	Before young can fly				
Horse Chestnut	Leaf spot or blight	Bordeaux I	When leaves are half grown	Two weeks later	Two weeks after 2	Two to three weeks later.	
Muskmelon	Anthracnose	Bordeaux I and II	In seed bed or when plants begin to vine Bordeaux II	Two weeks later Bord. I	Two weeks later	Two weeks later	Rep'tas nec'y, use II very early
	Downy mildew	Bordeaux I	July 25 to August 1	Eight to ten days later	Eight to nine days later	Eight days later	Repeat same.
	Leaf blight	Bordeaux I	When plants begin to vine	Three weeks later	Three weeks after second	Two weeks after third.	
Oats	(See seed treatment.)						
Peach	Leaf curl	Bordeaux 1, 4 or 13 and II	In fall, or in March, Bordeaux I or 4	As buds are opening 1 or 4 Also 13	Just after calyx drops Bord. II	Not required, ditto 3, if others well done	Whale oil soap serves as second.
	Pustular spot	Bordeaux II	Just after calyx drops	Two weeks after first	Two weeks later		Cover fruit well.
	Rot	Bordeaux I and II	As buds are swelling I	Just after calyx drops, II	Three to four weeks later II	As fruit begins to color II	Every 7–10 days repeat. Destroy all mummies. 3 may be used 4th.
	Scab	Bordeaux I or 4 and II	As buds are swel. Bord. I or 4	Just after calyx drops Bord. II	Two weeks later Bord II	Two weeks later Bordeaux II.	
	Bud moth	Arsenites in Bordeaux I	With opening of buds				Use only half usual amount of poison.
	San Jose scale	Whale oil soap solution	As buds are opening in spring				Two lbs. soap to 1 gal. water. Use only in spring as buds are opening.
Pear Stocks	Leaf spot or blight	Bordeaux I	When leaves are half grown	Two weeks later	Two weeks later	Two weeks later	5 to 7 sprayings are needed.
Pear	Leaf blight	Bordeaux I and 3	When leaves are half grown	Two weeks later	Two weeks after second	Bord. may make russet fruit	Use 3 for 3d; not Bord. after 2d.
	Scab	Bordeaux I	Before blossoms open	After blossoms drop			Bordeaux after second may injure fruit.
	Bud moth	Arsenites in Bord. I	With opening of buds				
	Canker worm	Arsenites in Bord. I	As with the apple				
	Codlin moth	Arsenites in Bord. I	After blossoms fall	Seven to ten days later.			
	San Jose scale	Whale oil soap solution	As soon as leaves drop in fall	Just as fol. starts in spring			Two lbs. soap dissolved in 1 gallon water.
	Slug	Arsenites in Bord. I or dust with slaked lime	When slugs appear	Repeat if slugs remain.			
Pea	Mildew	Bordeaux I	When mildew appears	Two weeks later	Repeat if needed.		
Plum	Rot	Bordeaux I, also 3	As buds are swelling I	Just after calyx drops I	Three or four weeks later I	As fruit begins to col. use 3	Every 7–10 days repeat 4th; useless to spray for rot, unless mummies are destroyed.
	Shot-hole fungus	Bordeaux I	When leaves are half grown	Three weeks later	Three weeks later, if needed.		
	Curculio	Arsenites in Bord. I	With starting of buds	Just after calyx drops	Five days later		Jar and gather stung plums in addition.
	Aphis	Whale oil soap	On appearance of aphis				Use 1 lb. soap to 6 gals. water.
Potato	Early blight	Bordeaux I	When plants are 6 in. high	Two weeks later	Two weeks later	Two weeks later if needed	
	Late blight	Bordeaux I	As for early blight in all				
	Blister beetle	Whale oil soap	When beetles appear	Repeat if necessary.			
	Colorado beetle	Arsenites alone or in Bord. I	When beetles or young appear	As for first	As for first and second.		
	Flea beetle	Bordeaux I	When beetles appear	Repeat if necessary.			
Quince Stock	Leaf spot	Bordeaux I	When leaves are half grown	About two weeks later	Two weeks later	Two weeks later	Perhaps 5th spraying will be needed.
Quince	Leaf spot	Bordeaux I	As buds are swelling	When leaves are half grown	Two weeks later	Two weeks later	Second should come after blossoms drop.
	Fruit and leaf spot	Bordeaux I	Before blossoms open	After blossoms drop	Two weeks after second	Two weeks later.	
Raspberry and Blackberry	Anthracnose	Bordeaux I and II	Before leaves open use I	II on young canes 6 in. high	Repeat second one week later		Keep spray from leaves on bearing canes.
	Leaf spot	Bordeaux I	When leaves are half grown	Two weeks later	Two weeks later.		
	Saw fly	Pyrethrum or hellebore	As for currant worm	In 3 or 4 days repeat.			
Rose	Leaf spot	Bordeaux I or ½ of 4	With first apperance of fungus	Two to three weeks later	Repeat if necessary		Bordeaux shows on plant.
	Slug	Arsenites in Bordeaux II or hellebore	On apperance of slugs	Repeat if needed.			
Sugar Beet	Leaf spot	Bordeaux I	With first appearance of spots	Two to three weeks later	Two to three weeks later	Three weeks later if needed	
	Blister beetle.						
	Flea beetle	Bordeaux I	When beetles appear				Bordeaux I some danger.
Tomato	Anthracnose	Bordeaux I	Soon after fruit begins to set	Three weeks later	Three weeks later.		
	Leaf blight	Bordeaux I	Three weeks after transplanting	Three weeks after first	Three weeks later.	Three weeks later.	
Watermelon	Anthracnose	Bordeaux II	When plants begin to vine	Three weeks after first	Two weeks later	Three weeks later	
	Downy mildew	Bordeaux II	July 25 to August 1	Eight to ten days later	Eight to nine days later	As for cucumbers	Bordeaux I some danger.
	Leaf blight	Bordeaux II	As disease appears on muskmelon	Repeat as on muskmelons	As on muskmelons		