Spray Chemical Concentrations

recommendations for bulk, semiconcentrate, concentrate methods of spray application on deciduous fruit trees

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The application of spray chemicals to deciduous fruit orchards by the semiconcentrate and concentrate methods has resulted in a saving of about 70% in labor costs, and some 20% in materials.

To obtain these savings it is necessary to have equipment with adequate air volume and the proper type of liquid discharge to fit the trees to be sprayed. The wide variance in types of trees—varietal and growth variations—acreages and terrain in different orchards makes the use of various types of equipment necessary.

To obtain the savings of the semiconcentrate and concentrate spray methods it is also necessary to know the proper dosages. For many years the recommendations of spray chemical dosages in deciduous fruit orchards have been based on the use of the conventional type of equipment using water under high pressure as carrier of the chemical. These dosages have been expressed as the number of pounds of dry chemicals, or in pints, quarts, or gallons of liquid chemicals per 100 gallons of water. With the increasing use of air-carrier types of equipment much smaller volumes of spray liquid and variable concentrations of spray chemicals are applied. It becomes more practical to express the dosages not in terms of pounds or gallons per 100 gallons of water, but in amounts of chemicals and the gallonage of spray liquid to be applied per acre.

The variance in the number of gallons of spray liquid delivered per minute through the nozzles of the different types of air-carrier equipment now available makes it necessary to further classify the methods of application as bulk, semiconcentrate, and concentrate.

Bulk Application

In *bulk* applications trees are wetted to the point of excess runoff.

To insure thorough coverage this method takes a large volume of spray liquid—250 gallons per acre on the smaller trees, and over 2,700 gallons per acre on large trees.

Equipment used in bulk application include the conventional spray rig with manually operated spray guns, the stationary spray outfits, the mechanical booms, and the larger-sized air-carrier types of equipment which are capable of delivering 25 to 80 gallons of spray liquid per minute.

The concentration of the spray chemical used in the bulk method are the conventional standard dosages—1X. All other dosages are expressed as multiple of this standard dosage. If a spray concentration is said to be 4X, it means four times the standard dosage used in bulk applications.

Semiconcentrate

In *semiconcentrate* applications trees —twigs, fruit and foliage—are only wetted to the point of drip. There is practically no runoff.

This method requires approximately 1/5 to 4/5 the volume of spray as is applied by the bulk method.

In semiconcentrate applications, most air-carrier types of equipment can be used if they have adequate air volume and can deliver—through the spray nozzles—eight to 18 gallons of liquid per minute.

For a full peripheral—two-sided—discharge a volume of about 30,000 cubic feet of air per minute is apparently desirable in the average orchard. Even greater air volumes are necessary where the trees are large or where they have heavy foliage.

The concentration of the spray chemicals may vary from 1X to 4X. In an orchard with average-sized trees—15 gallons per tree by the bulk method—semiconcentrate applications may require at least 200 gallons per acre in the dormant period, and 350 gallons per acre when the trees are in foliage to give adequate coverage.

Concentrate Application

Concentrate applications are made with the least volume of spray liquid that will give uniform distribution and coverage of the trees. There is no drip or runoff.

The applied gallonage per acre may be 1/8 to 1/12 of the gallonage applied by the bulk method. The high concentration of the spray liquids may cause more spray injury unless the chemical is very evenly distributed. Air-carrier types of equipment delivering up to eight or 10 gallons of spray liquid per minute are employed.

The concentrations of the spray chemicals may range from 6X to 10X, and even higher with some materials. An applied gallonage of less than 80 to 100 gallons per acre on average-sized trees during the dormant period, and less than 120 gallons per acres when the trees are in foliage is not apt to give a uniform distribution and coverage.

Proper Dosages

In orchard applications with the semiconcentrate and concentrate methods one great difficulty is to find the basic principle of determining the proper gallonage to be applied with the different concentrations, and the correct amount of material to be used per acre. The reduction in applied gallonage is best obtained by a change in the nozzle disc openings, and *not* by increasing the speed of operation. In both semiconcentrate and concentrate methods of application to trees of the same size the same amount of material should be applied per acre. To obtain this it is necessary to vary the applied gallonage per acre for each concentration. Both the applied gallonage and the amount of material to be applied per acre varies with the size of the trees and with the planting.

Several factors must be considered in determining the applied gallonage per acre.

1. Season. Trees in the dormant stage have less surface area than trees in foliage, and require less gallonage.

2. Size of trees. Larger trees take more gallonage and are more difficult to cover thoroughly, especially in the tops.

3. Density of foliage. Trees with heavy foliage and many scaffold limbs are more difficult to wet.

4. Number of trees per acre. The greater number of trees per acre—having proportionately a larger surface area—require the greater volume of spray.

5. Rate of travel of the equipment. To insure adequate coverage the rate of travel must not be too great. With most equipment a travel rate of 0.8 mile per hour—70 feet per minute—to 1.5 miles per hour—132 feet per minute—is required to replace the air in the tree area by the air developed by the equipment.

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Gallonage and Amounts of Material per Acre to Be Applied by Bulk, Semiconcentrate, and Concentrate Methods of Application

Square[1] planting in feet	Bulk method		Semiconcentrate				Concentrate			Units[2] material per acre
	Gals. per tree	Gals. per acre	1X	2X	3X	4X	6X	8X	10X	
				Gallons per acre				Gallons per acre		
18 x 18 134 trees per acre	2	268	216	...	...	...	...	...	...	2
	5	670	536	268	201	...	...	...	...	5
	7	938	752	376	281	...	117	...	...	8
	9	1206	964	482	362	241	151	121	100	10
	10	1340	1088	544	402	272	168	134	112	11
	12	1608	1288	644	482	322	201	161	134	13
	15	2010	1608	804	603	402	251	201	168	16
	20	2680	2144	1072	804	536	335	268	223	22
20 x 20 109 trees per acre	2	218	...	...	...	...	...	...	...	2
	5	545	436	218	...	...	...	...	...	4
	7	763	612	306	229	...	...	...	...	6
	9	981	784	392	294	196	123	...	...	8
	10	1090	872	436	327	218	135	109	...	9
	12	1308	1048	524	392	261	164	131	109	11
	15	1635	1308	654	490	327	205	164	136	13
	20	2180	1744	872	654	436	273	218	182	18
	25	2725	2180	1090	817	545	341	272	227	22
22 x 22 90 trees per acre	2	180	...	...	...	...	...	...	...	2
	5	450	360	...	...	...	...	...	...	4
	7	630	504	252	...	...	...	...	...	5
	9	810	648	324	243	...	101	...	...	7
	10	900	720	360	270	...	113	...	...	7
	12	1080	864	432	324	216	135	108	...	9
	15	1350	1080	540	405	270	169	135	113	11
	20	1800	1440	720	540	360	225	180	150	15
	25	2250	1648	924	675	462	281	225	188	18
	30	2700	2160	1080	810	540	338	270	225	22
24 x 24 75 trees per acre	2	150	...	...	...	...	...	...	...	1
	5	375	300	...	...	...	...	...	...	3
	7	525	420	210	...	...	...	...	...	4
	9	675	540	270	203	...	...	...	...	5
	10	750	600	300	225	...	...	...	...	6
	12	900	720	360	270	...	113	...	...	7
	15	1125	900	450	338	225	141	113	...	9
	20	1500	1200	600	450	300	188	150	125	12
	25	1875	1500	750	563	375	234	188	156	15
	30	2250	1800	900	675	450	281	225	188	18
26 x 26 64 trees per acre	2	128	...	...	...	...	...	...	...	1
	5	320	256	...	...	...	...	...	...	3
	7	448	358	...	...	...	...	...	...	4
	9	576	460	230	...	...	...	...	...	5
	10	640	512	256	...	...	...	...	...	5
	12	768	616	308	230	...	...	...	...	6
	15	960	768	384	288	...	120	...	...	8
	20	1280	1024	512	384	256	160	128	107	10
	25	1600	1280	640	480	320	200	160	133	13
	30	1920	1536	768	576	384	240	192	160	15
28 x 28 55 trees per acre	2	110	...	...	...	...	...	...	...	1
	5	275	220	...	...	...	...	...	...	3
	7	385	308	...	...	...	...	...	...	4
	9	495	396	...	...	...	...	...	...	5
	10	550	440	220	...	...	...	...	...	5
	12	660	528	264	198	...	...	...	...	6
	15	825	660	330	248	...	103	...	...	8
	20	1100	880	440	330	220	138	110	...	9
	25	1375	1100	550	413	275	172	138	116	11
	30	1650	1320	660	495	330	206	165	138	13

[1] For hexagonal plantings increase the gallonage by 15%.

[2] A unit of material may be any single quantity such as one pound, one pint, one quart or one gallon. The units of material per acre as given in the tables express the quantities of material required per acre for the tree of a definite size for each gallonage as listed. If the standard or bulk dosage is more than one pound per hundred gallons—for example, four pounds per 100 gallons—the units of material per acre must be multiplied by the number of pounds, in this example, by four.

SPRAY

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6. Spray chemical. Fumigant types such as TEPP and parathion may require less gallonage per acre in aphid control. Oil emulsions and lime sulphur must be applied at lower concentrations and gallonage to avoid excess deposits.

7. Condition of bark at time of application. Dry bark absorbs more spray liquid and requires a higher gallonage.

8. Atmospheric conditions. Warm, dry air increases evaporation and requires larger gallonages to wet the trees adequately.

9. Amount of wind. An increased gallonage is generally required even if a light wind is blowing.

10. Insects to be controlled. Bark infestations of scale insects are more satisfactorily controlled by bulk sprays or increased applied gallonage.

In general, the applied gallonage per acre required for fruit trees with the semiconcentrate and concentrate methods of application may be expressed as the following fractions of what is required in the bulk application method:

	Concentration (in multiples of standard dosage 1X)	Gallonage required (in fractions of requirements by the bulk application method)
Semiconcentrate applications	1X	4/5
	2X	2/5
	3X	3/10
	4X	1/5
Concentrate applications	6X	1/8
	8X	1/10
	10X	1/12

The table on page 12 gives the gallonage and amount of material to be applied per acre with the various concentrations of spray chemicals, as used in bulk, semiconcentrate and concentrate methods of application.

The gallonage as applied by the bulk method—being most familiar to growers—is used as a base in determining the data.

The variance in planting and number of trees per acre is covered in column one.

The variance in tree size is indicated in column two by the number of applied gallons per tree in the bulk method.

The variance in concentration of the three methods is indicated in columns three to 10 by the multiples of 1X, the standard dosage.

The reduction in the amount of material applied per acre by the semiconcentrate and concentrate methods of application does not exceed 20% of that as applied by the bulk method.

The amounts of material applied by the semiconcentrate and concentrate methods of application are comparable or equal.

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TOMATO

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earworm, tomato pinworm, and the larvae of the potato tuber moth. In Central California it is seldom necessary to initiate control against these pests before early July. In the warmer portions of the San Joaquin Valley, it may be necessary to start treatments in May or June.

Sulfur is the principal material used to control the tomato mite, while DDD and DDT are the chief insecticides used against the several species of caterpillars. Sulfur for the control of the tomato mite can be used in combination with the insecticide selected for the control of caterpillars. In such cases the concentration of sulfur should not be less than 50% and—for the first application—best control of the mite will be insured if the sulfur content is 75%. In most cases, where it appears that there is poor control, it is because applications were made too late; poor coverage was obtained especially in the vicinity of aerial obstructions such as buildings, trees, or power lines; insufficient material; or faulty equipment. To the present time there has been no positive indications that a strain of mite resistant to sulfur is being selected from the population.

In general if the control of the mites has been satisfactory and no evidence of them can be found by the first part of September, sulfur can be omitted from later applications of insecticides intended for caterpillar control.

DDT is not nearly so effective as DDD for the control of the tomato hornworm, *Protoparce sexta*. Therefore, in the warmer interior valleys where this caterpillar is likely to be present in destructive numbers, DDD is the recommended insecticide for the first two applications. However, DDD is not effective against flea beetles. A switch to DDT for a final application is frequently desirable as flea beetles may appear in destructive numbers in tomato fields in late summer and early fall. By this time hornworms no longer present a problem, and the important caterpillars likely to be present include the corn earworm, beet armyworm, tomato pinworm and the potato tuber moth. Against these pests both DDT and DDD are highly effective.

For an effective control of the tomato mite and the several species of caterpillars, usually two to three applications of insecticides are necessary, applied at intervals of from four to six weeks. The concentration of DDD or DDT in the dust should be 5% and the dusts applied at the rate of from 30 to 35 pounds per acre per application. Best results are assured where the dusts are evenly and thoroughly applied. Where obstacles—such as trees, buildings, power lines, oil derricks—interfere with airplane applications, supplemental measures should be used to treat any areas missed, If this is not done, the harvested crop may contain annoying amounts of infested fruit, particularly in the late shipping crop from the southern San Joaquin Valley. Failure to obtain highly satisfactory control should not be blamed at present upon the insecticide but upon the application.

In recent years a leafminer occasionally has caused serious defoliation of tomato plants. At first, some of the newer insecticides—such as DDD and DDT—were held responsible for an increase in the population of the leafminer. After investigation it appears that serious infestations by the leafminer are more dependent upon natural surroundings and conditions than upon insecticides used.

The insecticides used in the tomato insect control program will not result in a residue problem if used as recommended and if the fruit is washed or wiped carefully before being marketed.

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SCALE

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after the application but such populations did not persist so long as in the previous two years.

Multiple applications of parathion in 1951 were no more serious in this respect than single treatments were in 1949 and 1950. One possible explanation is that the increased populations of this scale in 1948 and 1949 because of parathion treatments followed unusually cold winters which may have reduced the number of parasites to much lower levels than the milder winter in 1950–51.

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