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Control of CATTLE LICE



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Table 1. — Recommended Treatments for Chemical Control of Lice on Cattle^{1, 2}

Chemical	Percentage of chemical in applied mixture	Form of material	Amount of mixture ³ per animal	Method of application	Number of applications	Time or interval	Use		
							Beef animals	Milking dairy cows	Important limitations
Malathion ⁴	0.5 0.5	Wettable powder Emulsible concentrate	1 gal. 1 gal.	Spray Spray	One One	Oct.-Nov. Oct.-Nov.	Yes Yes	No No	Not on young calves
DDT ⁴	0.5 5.0	Wettable powder Dust	1-1½ gal. Visible coverage	Spray or wash Hand or power duster	Two Three	12-16 days 3 weeks	Yes Yes	No No	Not within 12 weeks of slaughter
Lindane ⁴	0.05 0.5	Wettable powder Dust	1 gal. Visible coverage	Spray Hand or power duster	Two Three	12-16 days 3 weeks	Yes Yes	No No	Not on young calves
Chlordane ⁴	0.25	Wettable powder	1 gal.	Spray or wash	Two	12-16 days	Yes	No	Not within 30 days of slaughter
Toxaphene ⁴	0.5	Wettable powder	1 gal.	Spray	Two	12-16 days	Yes	No	
Rotenone	0.05	Wettable powder	1 gal.	Spray or wash	Two	12-16 days	Yes	Yes	
	1.0	Dust	Visible coverage	Hand or power duster	Three	3 weeks	Yes	Yes	
Methoxychlor ⁴	0.5	Wettable powder	1 gal.	Spray or wash	Two	12-16 days	Yes	No	Not on sick animals
Co-Ral	0.25	Wettable powder	1 gal.	Spray	One	Oct.-Nov.	Yes	No	Not on young calves or on sick animals. Not within 7 days of slaughter or on dairy cows within 14 days of lactation
Ronnel ⁴	0.25 0.25	Wettable powder Emulsible concentrate	1 gal. 1 gal.	Spray Spray	One One	Oct.-Nov. Oct.-Nov.	Yes Yes	No No	Not on cattle within 60 days of slaughter, or on dry dairy animals within 21 days of lactation. Not on young calves
	—	Drench	5 gm./100 lb. body wt.	By mouth	Three	10 days	Yes	No	
Ruelene	0.5 8.0	Emulsible concentrate Emulsible concentrate	1 gal. 1 fluid oz./100 lb. body wt.	Spray Pour-on ⁵	One to three One	2-3 weeks —	Yes Yes	No No	Not on calves under 300 lb. or on dairy animals within 28 days of lactation. Not within 28 days of slaughter
Piperonyl butoxide + pyrethrins	1.0 pip. but. + 0.1 pyrethrin	Aerosol Emulsible concentrate	2-3 seconds 3 qt.	Pesticide bomb Spray	Several Two	Daily as needed 12-16 days	Not economical No	Yes Yes	Expensive for commercial use

¹CAUTION: See manufacturers' labels about restrictions on use.

²See "Method of Application" for formulations in back-rubber devices.

³For fall applications on mature animals with short hair. Increase the amount by 50 percent for winter applications when hair is thick and long.

⁴Effective up to a few weeks.

⁵Only when treatment is for cattle grubs — may not give winter protection from lice.

CONTROL OF CATTLE LICE

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Chemicals are not the perfect means of controlling lice and other pests of livestock. Do not assume that routine use of them will replace the need for good husbandry practices in maintaining the health of animals.

Animals vary in susceptibility to infestation. Nutrition and shelter, especially during cold weather, also affect an animal's natural resistance to the rapid development of parasites. First of all, keep animals in comfortable, sanitary quarters with adequate nourishment. Then use pesticides as recommended for the most satisfactory results.

Insecticides are toxic materials for emergency uses. Indiscriminate use or use in place of proper animal care is misuse.

GENERAL CAUTIONS: Follow closely all the cautions listed on the insecticide label, especially those on toxicity to livestock, harmful residues in animal products for human consumption, and hazards to the user in handling. The interval required between the last application and slaughter for some of the treatments varies with the material used, the number of applications, and the amount applied. Keep to the interval given to avoid residues that would render the meat unfit for sale. You may be held responsible for misuse of materials.

Handle all insecticides carefully and store them safely to avoid accidental poisoning of animals or humans.

Two species of sucking lice are common on cattle in Canada: the short-nosed cattle louse (cover illustration, top)¹ and the long-nosed cattle louse (cover illustration, bottom).² One species of biting louse (cover illustration, middle)³ is also common.

SYMPTOMS AND ECONOMIC IMPORTANCE

Lice are usually noticed first on weakened and unthrifty animals, especially those wintering outdoors. Some animals may be heavily infested

¹*Haematopinus eurysternus* (Nitz.).

²*Linognathus vituli* (L.).

³*Bovicola bovis* (L.).

whereas others in the same herd carry few or no lice. Therefore, to learn the full extent of an infestation it is necessary to examine most or all of the animals. This is particularly true in large range herds, since most lousy animals are irritable and wary and avoid handlers unless the whole herd is worked through a chute.

Very lousy cattle, especially white-faced ones, usually look greasy, dirty, and rough; they smear themselves with blood from scratches and open sores and from crushed, blood-engorged lice. When an animal has many lice for a long time without treatment, the whole body may become infested, and large patches of skin may become bare from rubbing.

Lousy cattle spend much time scratching and rubbing themselves instead of feeding. Louse-free cattle may gain from 1/2 to 2/3 pound a day more than heavily infested ones during the first two years of growth. Calves heavily infested with biting lice may not gain normally in unfavorable falls and winters. The poor appearance of cattle infested with any kind of lice may seriously reduce the market value of either commercial or purebred stock.

In older cattle, long-lasting heavy infestations cause low vitality. Sucking lice feed largely on red blood cells and can reduce their number to half of normal. Animals weakened by anemia in this way are unable to withstand severe conditions or unusual exercise and become easy victims of cold weather, severe conditions of transportation, and diseases that are resisted by healthy animals.

IDENTIFICATION AND LIFE HISTORIES

Sucking and biting lice differ in habits, and you need to know which kind your cattle have so that you may get the best results from control treatments.

Sucking lice may be distinguished from biting lice by their slate-blue color. They are usually found on mature stock; few nursing calves are susceptible. They usually have their heads partly buried in the skin, and often form dense colonies on small areas of the animal.

The adult female is about 1/8 inch long and the body is about as broad as long. The male is slightly smaller. The head is short in comparison with the body.

Sucking lice spend most, if not all, of their life cycle on cattle. Although they usually feed in one place on the animal, they sometimes crawl to other animals in the same pen or pasture as well as to stable litter, bedding, walls, and floors. The eggs, or nits, are cream-colored and are attached singly to hairs close to the skin. They usually hatch in 11 to 20 days, the average period being about 15 days. The newly hatched lice look much like the mature ones except that they are much smaller.

The *cattle biting louse* may be distinguished from a sucking louse by its conspicuously red head and light-cream or yellowish-white body. It is commonly found under flakes of scurf as well as on the surface of the skin, since it feeds on hair, loose scales, and other sloughed debris. Unlike the

sucking lice, it usually moves about on the animal as it feeds and causes considerably more irritation. It is also common on young as well as on mature cattle.

The adult female is about 1/16 inch long and has a broad, blunt head. Its small size makes it difficult to detect, but you can see it if you examine the coat of the animal closely. The life history of this louse is similar to that of the sucking lice except that it develops more rapidly.

Differences in size and shape of the two kinds of lice are shown in the cover illustrations.

DISTRIBUTION AND HABITS

Both biting and sucking lice may infest cattle in any of the stock-raising areas of Canada. The short-nosed sucking louse is usually the most abundant on both range and farm cattle in Western Canada, and the long-nosed sucking louse in Eastern Canada. Serious infestations of the short-nosed louse may occur in Eastern Canada on feeder cattle shipped from the west in the fall for finishing.

Lice usually become less abundant with the approach of warm, moist weather in spring. Natural shedding of hair at this time of year may contribute to this decrease. During the summer, lice become hard to find on grazing cattle; but from only a few survivors they may increase rapidly in the following fall and early winter. In large herds, especially on ranges, a few head usually have many more lice than the others and act as 'carriers.' Unlike most cattle, these have

noticeably large numbers of lice throughout the summer, even when they shed their hair.

During the winter, sucking lice may form colonies on parts of the animal where they cannot be dislodged by licking, or by rubbing against walls, fences, trees, or other objects. On lousy animals, dense colonies are usually found on the crest; in the folds on the sides of the neck; on the brisket and inner surfaces of the legs; around the ears, scrotum, udder, and hindmost part of the animal; at the bases of the horns; and on the tail and tailhead. If neglected, they may even surround the eyes and nose. In rapid inspection of large numbers of range animals passing through a chute, a few partings of the hair on the dewlap and in the folds of skin on the side of the neck below the ear usually expose sucking lice even if the animal has few.

Sucking lice move little while developing under favorable conditions. But they crawl about on the hair and skin before attaching for feeding and after completing their growth. They may then move from animal to animal by contact or by crawling across walls and bedding.

Since biting lice move over the hair and skin while feeding, they are generally found on larger areas of the animal than are sucking lice. On heavily infested animals they congregate around the base of the tail, on the shoulders and neck, and occasionally on various parts of the body. They may live a week or more off the host as compared with two to three days at most for sucking lice. Therefore,

biting lice are more likely to spread within a herd than are sucking lice. Lice that hatch from eggs sloughed off on shed hair usually do not live more than three days without a host.

METHODS OF CONTROL

Keep animals in a favorable environment with adequate nourishment. Inadequate diets and exposure to severe weather and hardship in winter create the conditions for heavy infestations of lice. Good management is as important as treatment with chemicals in preventing infestations.

Because chemicals vary in effectiveness according to husbandry practices, certain chemical treatments may be more successful in some regions than in others. Therefore, plan chemical treatments carefully to fit your particular type of feeding operations and marketing practices.

Helpful Husbandry Practices

The following practices ensure adequate protection of animals:

1. Keep pens, stalls, feedlots and barnyards clean and dry. Comfortable, thrifty animals help to keep themselves louse-free by grooming if they are properly housed.

2. Before bringing in louse-free animals, see that their new quarters are free of lice. If the quarters have been occupied by lousy cattle in the last three days, clean and then spray or wash them with a suitable insecticide. Use an economical residual insecticide (4, Table 1) at the same concentration recommended for use on

cattle. Spray the walls and floor with enough material to wet all surfaces, or scrub them with a stable broom dipped in the insecticide. Do not spray bedding.

3. *In the fall*, inspect cattle before putting them in feedlots or barns or when moving them to winter feeding areas. Spray all cattle with an insecticide, preferably one that is effective with one application.

If careful inspection is impractical, as in some special ranching operations, spray all the winter stock when sorting animals for sale. In Western Canada, as a general rule complete this treatment between September 15 and October 31 for best results. Fall treatments in southern Alberta may be delayed until November if the weather is favorable; but the later treatments have less preventive value against winter infestations in other parts of the prairies.

In cold seasons, long, thick hair keeps the insecticide from reaching the skin unless increased care and labor and high-pressure equipment are used. High-pressure sprays are best applied during warm weather. Then treated animals have time to dry before exposure to chilling night temperatures, which may induce or aggravate respiratory infections.

If preventive fall applications are thorough and well timed, they are equally effective on range, feedlot, and barn cattle.

In spraying, wet the animals to the skin and cover all parts. Pay special attention to the underline and protected parts such as the escutcheon

and brisket, where lice (especially sucking ones) usually congregate. One or two colonies of sucking lice missed on an animal may be enough to reinfest it quickly after the spray has lost its effect.

You may prefer to use the less expensive insecticides for economy if labor and convenience in handling animals are not the more important factors in cost of production, i.e., for sheltered animals on small farms. DDT, lindane, chlordane, and toxaphene are low-cost materials but must be applied at least twice in the fall to ensure lasting protection through the winter. Make the second application of these materials 12 to 16 days after the first, to kill lice that hatch in the interval.

For most commercial operations, especially on ranches in southern Alberta and British Columbia, it is economical to use an organophosphate insecticide in a single application. Malathion, Co-Ral, ronnel, or Ruelene is satisfactory. Lower labor costs and lower losses in weight because of handling compensate for the higher costs of materials. Further, when an organophosphate is applied in late fall no follow-up treatment is needed in cold weather.

4. *In the spring*, inspect animals before letting them out to pasture, especially on the range. Otherwise, highly susceptible cows with calves may become severely infested by late summer. These animals may act as 'carriers' and reinfest the herd in the fall when normal animals are more easily infested. Shedding of hair in

early spring may help to reduce numbers of lice on moderately infested animals. If infestations are still noticeable in late spring, consider these animals as 'carriers' since they do not normally rid themselves of lice during the summer months. Treat these animals with one of the organophosphate insecticides, and see that the treatment has been satisfactory before putting them out to pasture with other animals.

Since it is difficult to control lice satisfactorily on 'carrier' animals, it is sound practice to cull habitually lousy ones, especially from breeding stock, and market them at the earliest opportunity.

Spring treatment is most beneficial on infested cows mothering calves. Severe infestations usually cause anemia. Anemic cows are poor milk producers and their suckling calves fail to reach the desired weight at weaning time in the fall.

5. *In winter*, cattle require special attention if they become lousy during cold weather. Limit treatment to hand washing or scrubbing with a suitable insecticide (Table 1) in sheltered quarters, or to dusting with an insecticide powder if shelter is not available. During mild weather in winter, use a high-pressure spray outdoors for large groups if they have time to dry before they are exposed to a freezing temperature or cold winds; in southern Alberta, for example, chinook weather may be used to advantage. If you separate heavily infested animals from the herd during

and shortly after treatment, fewer lice will spread to untreated animals.

Uses of Insecticides

Effective insecticides, rates of application, and uses are listed in Table 1 (inside front cover). The recommendations are only for use against cattle lice.

Table 2 (inside back cover) gives the amounts of insecticide to add to 100 imperial gallons of water to have spray mixtures of the exact strengths desired; the amounts of powdered materials are given on the basis of weight and those of emulsible concentrates on the basis of liquid volume. This table may be used also, with Table 1, to estimate the amount of concentrate needed for a given number of animals.

Mix materials exactly at the concentrations recommended. The dosages are given for best results. Increasing the dose does not kill more lice. It may cause pronounced ill effects on the animal, and may make the meat unfit for sale because of illegal residues.

Most insecticides deteriorate in prolonged storage. If stored from season to season, especially in opened packages, they may not give satisfactory control.

CAUTIONS: Note the following cautions as well as those on page 3.

Do not use wettable powders as dusts on animals. The animal may absorb an overdose of toxic materials through the skin if soaked by rain after treatment. Be safe by using only

materials that are labeled for use on animals as dusts.

Do not mix different materials even though they may be recommended for use separately on animals. In special cases a combination of chemicals is more effective against a pest, i.e., the common treatment for lice and ticks (See "Multipurpose Treatments," p. 11). Other insecticides may interact in the animal and be much more potent than either alone. Therefore, do not mix materials unless the label states that the two formulations are compatible for use on livestock. For the same reason, do not treat animals for lice with an insecticide if they have been treated recently with another. Either use a material that is effective against both pests or allow an interval of two to three weeks between applications.

Especially if you handle insecticides often, *take care not to get any on your skin or to inhale the vapor.* If you handle different insecticides, they may interact in your body and be much more toxic than any of them alone. The toxic effects persist in man for long periods. Use waterproof clothing and respirators with adequate filters. Always remove your clothing and launder it before wearing if it is contaminated with an insecticide. If you wash animals by hand, wear clean rubber gloves, preferably unlined ones, and a rubber apron.

Sprays.—Plan louse-control operations in advance and *do not spray in cold weather unless you can protect the animals until they are dry.*

For effective, economical, time-saving treatments, use any type of

pump that can deliver 6 gallons a minute at a nozzle pressure of 400 pounds per square inch. With such a pump you can readily handle large groups of cattle. Weed sprayers and some general-purpose sprayers that cannot deliver pressures above 200 p.s.i. may not wet the animal right to the skin.

The amount of spray required for adequate wetting varies widely, depending on weather, season, and condition of the hair. Two gallons per head is enough to wet the largest and most heavily coated animal in winter. One gallon is enough for full-grown animals in early-fall applications on short-haired animals. Late-fall and winter applications on thick-coated animals require an average of 1½ gallons.

Economy in the use of spray materials depends largely on the ability of the spray operator and on the facilities for holding cattle. Cattle cannot be sprayed thoroughly for lice in some chutes. A small pen that holds three to six animals and leaves enough space for the operator to handle a spray gun and reach all parts of the animals is best for range stock and large herds.

The fall application for preventing winter infestations is effective only if all, or most, of the underline, escutcheon, and brisket of the animal is wet as well as the back and sides. The lower parts mentioned are the centers of the initial build-up and spread of lice. Therefore some confining devices such as squeezes and chutes are not suitable for thorough single-application operations. Tether

barn animals by the head to a fence or a wall, leaving enough space to move them with the force of the spray and thoroughly wet all parts of their bodies.

A 4- or 4½-foot spray gun is a handy size for treating animals in pens. If the gun has a shut-off and an adjustable-angle nozzle controlled at or near the hand grip, it is more readily handled and wastes little insecticide. Disk sizes should not exceed No. 4 (4/64 inch) for most sprays recommended. No. 3 (3/64 inch) disks are best for emulsible materials in cone-pattern sprays. Disks should be replaced regularly, especially when wettable powders are used in high-pressure sprayers. Worn or large disks waste spray materials, especially in treating large herds. Nozzles of any design, including those with a fan spray, are satisfactory if they allow rapid and thorough wetting of the animals to the skin.

Aerosol bombs.—Synergized pyrethrin mists, available in aerosol bombs, are useful in treating a few lousy milking cows. They are effective only when used inside a stable or a closed barn and when the lice are hit with the mist.

Hold the bomb within a few inches of the animal and cover infested areas by ruffling the hair and directing the mist into it. Careful application indoors reduces the number of lice in winter, but the bombs are not economical for large numbers of animals or for fall applications to prevent infestations.

An alternative for a few lousy milking cows is to apply a pyrethrin emulsible concentrate mixed with water. The mixture may be prepared easily in small amounts and applied with a hand sprayer.

Washes.—Washes are economical occasionally for a few lousy animals but are expensive in time and labor for large herds. Power spray equipment is more economical in large livestock operations.

However, washes prepared from emulsible concentrates or wettable powders are more easily applied than dusts when the coat is thick and shaggy. If thoroughly applied, washes can be the most effective treatment.

In winter, treat the animals in a warm place. Be sure to scrub them enough with a stiff-bristled brush to wet the skin. Give special attention to areas along the escutcheon and underline, between the legs, and on the brisket and neck although these are hardest to reach.

Dusts.—Dusting is less effective than other methods of application but the materials cost less. When lice are a perennial problem in a herd, use dusts only for emergency treatment in severe winter weather.

DDT, lindane, chlordane, rotenone, and most other dusts are ineffective, especially against sucking lice, unless they are rubbed or brushed through the hair to reach the skin. As with other external applications, the areas along the underline where lice congregate must be treated to achieve satisfactory control. A hand brush with long, thick, flexible bristles is

useful in tapping or brushing the dust through the hair, especially on parts of the animal with dense colonies of lice.

Applying dust only to the back is ineffective because few, if any, lice are found near the back line. For this reason, dusting by hand may not give protection throughout the winter even when done often. Power dusting equipment gives more thorough application and better results, but it is practical only in large ranching and feedlot operations.

If lice are still numerous after three applications of dust, treat the animals thoroughly with a wash in a warm shelter.

Internal treatment.—When one or a few very lousy animals need prompt treatment to prevent serious debility during severe winter weather, give them a systemic insecticide by mouth. Boluses, or pills, are no longer on the market but can be prepared by veterinarians. They eliminate the expense and inconvenience of preparing heavy equipment and spray materials for treating a few animals. Or a systemic insecticide may be prepared as a suspension in water and given as a drench (Table 1) from a narrow-necked bottle.

Dips and spray-dips.—For single fall applications some insecticides may be used to treat cattle in dipping vats, or with spray-dip machines if this equipment is available. These methods entail more hardship and rough handling for animals than others. The losses in weight from rough hand-

ling and physical injury may offset the gains obtained by controlling the lice. Use only insecticides specifically labeled for dipping vats and spray dips.

Back rubbers.—Back rubbers impregnated with insecticides vary greatly in effectiveness depending on design, weather, and especially animals' acceptance of the equipment as a scratching device. Since there is no control of the dosage on individual animals, some devices may be unsatisfactory in ridding herds of lice and preventing reinfestation. Some animals may not use the device, especially when other scratching surfaces such as fences, trees, and shelters are available. Even the animals that use them may continue to carry lice on the inaccessible underparts of the body. Back rubbers are useful in preventing heavy infestations in large feedlot operations if animals are trained to use them.

Use a formulation labeled for use on back rubbers such as 25 percent emulsible ronnel at 1 gallon in 21 gallons of diesel or No. 2 fuel oil, or 5 percent emulsible toxaphene in diesel or No. 2 fuel oil, or 2 percent emulsible malathion in highly refined mineral oil (5 ounces of 50 percent malathion in 1 gallon of oil).

Do not mix the insecticide with used motor oil. Do not use emulsions of insecticides for back-rubber mixes unless the label states that the formulation is suitable for back-rubber application.

MULTIPURPOSE TREATMENTS

When cattle have other external parasites as well as lice, a single treatment may often be used against both pests. The following treatments are recommended when lice are found with the pests indicated.

Winter Tick

Especially in the Alberta foothills, herds are occasionally infested with the winter tick⁴ and it may be desirable to treat cattle for this pest when making applications against lice in midwinter. For this purpose use lindane or toxaphene (Table 1). Cattle in areas heavily infested by the tick may be better protected with a combination of 0.5 percent toxaphene and 0.025 percent lindane. This treatment is applied as a spray or wash only during mild weather, or on animals that are sheltered until dry. Use 0.5 percent lindane dust on animals outdoors if the weather is severe.

Cattle Grubs

If cattle become very lousy in March or April, both lice and cattle grubs⁵ may be controlled with a rotenone spray or wash. Treatments for grubs with Co-Ral, ronnel, and Ruelene (Table 1) in the fall generally also prevent lice from becoming serious later in the winter.

⁴*Dermacentor albipictus* (Pack.).

⁵*Hypoderma lineatum* (de Vill.) and *H. bovis* (L.).

Mange

Lice (especially biting forms) may infest animals that have mange. Use lindane for control of both the mange mite and the lice when the two occur together in a herd. Some animals may continue to scratch and show discomfort after treatment for lice and the treatment is often assumed to be ineffective. Examine these animals carefully. If you find no lice the irritation may be due to mange mites, which can only be detected by examination of skin scrapings. Certain mange diseases are notifiable to authorities for the health of animals.

RESISTANCE OF LICE TO INSECTICIDES

Occasionally lice on some groups of cattle become resistant to certain insecticides. This may happen when dusts are used often year after year. If you use dust every winter, you may find that DDT and perhaps lindane are unsatisfactory. When this happens, use chlordane or malathion spray as soon as the weather permits. If you

use an effective spray in the fall, you are less likely to have this problem. Also, avoid using DDT on animals that persistently carry many lice. It is good practice not to use the same insecticide for several years in succession if effective substitutes are available. Check the adequacy of method and equipment before attributing poor results to the insecticide, for failure is often traceable to faulty application.

INQUIRIES

For more information, consult your local agricultural representative. If extension services are not available, write to the Scientific Information Section, Canada Department of Agriculture, Central Experimental Farm, Ottawa.

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Some brand names are used in this publication because the chemical names are difficult for general use and there are no official common names for the active ingredients.

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Table 2.—Amounts of Insecticides Needed to Prepare Various Spray Mixtures from Concentrated Materials^{1,2}

WETTABLE POWDERS

A	Percentage of active ingredient needed in spray or wash	B									
		Pounds of wettable powder to add to 100 gal. of water if percentage of active ingredient in package is									
		5%	6%	10%	12%	20%	25%	40%	50%	75%	
	0.05	10.0	8.3	5.0	4.2	2.5	2.0	1.25	1.0	0.66	
	0.1	20.0	16.6	10.0	8.3	5.0	4.0	2.5	2.0	1.32	
	0.25	50.0	41.5	25.0	20.8	12.5	10.0	6.25	5.0	3.3	
	0.5	100.0	83.0	50.0	41.6	25.0	20.0	12.5	10.0	6.6	
	0.75	150.0	124.0	75.0	62.4	37.5	30.0	18.75	15.0	9.9	

EMULSIBLE CONCENTRATES

A	Percentage of active ingredient needed in spray or wash	B								
		Amount of liquid concentrate to add to 100 gal. of water if percentage of active ingredient in the container is								
		18%	20%	25%	40%	50%	60%	75%	80%	90%
	0.05	1.1 qt.	1 qt.	1.6 pt.	1 pt.	16 oz.	13.3 oz.	10.7 oz.	10 oz.	8.9 oz.
	0.1	2.2 qt.	2 qt.	3.2 pt.	1 qt.	32 oz.	26.7 oz.	21.3 oz.	1 pt.	17.8 oz.
	0.25	5.5 qt.	5 qt.	1 gal.	5 pt.	2 qt.	3.3 pt.	2.7 pt.	2.5 pt.	2.2 pt.
	0.5	11 qt.	10 qt.	2 gal.	10 pt.	1 gal.	6.6 pt.	5.4 pt.	5 pt.	4.4 pt.
	0.75	16.5 qt.	15 qt.	3 gal.	15 pt.	1.5 gal.	10 pt.	1 gal.	7.5 pt.	6.6 pt.

¹Imperial measure. Spray tanks manufactured under U.S. patents usually hold 80 imperial gallons (100 U.S. gal.).

²To calculate the amount of concentrate (Column B) needed to make 100 gallons of mixture at a required concentration (Column A):—

For powders: Multiply the percentage of active ingredient required in the mixture (A) by 1000 and divide by the percentage of active ingredient listed on the package.

For liquids: Multiply the percentage of active ingredient required in the mixture (A) by 100 and divide by the percentage of active ingredient listed on the container.

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