Chapter 2

HANDCREW APPLICATION METHODS FOR WOODY PLANT CONTROL

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Handcrew applications are herbicide treatments that can be applied by an individual or a work crew using backpack sprayers, spotguns, and injectors. Hand crew methods are mainly aimed at individually treating woody stems. Application is on a stem by stem basis.

An applicator must be consistent to be effective, and a commercial applicator must be fast to be profitable. Consistency means mixing the correct herbicide accurately over and over. It means using well-maintained backpack sprayers, injectors, or spotguns with a steady effort. To be fast, applicators must be trained to move easily and rapidly through the woods, from stem to stem, while always planning routes around and through the vegetation. New applicators will need experience and training to be both consistent and fast, while being safe. Crews of individuals will have to learn to work as a team.

By treating individual stems, a knowledgeable applicator can slightly change the rate when necessary. Difficult-to-control species can receive a higher dose of directed spray or more injection cuts. Desirable plants and crop trees can be missed altogether. Someday, crews may even be able to go through mixed hardwoods stands or pine-hardwood stands and eliminate the undesirable or nonmerchantable stems without a forester having to premark the trees. This will all take training and experience.

The treatments presented in this chapter are 1)directed foliar sprays, 2)streamline basal sprays, 3)soil spots, 4)tree injection, and 5)stump sprays. Hand application of pelleted and granular herbicides by handcrews is explained in chapter 5.

All sizes of hardwoods and shrubs can be controlled by using the right treatment, combined with the proper herbicide, applied at the correct time. Here are the sizes of woody plants that can be treated most effectively by handcrew methods:

Method	Effective size of Target Stems
directed foliar sprays	up to 6 ft tall
streamline basal sprays	up to 2 inches d.b.h.
soil spots by grid	up to 10 inches d.b.h.
basal soil spots	all sizes
injection	all sizes greater than 1 inch d.b.h.
stump sprays	all sizes

The selection of the best herbicides and timing are presented in the following sections.

DIRECTED FOLIAR SPRAYS

Directed foliar sprays are best used to release first- and second-year-old conifer stands when hardwood competition is less than 6 ft tall. Caution must be taken to direct the spray away from pine foliage and growing tips. The benefits from release can be taken away by too much pine damage from herbicides misapplied to needles and shoots.

Equipment

Directed foliar sprays are usually applied with a backpack sprayer and a spray wand equipped with a full cone, flat fan, or adjustable cone spray tip. The selection of a spray tip depends on the applicator's preference. Most commercial applications are made with Spraying System's disc core hollow cone tip, orifice disc D4 and core 46. A suitable flat fan tip is a 6503 (65° and 0.3 gpm). With these tips, spraying pressures of 20 to 30 psi permit good productivity with few fine droplets that may drift onto the pines.

For treating brush that is about 6 ft tall, a PVC wand extension of about 18 to 24 inches can be helpful. A handgun equipped with a 2503 tip can also be used to apply directed sprays.

Herbicides and Mixing

Current recommended rates and application periods of the labeled herbicides are:

<u>Herbicide</u>	Percent mixture in water	Application period
Accord	1 to 2	April to October
Arsenal AC	1/2	June to October
Garlon 3A	2 to 5	April to October
Garlon 4	1 ½ to 4	April to October
glyphosate	1 to 2	April to October

Accurate and through mixing is needed to assure consistent control. A wetting agent or penetrant can be added to the mixture to increase control of all herbicides, but is a label requirement for Arsenal. Also, a drift control additive can reduce drift that damages pines when applying during windy conditions. Adding of water soluble dyes can assist in training new applicators and for guiding applicators, but are messy to use.

Application Method

To apply, direct the spray on to the target foliage, being sure to cover the growing tips, but kept it off conifer terminal shoots and needles. Do NOT directly spray conifer it may kill or injure them. Accord CR, glyphosate, and Garlon 3A are particularly damaging to pines; Arsenal is the safest. Accord CR, Roundup, and Garlon 3A can be useful for pre-commercial pine thinning.

Species Susceptibility

Arsenal provides the most broad-spectrum control and requires that the foliage only be covered with the spray. For the other herbicides, the lower percentage mixtures (1 to 2 percent) require heavy foliage wetting and most of the foliage must be covered. The higher percentage mixtures (3 to 4 percent) require less wetting and coverage. For instance, when using lower percentage herbicide mixture, spray at least 80 percent of the foliage nearly to the point of leaf runoff. The higher percentage mixtures need only about two to three drops per leaf on about 70 percent of the foliage. The growing tips should always be sprayed.

STREAMLINE BASAL SPRAYS

Streamline basal treatments can control many hardwoods and woody plants up to 2 inches d.b.h.. Trees up to 6 inches in diameter of susceptible species have been controlled with this treatment. Handcrews are most effective when treating very young

plantations, with diameters less than 1 inch at groundline. The treatment of small hardwoods buys the most control.

Treatment of just the hardwoods around individual pines, such as within 3 ft, is being used to release pines at lower costs. At \$14/gal for the Garlon 4 mixture, herbicides costs become excessive when applying 2 to 3 gal/acre. Use rates, for treating all stems, range from ½ gal of mix for treating 1-year-old plantations with about 2,000 hardwood rootstocks per acre up to 8 gal for treating around 4-yr-old pines with 7,000 hardwood rootstocks per acre.

Streamline basal sprays can also be used for treating undesirable stems in pinehardwood and all-age stands. Small diameter hardwoods and pines can be selectively removed to promote crop pines and quality hardwoods. For hardwood management, natural and planted seedlings can be released at relatively low costs using low-volume basal treatments combined with injection treatments.

To apply this treatment, a certain amount of skill is required to hit small stems with the narrow herbicide stream. This is where past handgun skills can be used. After some practice and on-the-job training, most people are capable of applying this treatment. To be competitive in pricing, contracting handcrews must learn many tricks to assure accurate treatment and rapid movement through thick plantations.

Equipment

A backpack sprayer is used with a Model 30 Gunjet and a straight stream 0001 spray tip. This is one of the smallest straight stream tips and permits good control of herbicide usage to minimize herbicide costs. More experienced applicators may use the 0002 tip which gives twice as much output. A narrow-angled tip, such as the 1501 (15° and 0.1 gpm), also can be used.

A pressure regulator is needed to control herbicide usage. Pressure should be maintained between 20 to 30 psi. At these pressures, an effective reach of 9 ft is possible and bark splash is minimized. A 20 psi regulator is available that can be attached to the Gunjet and some backpack sprayers can be set for 30 psi. Sprayers with diaphragm pumps will maintain about 30 psi with slow, steady pumping.

The hose on many back pack sprayers may need to be lengthened so that the aim and reach of the applicator is not restricted when using the Gunjet.

Herbicide and Mixing

The most common streamline mixture is 20 percent Garlon 4, 10 percent Cide-Kick or Cide-Kick II, and 70 percent diesel fuel. For an approximate 20 percent Garlon 4 mixture:

1-gallon mixture

Add 26 oz or 1-1/2 pints of Garlon 4 Add 13 oz or ³/₄ pint of Cide-Kick Then fill the container to the 1-gal mark with diesel.

3-gallon mixture

Add 77 oz or 4-3/4 pints of Garlon 4 Add 38 oz or 2-1/2 pints of Cide-Kick Then fill to the 3-gal mark with vegetable oil.

4-gallon mixture

Add 102 oz or 6-1/2 pints of Garlon 4 Add 51 oz or 3 pints of Cide-Kick Then fill to the 4-gal mark the vegetable oil.

This mixture is reddish-brown and clear when made correctly. A white liquid or jell will form if even a small amount of water is present. No amount of water should be in the sprayer or mixing container. Make sure that all water has been drained from the sprayer, the pump has been pumped dry, and the sprayer has been rinsed and pumped with diesel before filling with the mixture. The pump on most backpacks sprayers can hold about 1-1/2 pints of water, which must be pumped out before using the streamline mixture. If the white gel forms, it will take a good effort and much time to clean it out.

Application Method

Apply the stream of spray as a 2- to 3-inch-wide band to one side of stems less than 2 inches in basal diameter. Direct the spray stream at a point about 6 to 24 inches from the ground, to smooth juvenile bark. Stems that are beyond the juvenile stage, thick barked, or near 3 inches in diameter require treatment on both sides, unless they are susceptible species. Because the Garlon 4 mixture is wasted on the ground, single stems should be him directly. A slight waving motion of the hand can help in hitting single stems. For multiple-stem clumps, the stream can be waved back and forth across all stems. Back-and forth bands can also be sprayed on larger stems. An hour or more after application, the wet-treated area should spread 6 to 10 inches down and around, encircling the stems.

Commercial applicators must move quickly and effectively to make this treatment economical. As the applicator moves forward, the 9-ft reach of the spray stream should be used for treating both sides and in front. One or two pine rows can be handled effectively with one pass.

An oil soluble dye can be added to the mixture to aid in application and application inspections. Bas-Oil Red by Becker-Underwood, Ames, Iowa, is a useable dye at an acceptable price. Unfortunately, the dye is only visible about 1 or 2 days.

Timing

Applications are usually made during the latter part of the winter and early spring when leaves do not hinder spraying the stem. The best timing of application in the mid-South appears to be February to March. Early dormant season treatments in November and December are not recommended for the mid-South, but have been effective in Tennessee. Do not treat in April. Growing season applications appear effective, if the stem is not hidden by leaves. During the growing season, some stems may need to be treated higher than 24 inches, because of opening in the foliage at these heights. Applications should be avoided in young pine plantations on hot days, because Garlon 4 can volatilize and injure pines.

Species Susceptibiltiy

Hardwoods and shrubs have been tested using Garlon 4 at the 20 percent mixture, with a 0002 tip sprayed on two sides that were 90 degrees apart. Applications were made in February. Most stems killed were less than 2 inches d.b.h., unless specified. The findings after 2 years were:

Susceptible Species (80 percent of greater root stock control)

Water oak	Winged sumac
Black locust	Hornbeam (Carpinus)
Waxmyrtle	Mountain laurel
Boxelder	Mountain ivy
Huckleberry	Low gallberry

Almost-susceptible Species (70 to 80 percent rootstock control)

Southern red oak	American beech (up to 6 inches)				
Post oak	Yaupon				
Marginally-susceptible Species (40 to 70 percent control)					
Sweetgum	Blackgum				
Red maple	Dogwood				
Pignut hickory	Hophornbeam				

Black cherry

Tolerant Species (40 percent or less control)

Yellow-poplar

Sweetbay

Sourwood

Titi

Control can be increased by applying a higher concentration or more herbicide to marginally susceptible species, or by treating these and tolerant specie when they are very small (less than $\frac{1}{2}$ inch basal diameter).

SOIL SPOT APPLICATIONS

Soil spot of Velpar L herbicide are applied in grid patterns or around target stems for site preparation, preharvest hardwood control, and pine release treatments. The labeled crop pines for release are loblolly, slash, shortleaf, and longleaf. Release treatments should only be applied to new plantations and 3 year old or older plantations. Severe damage can occur to seedlings that are 2 and 3 years old where root growth is extensive but hardiness is lacking.

In this method, prescribed amounts of Velpar L, specified in milliliters (ml), are applied to the soil surface at specified spacings. Thus the effectiveness of the treatment depends on the applicator being accurate and consistent in both amount and spacing. Eye protection and rubber gloves should always be worn when mixing, calibrating, or applying Velpar L.

The rate for soil spot applications is made on the basis of whether it is a site preparation or release treatment, the soil texture, and the susceptibility of species to be controlled. Because of pine damage, less herbicide is used for release treatments. Less herbicide is used on sand soils and more on clay soils. Higher rates are required to suppress difficult-to-control hardwood species such as hickory, dogwood, maple, blackgum, sassafras, and sourwood. Velpar L provides little control of yellow-poplar, ash, mountain laurel, persimmon, huckleberry, boxelder, and large cull pines. Seedling pines can be severely damaged or killed, especially when spots are placed too near.

When applying release treatments, soil spots are NOT to be placed within 36 inches of pines. This requires constant attention during application because pine damage and kill can be a problem with this method. On the plus side, pine growth apparently can be stimulated with soil spot applications of Velpar L.

Equipment

Soil spots are applied by using a spotgun or a Gunjet equipped with a straight stream spray tip. The spotgun delivers a set amount while the Gunjet requires training of

the applicator to judge the amount applied. Both can be connected to a backpack sprayer to carry the herbicide or the spotgun can be connected to a backpack or side-pack container. A spotgun consists of an adjustable graduated cylinder or syringe which is operated by squeezing the handle. A forceful squeeze is used to project spots up to 15 ft. A Gunjet uses the pressure of the backpack sprayer to project spots to over 20 ft, and thus requires less exertion. Spots are more defined with the Gunjet than the spotgun. The Model 30 Gunjet should have Viton seals when applying Velpar L.

Spotguns are available in three models; one metal and two plastic models. The more durable metal spotgun is for long-term use, while the plastic guns last for one area or one season. One of the plastic guns is available through DuPont and is called a "disposable" spotgun. A Velpar resistant cylinder can be purchased for the metal spotgun (which unfortunately is not clear) because Velpar will eventually warp the clear plastic graduated cylinders that come with all three models. Daily maintenance will extend the use of the clear cylinders.

Calibration of spotgun. Spotguns are exact delivery devices and thus either water or Velpar L can be used for calibration. One pull of the handle will deliver the same amount of water or Velpar. By turning the adjustment screw, set the piston of the syringe on the prescribed delivery amount, for example 2 ml. These graduations are not exact and must be checked. To do this, squeeze the handle 10 times and collect the solution in a container without splashing. Measure the amount using a cup or cylinder graduated in milliliters. For a 2-ml setting, it should deliver 20 ml. If the cup contains more or less, adjust accordingly and repeat the procedure until the exact calibration is achieved. If the desired amount is 3 ml, the cup should read 30 ml for each 10 pulls of the handle. Any small error becomes large when thousands of spots are applied per acre and can result in wasted herbicide and poor control or pine damage. Calibration should be checked at least once or twice a day.

Maintenance of spotgun. Velpar will deteriorate rubber seals and gum the oneway valve in the spotgun. Daily maintenance is required to keep a spotgun functioning. Wash the outside and squeeze soapy water through the gun. Rinse with clear water, dry, and lubricate with vegetable cooking oil.

Gunjet for soil spot application. With practice, an applicator can use a Gunjet equipped with a straight tip to apply 1- to 3-ml spots. The volume is determined by how long the handle is held in the pulled position and the size of the spray tip and pressure. A 0001 tip is best for applying spots of about 1 ml, a 0002 tip for spots of about 2 ml, and a 0003 tip for spots of about 3 ml. Also, a 15457-3-031 tip can apply three spots, up to 2 ml per spot, with one pull of the handle. Although the Gunjet is not an exact delivery device, very accurate dosages can be applied with practice and calibration.

Calibration of the Gunjet. The backpack sprayer is pumped to the pressure that will be maintained during application, 20 to 30 psi. An appropriate tip is installed that matches the prescribed spot volume: 0001 for 1-ml spots, 0002 for 2-ml spots, or 0003 for 3-ml spots. For spots of uneven volume, that are specified on the Velpar L label, a tip

should be selected that is closest to the prescribed volume. For example, a 0002 tip can be used to apply a 2.33 ml spot and so on. The Gunjet handle is pulled a few times and the clicking sound is noted—it helps to judge the rate of opening and closing of the handle. With a container that prevents splashing, the volume from 10 pulls of the handle is collected. This volume is accurately measured using a cup or cylinder graduated in milliliters. The volume should be 10 times the desired volume per spot. For example, 10 pulls form a 0002 tip, with a consistent rhythm of clicks, should give 20 ml. It will take practice to consistently achieve the correct volume. Calibration should be checked at least twice a day.

Maintenance of Gunjet. To apply soil spots of Velpar L, use a Gunjet that has Viton seals. After each days use, wash the outside and spray water through the Gunjet.

Herbicide and Mixing

Velpar L is the only herbicide presently labeled for soil spot applications in forestry. Velpar L can be diluted with water to aid spot applications. A dilution of 1 part Velpar L herbicide with 1 part water (1 to 1) requires that a 2-ml spot be applied to equal 1 ml of the concentrate. A dilution of 1 to 2 requires a 3-ml spot to equal 1 ml of the concentrate, etc. Dilution reduced the flammability hazard of Velpar L and reduces the chance of application error. For example, if a 1-ml spot of concentration is applied, and by mistaken calibration only $\frac{1}{2}$ ml is applied, the rate is changed by 50 percent. When the 3-ml dilutions are applied, a variation of $\frac{1}{2}$ ml only changes the application rate about 17 percent. CAUTION: Do not allow a dilution of Velpar L, at less than 5 to 1, to stand for more than 4 hours, because crystals may form in the solution, especially at temperatures below 50° F.

Application Methods

Soils spots are applied as grid applications to treat areas and as single stem applications.

Spot Grid Applications. A prescription for soil spots of Velpar L are usually specified by the volume per spot and the spacing between spots. If the prescription is given only in quarts per acre, then the volume per spot can be selected and the spacing calculated. For example, if the prescription specifies 6 quarts per acre and 2-ml spots are chosen, the number of spots per acre can be calculated by:

Number of spots per acre = Qt/acre X 946 ml/qt / Number of milliliters per spot

$$= 6 \times 946 / 2 = 2,838$$
 spots/acre

Then to calculate the spacing between spots, the area per spot must be determined:

Area/spot (ft^2) = 43,560 ft² per acre / 2,838 spots per acre

= 15.3 ft² or rounded to 15 ft²

Thus, if the area around each spot is 15 ft², then a 3 ft by 5 ft spacing would work. Natural walking strides tend to match spacings of 3, 4, 5, and 6 ft.

When the prescription is given in quarts per acre and commonly used spacing has been selected, then the volume per spot is as follows:

Spacing(ft	t): 3x3	4x3	5x3	6x3	4x6	5x6	6x6		
Spot/acre:	4,840	3,630	2,904	2,420	1,815	1,452	1,210		
Rate (qt/ad	cre)								
milliliters per spot									
2	0.4	0.5		0.6	0.8		1.0	1.3	1.6
3	0.6	0.8		1.0	1.2		1.6	2.0	2.3
4	0.8	1.0		1.3	1.6		2.0	2.6	3.1
5	1.0	1.3		1.6	1.9		2.6	3.3	3.9
6	1.2	1.6		1.9	2.3		3.0	3.9	4.7
7	1.4	1.8		2.3	2.7		3.6	4.6	5.5
8	1.6	2.1		2.6	3.1		4.0	5.2	6.2
9	1.8	2.3		2.9	3.5		4.7	5.9	7.0
10	2.0	2.6		3.3	3.9		5.0	6.5	7.8

These spot volumes have been rounded for the readers' convenience.

To be most effective, the applicator paces the larger dimension of the grid and applies the spots across in front using the smaller dimension. For example, when applying a 3-x-5 ft grid, the applicator paces 5 ft and applies up to 5 spots that are 3 ft apart. One spot can be applied directly in front of the applicator and then one spot 3 ft to the right and another 3 more ft over; then, this is repeated on the left side. After practice, the fastest application is by continuous pacing and shooting of spots, sweeping back-and-forth across the treatment swath.

To be most effective and efficient, the grid pattern should be spaced so that the herbicide spots intercept the most hardwood roots using the least number of spots per acre to minimize application time. Generally a close grid pattern is used when the hardwood competition is small and a wider pattern is used when hardwoods are larger. Thus close patterns are more commonly used for pine release and the wider spacing for site preparation, both pre- and post-harvest, and hardwood stand conversion. For example, to control mainly 6- to 8-inch d.b.h. trees, a wide grid is preferred, such as a 6 x 6 ft, 5 x 6 ft, or 4 x 6 ft. To control thousands of small stems per acre, the most common pattern is 3 x 3 ft.

Two methods are specifically recommended for release treatments and both account for leaving a 3 ft untreated circle around crop pines. One method used 3-x-3 ft spacing for two rows of spots centered between pine rows and applies no spots within the row. About 3,226 spots/acre are applied with this method. The milliliters per spot can be calculated by:

Milliliter per spot = Qt/acre X 946 ml/qt / 3,226 spots per acre

The second method is recommended for 3-year-old or older plantations that have had poor survival and undefined rows. It used a 3-x-3 ft grid and no spot is applied within a 3 ft of a pine. To determine the average number of spots per acre, an estimate is made of the stocking or trees per acre. The average stocking is subtracted from 4,840, which is the number of spots for a 3-x-3 ft grid. For example, if the stocking is 600 trees/acre then: 4,840–600= 4,240 spots/acre. This can be substituted for 3,226 in the above equation, along with the prescribed rate in quarts per acre, to determine the milliliters per spot.

Single Stem Application. Apply 2 to 4 ml of undiluted Velpar L for each 1 inch of d.b.h. The higher rate is needed for most situations other than for sandy soils. Apply the spots on the soil within 3 ft of the root collar of the unwanted tree. When more than one spot is required per stem, apply the herbicide evenly spaced around the stem. All small stems of susceptible species that have roots in the treated area also will be killed.

Marking Treated Areas. Water soluble dyes are available for adding to Velpar L for marking spots, which aids in application. Blue or other brilliant colors provide the highest visibility. Dye marking is short-lived and may only last a few days, if that long. The most common method used for marking treatment passes by crews is the use of plastic flagging or tissue paper that is draped on branches by the outside applicator. On the return pass the inside applicator guides on this line.

Timing.

The best time to apply soil spots of Velpar L starts in early February and goes through May to early June. Spring rainfall is needed to wash the herbicide into the soil and down to the roots for uptake.

Species susceptibility

Species susceptibility is given on the label summary for Velpar L.