

# Chemical Weed Control and Field Calibration of Knapsack Sprayers

## *Chemical weed control in conservation agriculture (CA)*

Weed control is one of the most important activities in smallholder agriculture and success or failure depends on effective and timely management of weeds. Poor weed control at the beginning of the season may greatly reduce yields. One of the options for effectively controlling weeds is the use of herbicides. Chemical weed control is quick, labour saving and can be very effective if applied properly. However, the cost and availability of herbicides, and the lack of technical capability to apply them safely, correctly and precisely can be major draw backs. Glyphosate has long been a preferred herbicide in CA and this bulletin will focus on its correct use.

## *The use of glyphosate in CA*

- Glyphosate is highly effective and affordable.
- Glyphosate is a desiccant and will give complete control of all growing (green) plants i.e. control of the first flush of broadleaved weeds and most of the perennial grasses. After successful and continuous control of weeds in the first years, the herbicide dosage can gradually be reduced.
- Glyphosate is relatively friendly to the environment and there are few cases of its release into groundwater. On contact with the soil, the herbicide is rapidly deactivated by clay and therefore has little or no residual effect.
- It is extremely important to mix glyphosate with clean water in the sprayer to avoid deactivation.
- Year-round weed control, which involves glyphosate, will eliminate problematic weeds like couch grass (*Cynodon dactylon* L.).

## *Are there any risks when applying glyphosate?*

Glyphosate is not recommended for use on soils with very high sand content (>90%) as it may remain active and damage emerging crops. Glyphosate has sometimes led to weed resistance; however, very few cases have been reported to date.

## *When is it useful to apply glyphosate and at what rate?*

- ✓ Glyphosate only controls living and growing plants and will kill plants only if it is effectively absorbed by living tissue.
- ✓ The best application time is before or soon after sowing the crop.
- ✓ Glyphosate is more efficient at low pH and a handful (150gr) of urea mixed with the water and herbicide in the knapsack sprayer will decrease pH and increase its efficacy.
- ✓ On a maize field it can be applied up to four days after planting but before crop emergence.
- ✓ In general, a rate of 2.5 litre/ha glyphosate applied at an application rate of 100 litre water/ha will give good weed control for most perennial weeds.
- ✓ Some problematic weeds will need several consecutive years of application to be completely controlled by the herbicide.



Typical maize field at the beginning of the cropping season without initial weed control



New cropping land is treated with an initial spray of glyphosate before seeding to control weeds

## **How do you apply glyphosate?**

Knapsack sprayers are commonly used to apply glyphosate. For successful and uniform application the type of nozzle used is critical. Flat fan nozzles are recommended for glyphosate application. Damaged or worn out nozzle tips lose the ability to properly regulate the spray pattern and should be replaced. Nozzles mounted on multiple nozzle booms increase efficiency and coverage of the herbicide application, which is important to achieve complete control. Use protective clothes when applying herbicides. These should include a rain coat, gum boots, rubber gloves and respiratory mask.

## **What factors affect the application of herbicides with the knapsack sprayer?**

Sprayers must be calibrated to avoid too high or too low application rates of any herbicide. The application rate depends on:

- (a) the pressure in the boom;
- (b) the size of the nozzle;
- (c) the width of the spray (swath) and
- (d) the walking speed of the operator (which should not vary).

It is very important to keep the pressure in the sprayer boom constant, select the right nozzle type and size (e.g. LF3) for your application rate, and keep all nozzles operating correctly.



Photo: Christian Thierfelder

**Flat fan nozzles are the recommended nozzles to apply glyphosate with a knapsack sprayer**

## **How do you calibrate a knapsack sprayer?**

**Preparation:** Rinse and fill the tank with water; remove, clean and replace nozzles and strainers; start the pump and check for leaks; apply pressure and check if nozzles work properly. **Determine speed:** Measure off a convenient distance e.g. 50 m and, with a watch determine how long it takes to walk the measured distance. It is useful to walk the distance several times until the walking speed is fairly constant. Select a walking speed that you can maintain through the working day. **Determine the width of application (swath):** With a single nozzle lance put the nozzle at spraying height (about 50 cm above the ground), apply pressure and turn on the sprayer, measure the width of the area being covered. The swath of multiple nozzle booms can be calculated by as follows: Distance between nozzles x number of nozzles; or in a similar way as described for a single lance. **Determine discharge rate:** Fill the tank to a defined mark, apply pressure and start spraying and walking from the starting point at the previously selected walking speed, after the 50 m mark, return while spraying continuously. Immediately after spraying for 100 m (50m x 2), measure the remaining water in the tank with a measuring cylinder. Alternatively, if you have access to an accurate weighing scale, the sprayer can be weighed before and after application to estimate the amount of liquid sprayed. Remember that 1 litre = 1 kg.

### **Calculate amount of herbicide per-knapsack sprayer:**

- (a) Area sprayed ( $m^2$ ) = swath ( $m$ ) x walking distance ( $m$ )
- (b) Discharge rate (litres/ha) =  $\{[water\ in\ the\ tank\ before\ spraying\ (litres) - water\ in\ tank\ after\ spraying\ (litres)] \div area\ sprayed\ (m^2)\} \times 10\ 000$
- (c) Amount of herbicide per-knapsack sprayer (litres). When we know the discharge rate/ha of the sprayer we can calculate the number of spray tanks (usually 15-20 litres) needed to cover 1 ha. With the recommended herbicide dose rate (litres/ha) we can now calculate the amount of herbicide to put in each tank = [Recommended rate (litres/ha)  $\div$  Discharge rate (litres/ha)]  $\times$  tank capacity (litres)

Example: Glyphosate should be applied at 2.5 l/ha in a knapsack sprayer of 15 litre capacity and discharge rate of 105 l/ha.

$$\text{Herbicide per-knapsack sprayer} = \frac{2.5 \text{ litres/ha}}{105 \text{ litres/ha}} \times 15l = 0.357 \text{ litres}$$

Therefore, to apply glyphosate at a rate of 2.5 l/ha, 375 ml of herbicide have to be mixed with water in a 15 litre knapsack sprayer. There will be 7 full tanks applied per hectare ( $105 \div 15$ ).



This technical bulletin was prepared by Christian Thierfelder and Walter Mupangwa as part of CIMMYT's BMZ and IFAD-funded projects on „Facilitating the Widespread Adoption of Conservation Agriculture in Eastern and Southern Africa“. Contacts: c.thierfelder@cgiar.org

Reprints were funded by USAID-Zambia

For more information please contact:  
CIMMYT, Southern Africa Regional Office  
P.O. Box MP 163  
Mt. Pleasant, Harare, Zimbabwe  
Tel +263 772815230  
[www.cimmyt.org](http://www.cimmyt.org)