

SUGAR CANE



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EDITORIAL

Weed control has one of the biggest impacts on cane productivity. A famous experiment conducted by SIRI in 1967 showed that weeds left uncontrolled may reduce cane yield by almost two thirds, all other things being equal, Table 1.

It is no secret that benefits of good weed control far outstrip the cost. Therefore, profitable cane production does not necessarily come from sharply reducing expenditure on weed control. In fact, the opposite often obtains. Cost of production surveys show that farms consistently producing at more than 80 tonnes cane per hectare are the farms which invest most heavily in weed control. Growers trying to reduce production cost should therefore not seek to do so by cutting back on weed control. In other words, it may be less appropriate to look at cost per hectare (which could be seemingly "improved" by failing to carry out proper weed control); but rather, a better measure is cost per tonne sugar. This cost may be reduced by greater cane and sugar yields obtained from efficient weed control (as part of a package of appropriate agricultural practices).

As Jamaica gears itself for increased cane production to take advantage of new market opportunities (ethanol and co-generation of electricity for sale to the national grid while maintaining supplies of sugar to local and international markets and satisfying demand for molasses for the rum industry) there is need to considerably sharpen approaches to sugar cane agriculture. This edition of Sugar Cane, with its focus on weed control, is a step in that direction.

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ENHANCING CHEMICAL WEED MANAGEMENT IN SUGARCANE

by M Edmond Lewis



M. Edmond Lewis

Whenever a grower plans to do chemical weed management, a number of circumstances are always present to mitigate against its effectiveness. Herbicides must overcome a variety of barriers to their entry into plants in order to be effective. Applied to foliage, herbicides must remain on the leaf instead of beading up and rolling off. They then must get past the leaf hairs and waxes on the leaf surface and finally penetrate through the cell walls and cell membranes. Some challenges to chemical weed management include:

- » Wind speed may be too high causing drift and cane damage along with less than adequate weed control
- » Weeds may have waxy stems

and leaves that prevent them from being wet by the herbicidal spray

- » Weeds may have hairy leaves and stems causing the spray particles to make poor contact with these surfaces
- » Weeds may be stressed/not actively growing, so there is a temporary shutdown of the weed's physiological processes and little or no absorption of the herbicidal spray into the plant. Plants under stress (drought, etc.) do not translocate herbicides as well as fast-growing, healthy plants and are therefore more difficult to kill with herbicides
- » Plant parts may accumulate dust particles to form a barrier between tissue and spray solution
- » The water used may not be at the pH for optimal effectiveness of the herbicide(s)
- » The water may have high levels of chemical impurities, mainly dissolved salts of calcium, magnesium and iron

A very effective way to alleviate these

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TRACTOR/BOOM SPRAYER USE

by Kenrick Chandon

Spraying often gives poor results, not because the farmer did not use the recommended chemical(s) or even a failure to mix the chemical to the right concentration. Many times the problem stems from a sprayer that is not properly adjusted or calibrated.

Faulty sprayer set up may contribute to drift levels and result in wasted money through inefficient application and sometimes overuse of chemicals. Sprayers must be checked regularly and proper maintenance carried out. Before attempting any work on a machine, it is wise to make sure that it is fully supported on stands, and that all the necessary protective clothing are on hand.

The cost of replacing a faulty pressure gauge that has been indicating at say 15% below the actual pressure could be recouped in just two hours' operation, depending on the chemicals involved. Maintenance measures such as fitting a new set of nozzles at the beginning of each season also save money. Cost of overdosing and the resultant crop damage could be avoided by simply installing a new set of nozzles.

Fitting the sprayer to the tractor

The selected tractor must always be powerful enough to operate the sprayer efficiently under the working conditions that will be encountered. All essential systems – hydraulic, electrical and pneumatic – must be clean and in good working order. Tractors fitted with cabs should have efficient air filtration systems. Trailed sprayers are often close-coupled to the tractor, so it is essential that the draw-bar and the PTO shaft are correctly adjusted for turning. PTO shafts must be disengaged when making very tight turns.

Checking the operation of the sprayer

Part fill the tank with clean water and

move the sprayer to uncropped waste ground. Remove the nozzles. Although not using any chemical at this point, get into the habit of wearing a coverall, gloves and a face visor when working with the sprayer. Engage the PTO and gently turn the shaft, increasing speed slowly to operating revs. Test the on/off and pressure relief valves, and check the agitation system. Flush through the spray lines, then switch off the tractor. Refit the nozzles and check the liquid system again for leaks.

It is a valuable exercise to assess the spray deposits at various points in the canopy and on upper and lower leaf surfaces of the weeds being sprayed. This is particularly important if the foliage is dense. Water-sensitive papers, food colouring or fluorescent tracers are available for this purpose. An increase in spray volume or adjustment of the nozzles and their locations may be necessary in order to achieve the correct coverage.

Calibration

Sprayer calibration involves determining how much herbicide and water should be mixed in the sprayer to deliver the herbicide at the desired rate. Herbicides are usually recommended at a particular rate of active ingredient per hectare. In order to apply the herbicide correctly, the application rate in l/ha or kg/ha must be known so that the sprayer can be calibrated to maintain the desired output. If inadequate dosages of herbicides are applied, the required level of control will not be achieved.

A quick and simple way to determine operating speed is to place two pegs at known points, select the engine speed and gear ratio. Travel between points of known distance and measure the time in seconds. Operating speed is distance between pegs (m) divided by the time taken to travel between pegs (seconds) divided by 3.6.

$$\text{speed} = \frac{\text{distance (m)}}{\text{time (s)} \times 3.6}$$

If the operating speed is less than that required, engage a higher gear while maintaining the engine speed. Remember that operating speed influences output (application rate); output influences herbicide rate; herbicide rate influences level of weed control; level of control influences yield; and yield influences profitability.

Pre-season maintenance

Before the start of the spray season some basic checks need to be performed, and corrective action taken as necessary. Hoses should be checked for cracks, splits and chafes particularly in routing clips and to ensure that all connections are water-tight. Where necessary replace damaged hoses.

Filters are to be checked for missing filter elements and seals, leakage, blockage or damage. Be sure to replace damaged or blocked filters.

Spray Tank is to be checked for fractures and any other damage. Ensure that it sits firmly in its mount with the security straps correctly installed and adjusted. Clean the tank and ensure the agitator is working. If necessary, contact the supplier and/or manufacturer to know about fractures and any other necessary repairs.

Controls are to be checked for correct operation of circuitry (electrical, hydraulic or air) and for internal and external leaks in valves. Be sure to replace leaky valves, which waste money and are potentially dangerous to operators and the environment.

Pump is to be checked for lubrication levels, possible leaks, and that air pressure in the pulsation chamber (if fitted) is at the recommended level. Ensure that

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Editorial contd...

The emphasis is primarily on chemical weed control. One article, Enhancing Herbicide Performance, looks at the factors that potentially limit effectiveness of herbicides and explores various chemical agents now available that may be added to enhance the effectiveness of sprays. Boom sprayers enhance the speed and efficiency of applying chemicals but, if not properly calibrated and operated, results can be disastrous. The article on Tractor/Boom Sprayer Use revisits those principles. Finally, to place all this in context, the third article "Outdoing the Weed Competition" addresses the concept of weed management, examining among other things the various types of weeds that are often problematic and various approaches to their control

Table 1: Results of a weed control experiment, Barnett estate, 1967

| |
|---|
| Plot never weeded Yield: 10 tons cane per acre (25 tc/ha) |
| Plot weed-free for first 8 weeks Yield: 16 tons cane per acre (40 tc/ha) |
| Weeds removed when 6 inches tall Yield: 21 tons cane per acre (53 tc/ha) |
| Plot always kept free of weeds Yield: 28 tons cane per acre (71 tc/ha) |

Enhancing Chemical Weed Management contd...

potential challenges is to include an adjuvant in the spray mixture. An adjuvant is any non-pesticidal substance in a herbicide formulation itself, or a substance which is added to the spray tank to improve herbicidal activity or application characteristics. Herbicides with built-in adjuvants in the formulations include Round Up, Nabu and Gramoxone. Others where the adjuvant may be purchased separately and added into a tank mix prior to use are chemicals such as 2,4-D, Igran and Gesapax. Most post emergent herbicides require the addition of an adjuvant for good results.

Formulation adjuvants are added to the active ingredient (herbicide) by the manufacturer for a number of reasons including better mixing and handling, increased effectiveness and safety, better distribution, and drift reduction. These properties are achieved by altering the solubility, volatility, specific gravity, corrosiveness, shelf life, compatibility, or spreading and penetration characteristics of the herbicide. With the large number of formulation options available (solutions, emulsions, wettable powders, flowables, granules, and encapsulated materials), adjuvants become even more important in assuring consistent herbicide performance.

Spray adjuvants, on the other hand, are added by the end user (sugarcane grower) to remedy many of the situations listed above. Spray adjuvants can contribute substantially to safe and effective weed management. Generally, no single adjuvant can perform all these functions, but different compatible adjuvants can often be combined to perform multiple functions simultaneously. There are two broad categories—activator adjuvants and utility adjuvants.

Activator adjuvants enhance the activity of the herbicide, often by increasing rates of absorption of the herbicide into the target plant(s) and aid chemical weed management in the following ways:

- » They make the herbicide ingredient more active, hence regular rates tend to give overkill
- » They may improve a herbicide's efficacy so that the concentration or total quantity of herbicide required to achieve a given effect is reduced
- » They improve the physical and chemical properties of the herbicide(s) allowing for increased absorption into tissues
- » Allow herbicide(s) to reach sites of action in a more concentrated

ed (toxic) form

- » Allow more herbicide(s) to remain on weed tissue in the event of rainfall during, or shortly after application
- » May decrease the rate of photo degradation of the herbicide allowing for longer exposure to tissues at toxic concentrations
- » Enhance leaf cuticle permeability, increasing rate of penetration of herbicide through the leaf especially in dry weather

Activator adjuvants include, but are not limited to surfactants, crop oil concentrates, and nitrogen fertilisers.

Surfactants are the most widely used and probably the most important of all adjuvants. Their primary function is to reduce the surface tension between the herbicide spray droplet and the leaf surface, and influence wetting and spreading of the herbicide on the weeds. Surfactants can modify the dispersion (spread), suspension (staying in the liquid), or precipitation (settling) of a pesticide in water. They are required for all post emergent herbicide sprays except Gramoxone and Roundup Max. When used, application is usually at 0.25% volume/volume (2.5

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Tractor/Boom Sprayer use contd...

the pump rotates freely without friction or noise. Do so by rotating manually or starting at low speed (corrosion may cause seizing up).

Pressure Gauge is vital for indicating whether or not the nozzles are delivering the correct quantity of chemical per unit time while spraying. If there are doubts about the pressure gauge, replace it or refer the problem to the manufacturer or supplier.

Nozzles need to be checked to ensure that all are of the same model and type; all are in good condition with no leaks around the body; all are clean and free from obstruction (note: clean with a soft brush or airline – don't damage nozzles by using wires or pins); and that all deliver to within + or - 5% of the manufacturer's chart value. Always ensure the

correct nozzles and operating pressure are selected before use. Have two or three sets of nozzles in stock to meet different spray qualities at different volume rates. Inspect nozzles throughout the season to avoid faults which could prove both costly and damaging to the environment if they develop unchecked.

The following checks should be carried out routinely:

- » All hoses are tightly connected and free from sharp bends; cracked or damaged hoses must be replaced.
- » All controls move freely and are fully adjustable.
- » Pressure gauge reads zero.
- » Pump can be turned over by

hand.

» Fan turns freely and is not obstructed; bearings are sound and lubricated.

» Air pressure in pump accumulator (if fitted) is correctly adjusted.

» Drain plugs and clean filters are in position.

» Tires on trailed machines are sound and correctly inflated; wheel nuts are tight.

CAUTION!! great care should be taken when adjusting a sprayer while the tractor engine is running. Always ensure that the fan is stationary before approaching the rear of the sprayer, and engage the hand-brake before dismounting the tractor.



Collecting output from nozzles

Measuring output from nozzles





Recording output from nozzles



Checking pressure gauge & adjusting pressure



Checking & adjusting spray nozzles



Testing boom sprayer after setup & calibration

Enhancing Chemical Weed Management contd...

ml/l). Surfactants are generally not added to pre-emergent herbicides that are applied directly to soil. Other popular surfactants include crop oil concentrates and vegetable oil concentrates.

Nitrogen fertilisers can increase herbicide activity on certain weed species particularly grasses. They improve the effectiveness of weak acid-type herbicides e.g. 2,4-D and glyphosate. Ammonium sulphate can reduce problems with hard water and is generally used in combination with surfactants or crop oil concentrates. Application rate varies depending on product.

There are in fact many chemicals which fall under a group called utility adjuvants or simply spray modifiers which enhance the effectiveness of herbicides (making them easier to apply, increasing adherence to plant surfaces etc) under various conditions. These are themselves classified as wetting agents, sticker-spreaders, deposition agents, plant penetrating agents, drift control agents etc. The SIRI officer stands ready to guide growers in the appropriate use of these products which are usually far more effective than soap which is sometimes used as a substitute.

Remember, soap acts only as a spreader/sticker in spray mixtures, and in most cases, is not very effective. Oil-based adjuvants are superior to soaps, in sticking and spreading, plus they bring are other important features such as enhancing penetration and drift control. The silicone-based adjuvants are most useful, because they are capable of providing many of the characteristics of wetting, spreading, sticking, penetrating, drift control and anti-foam.

Certain herbicides are sold with adequate adjuvants already incorporated. Note should be taken of these herbicides including: Velpar when used with Karmex (diuron); Gramoxone; Roundup Max, and Roundup Ultra. Also, if a water conditioner and buffering agent such as pH Plus is used, it is recommended that no adjuvant be added to the spray mixture, because the product is already formulated with adequate activator and utility adjuvants.

Finally, chemical weed management depends on uniform application of the spray solution over the land. Best results are obtained when applicator is

well calibrated, nozzles well spaced and directed, and in good working order. (See associated article on Tractor/Boom Sprayer Use)

Table 1. Active pH preferences for certain sugarcane herbicides

| Common Name | Trade Name(s) | Most Active pH Range |
|--------------------------|---------------------------------|----------------------|
| 2,4-D | 2,4-D | 6.5 |
| Ametryn | Gesapax, Ametrex | 5.5 |
| Asulam | Asulox | 5.5 |
| Atrazine | Gesaprim, Atranex | 5 |
| Clomazone | Command | |
| Dicamba | Weedmaster, Kambamaster | |
| Diuron | Karmex, Diurex, Direx | |
| Ethephon | Ethrel | 4.0-5.0 |
| Fluazifop | Fusilade | 5.0-6.0 |
| Glyphosate | Roundup, Rodeo, Glyphos, Credit | 3.5-4.5 |
| Glufosinate | Finale | |
| Hexazinone | Velpar | 4.5 |
| loxynil | Actril | |
| Isoxaflutole | Merlin, Balance | |
| Metsulfuron | Ally | 7 |
| Metribuzin | Sencor, Carzone | 5.0-6.5 |
| Metolachlor | Dual (Gold) | |
| Paraquat | Gramoxone, Gaiquat, Herbiquat | 4.5-5.0 |
| Sethoxydim | Nabu | |
| Sulfosate | Touchdown | 4 |
| Terbutryn | Igran, Terbutrex | 5 |
| Trifloxysulfuron/ametryn | Krismat | 6 |

Good weed control essential for good yield



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OUTDOING THE WEED COMPETITION

by M Edmond Lewis

A very important component of sugarcane cultivation is weed management. Weeds are plants (whether economic or not) growing in a location where they are not needed, and tend to exert negative influences on crop plants. Grass weeds exert the greatest pressure on commercial agriculture. Sugarcane is a giant grass, therefore all conditions which favour sugarcane survival will, to a large extent, foster grass weed survival also. As an economic indicator of its importance, weed control cost of ~\$9,220/ha represents 18 - 28% of cultivation cost, or 5-6% of production cost. This figure will be low only if the process is done efficiently.

To keep weeds in check, a manager must understand weed dynamics in order to manage them satisfactorily. The more important aspects include:

- » Origin of weed seeds
- » Time of establishment
- » Dormancy period (if any)
- » Conditions fostering greatest survival rates
- » Period/stage of susceptibility
- » Most probable method of attack during susceptible phase

Having understood the foregone situation, a manager sets out to do control. The important decision to make is: What option to use? The available options include:

- » Mechanical: smothering weeds via ploughs, harrows, tines and other mechanically operated tillage implement
- » Physical/Manual: use of hand operated tools - hoe, cutlass, physical removal by hand; use of flammers. Manual methods are basically outmoded in commercial agriculture, and the use

of flammers in integrated weed management is moving into prominence.

- » Chemical: use of various types of herbicides, each suitable for specific weed classes, mode of application or moisture regime.

Most managers opt for chemical because of the following advantages:

- » Rapid, and labour efficient. Results can be seen in a short period of time
- » Ease of application - boom sprayer, broadcast and incorporated with tillage implement; aerial spraying via aircraft; and knapsack spraying from the ground.
- » Selectivity of chemicals, even against specific cultivars and ecotypes of plants and weeds.
- » Can give long, lasting effect beyond 75 days
- » There is a herbicide suitable for every situation

In former years knapsack sprayer was the main applicator used to dispense herbicides for weed control. Currently a tractor mounted boom sprayer can do in a day, the work equivalent of 15 workers operating with knapsack sprayers.

Effectiveness of boom spraying depends on a number of variables, all within the control of the manager and equipment operator. Adequate weed management by boom spraying could be compared to a medical team of doctor, pharmacist and nurse. The doctor diagnoses the problem and prescribes (recommends) a treatment which the pharmacist identifies, prepares and delivers to the nurse for application to the patient. In the context of weed management, the doctor is the agronomist, the pharmacist is the

store keeper, and the nurse is the equipment operator.

The doctor/agronomist may make the correct prognosis and prescribe the best remedy. The pharmacist/storekeeper may identify and prepare the remedy appropriately, but if the nurse/equipment operator does improper/incomplete delivery to patient, the malady could remain, or even magnify itself.

To ensure efficient delivery of weed control product there are some basic checks both agronomist and equipment operator need to make on a regular basis:

- » Check nozzles to ensure uniform discharge from each. If a nozzle from a set used during calibration is replaced, the equipment should be re-calibrated.
- » Check and ensure that the same type of nozzle is installed at all points on the boom. Different nozzle types should not be installed unless they are calibrated to deliver a different rate at a particular angle.
- » Check and ensure that the distance between nozzles on boom is constant and in accordance with inter-row spacing.
- » Decide on efficient rate of application and calibrate tractor and sprayer to achieve it. If, after calibration, there is need to attach the sprayer to a different tractor, there is need for re-calibration.
- » Check and ensure that the particulars of calibration are used (forward speed, pressure, swath).
- » Maintain boom height during

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Outdoing The Weed Competition contd...

operation: the coverage (swath) depends on it. The higher the boom, the greater the swath.

- » Check and ensure ideal operating pressure is selected and used. At high pressure the spray mixture becomes light and is easily carried by wind (drift). It is recommended to operate at a pressure of 1.0 -

1.5 bars (15 - 25 psi), and if moderate winds are expected use nozzles with larger aperture. Drift can also be reduced by using anti-drift agents in the spray mixture.

- » Check and ensure that whenever double drop-nozzles are used, the angles are sufficient to give required swath and over-

lap without damaging the sugarcane crop.

- » As much as possible, recommend and use crop-selective herbicides for post emergent spraying with boom sprayers, and use non-selective herbicides at pre emergence where the risk of cane damage is fairly low

Applying pre-emergent herbicide to field



Applying post-emergent herbicide to field