Spray Application Guide

Groundrig Operators






1936

1999 - 2000

An initiative of the
Cotton Research and
Development Corporation

KEY INFORMATION

Company Name: .....

Address: .....

Telephone 1: ..... Fax: .....

Telephone 2: ..... UHF: .....

A/H Tel.

Contact 1: ....

Contact 2: ....

Safety Officer: ....

	✘	✔	Location
Spill kit:	☐	☐	.....
First aid kit(s):	☐	☐	.....
Other:			

Emergency	Tel.	UHF
Fire:	.....	.....
Ambulance:	.....	.....
Police:	.....	.....
Other:	.....	.....
	.....	.....
Cotton Australia: (Local office)	.....	.....

Best Management Practices

Spray Application Guidelines for Groundrig Operators

Edited by: Ian Rankine and Peter Hughes

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CONTENTS

Spray Application Guide

INTRODUCTION

Adoption of Best Management Practice (BMP) in all facets of cotton growing and processing is now well under way.

Commitment to the process of constant improvement involves not only growers, but all personnel who play a role in this innovative industry.

Ground application of herbicides, pesticides, defoliants and biological agents is an important part of producing world class cotton.

Groundrig operators realise the necessity for their industry group to adopt BMP, and that BMP is fundamental to their success in the future.

The Cotton Research and Development Corporation (CRDC) is supportive of industry initiatives which will improve cotton management.

This pocket guide for groundrig operators is one part of the CRDC commitment to providing the tools to allow industry participants to achieve best practice.

The pocket guide is not comprehensive, but does provide practical information which will be useful for immediate field use and for the purpose of training personnel.

Ian Rankine September 1999

Peter Hughes

Principles

The principles of responsible groundrig application of pesticides are based on **due diligence**. Due diligence refers to the community's legal and moral expectation of you as an owner, operator, manager, or director to:

- act responsibly in all activities and decision making processes;
- know or be aware of information and issues associated with activities and decisions;
- approach and consider any activity and decision in an industrious and persistent manner, with emphasis on foreseeable events or situations;
- test and reassess assumptions before undertaking an activity or when making a decision.

Planning

Planning is fundamental to the success of best management practices (BMP) and is an integral part of the continual cycle of improvement. Planning allows situations to be more clearly identified and managed, before hazards and problems occur. A general planning process is:

- determine the objectives
- assess the current situation and resource availability
- identify priority areas
- develop solutions and alternatives
- decide on the best alternative
- document the decision in the management plan
- implement the solution
- reassess the situation
- evaluate and modify the operating plan.

Commitment

Commitment by groundrig operators to the principles of due diligence and planning their activities, will help to ensure that pesticides are applied in a safe and responsible manner.

Law

Ignorance of the law is not a defence.

Participants are expected to know or make every reasonable step to find out the correct practices and laws relating to their activities.

COMMUNICATION

SPRAY and DRIFT MANAGEMENT PLANS (SDMP)

SDMP form the basis for clear communication and best practices on an individual farm basis. All growers should prepare a SDMP for their cotton management area. SDMP are based on pre-season communication between growers, neighbours, operators and employees to develop workable guidelines for spraying to minimise off-target movement of pesticides.

Groundrig operators should familiarize themselves with SDMPs at the pre-season meeting, and any doubt about hazard zones should be checked.

The key elements of SDMP are:

Pre-season meeting

Growers are required to discuss their SDMP with neighbours, operators, consultants and employees prior to the season and agree on procedures.

Map

SDMP must include a detailed farm map. Drift hazards must be clearly identified. Buffer strips must be marked on the map.

Neighbours

SDMP contain contact information on neighbours to the farm and their individual concerns.

Consultants

SDMP contain details about the farmer's consultant(s). Groundrig operators should have a preseason meeting with the consultant, and the consultant's comments on specific problems and/or concerns should be noted.

Communication

SDMP must detail communication methods and responsibilities so that all parties understand procedures and alternatives.

A key component of the communication plan is WHO will de on whether a spray job starts, continues, is delayed or is al doned. Groundrig operators should agree to acceptable com nication procedures during the pre-season meeting.

Weather

SDMP contain details of weather data which the farmer wil monitoring. SDMP will also contain information on smoke inc tors and windsocks which will be used during the season.

Hazards

The SDMP map outlines potential hazards within and surrou ing the cotton farm. Groundrig operators should conduct a re naissance of hazard areas and amend their maps as require

Employees

Ensure that employees are familiar with client SDMPs and c pany best practice guidelines. All personnel handling and mi chemicals should have current ChemCert accreditation.

Clearly communicate handling and emergency procedures, sp job information and drift minimization procedures.

Establish 'points of contact' for each task, and note these in booklet. Explain complaint handling procedures to employee

Complaints

The operator must cease operations if there is a legitimate ca for concern or if a reasonable complaint is received. The far (or his nominated representative) must be available on the f during spray operations for referral if a complaint is recei Agreed SDMP complaint handling procedures should be lowed.

Spraying operations should be suspended by the groundrig o ator pending resolution of the complaint.

Record keeping

Records must be kept for each spray operation, and for e complaint received. Refer to specific recording requirements endosulfan applications.

RECORDS

It is essential for operators to maintain current and accurate records of each application. Not only do these records enable operators to check application rates and performance, but provide a record should a dispute arise.

Spray and Drift Management Plan (SDMP)
A copy of the relevant SDMP, maps and information should be kept on record.

Spray order form
The spray order form (if applicable) and associated notes should be kept with the application details as part of the 'job' record.

Spray application record
The following details should be recorded at application:

a) Date and time of application.
b) Farm details - based on the SDMP maps. Crop stage.
c) Chemicals and adjuvants used (Refer to restrictions on endosulfan usage).
d) Water volumes and any treatments used (e.g. buffers)
e) Target pests - cross reference this to the crop check report reference from the consultant/agronomist.
f) Weather conditions -record weather conditions and any changes during the application. Any significant weather events (e.g. thunderstorms) which occur 24hrs before or after application.
g) Equipment setup and operating details.
h) Details of job completion or delay.

ENDOSULFAN
Specific recording requirements apply.
Refer to the current product label.

WEATHER

If the weather conditions are not right, no amount of cor equipment will stop drift.

If in doubt - DELAY the SPRAY.

Weather should be monitored immediately pre-application, ev 30 minutes or every tankful (if less than 45 mins between ref throughout the application and if a significant change in co tions occurs. Any significant weather events 24hrs prior to anc ter application should be recorded.

Forecasts (72hr) should be examined when spraying is planr

Suggested weather conditions for ground spraying:

	✘	✔	✘
Windspeed (kph)	<3	3 - 20	>20
(m/s)	<1	1 - 4	>4
Wind direction		Away from sensitive areas.	
Temp. (°C)	<0°	0 - 30°	>30°
Humidity (%)	<35	40 +	>95
(ΔT) (°C)	>10°	1 - 10°	<1°

Refer to the ΔT tables in the 'Useful Information' section of the booklet.

CAUTION

Monitor the maximum speed (and direction) of gusts wind.

Do not spray in high temperature or thermal conditions.

Do not spray if conditions are unpredictable or variable.

Maintain communication during spraying.

Beware of inversion and/or fog conditions.

Refer to diagrams in Drift section for smoke indicators.

DRIFT

'Drift' occurs when a pesticide is carried outside the target area by air movement.

Vapour drift occurs when the pesticide volatilizes during or after spraying and the vapour is transported by wind movement.

Droplet drift occurs when wind or turbulence carries pesticide droplets off-target.

WEATHER - Stability conditions and inversion layers

Smoke	Condition	Notes	Spray?
	UNSTABLE (Daytime)	Hot. Low windspeed. Risk of upward movement of spray.	✘
	NEUTRAL (Morning)	Cool breeze (4-20kph) Optimum spray conditions.	✔
	STABLE (Night-time)	Low windspeed. Moderate off-target spray deposition.	✘
	INVERSION (Dusk)	Low windspeed. Hot during day. Risk of significant off-target deposition.	✘

COMMUNICATION

Ensure that all employees are familiar with the causes of drift, identification of drift conditions and the potential hazards.

Participate in the SDMP process with growers and agree on wind indicator and communication methods. Obtain SDMP hazard maps for each cotton farm to be sprayed, and conduct a confirmation reconnaissance of surrounding areas.

Maintain communication with support crew and the farmer during spray jobs. Watch the smoke indicators and windsocks. Communicate completion, delay or cancellation details to the client as soon as possible.

CHEMICALS

Read the label and follow directions to minimise drift and environmental impact. Use a nonvolatile, low odour formulation if available.

Give preference to low toxicity (to non-target areas) products. Discuss chemical selection with the farmer and consultant.

Give preference to products which can be applied effectively using large droplet placement (LDP) techniques.

Record all chemical usage and application rates (including adjuvants). Refer to specific requirements relating to endosulfan usage and recording (refer to information card in this booklet).

EQUIPMENT

Ensure that equipment checks and calibrations are carried out.

Select suitable nozzle types and pressures to minimise drift. Increasing pressure increases drift potential. Operate booms at the minimum practical height, and take care with 'boom bounce'.

WATCH the WIND

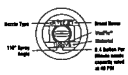
NOZZLES

Operators and employees should understand nozzle specifications and performance characteristics. Contact your supplier for detailed specifications for particular nozzles.

Examples of nozzle information which is readily available:

Nozzle identification

This information is printed on the nozzle.



DG TeeJet - Drift Guard (DG) type; made by TeeJet, 11002VS - 110° spray angle, 0.2 USgal/min@40psi pressure (0.8l/min@2.75Bar), Visiflow (V) colour coding, Stainless steel (S) orifice.

Output charts

Output charts are available from nozzle suppliers. The charts show suitable filters, working pressures, output and application rates. Nozzles colours indicate output and allow comparisons between nozzle types and manufacturers.

Droplet size charts

Droplet size charts are available from manufacturers. The droplets produced by the nozzle under different pressures are classified as:

- Very fine
- Fine
- Medium
- Coarse
- Very coarse
- Extra coarse

DG TeeJet® Flat Spray Tips

(bar)	DG80015	DG8002	DG8003	DG8004	DG8005	DG110015	DG11002	DG11003	DG11004	DG11005
2.0	M				VC	M				
2.5	M	M				M	M			
3.0	M	M	M			M	M	M		
3.5	M	M	M	M		M	M	M	M	M
4.0	M	M	M	M	M	M	M	M	M	M

Nozzle pressure

All spray nozzles have recommended working pressure rang (refer to Nozzle Output Charts and Nozzle Droplet Size Chart

In general, increasing pressure produces smaller droplets a increases drift hazard.

Droplet sizes (% vol.) produced by different nozzles

			Output	Droplet size (µm)		
Nozzle	Type	(L/ha)	<100	100-200	200-400	>
11001	FFan	31.2	30.4	43.5	24.4	1
TX6	HCone	31.2	47.5	42.2	10.1	0
11002	FFan	63.2	19.7	36.2	39.2	4
TX12	HCone	63.2	37.1	38.6	22.7	1
Pressure = 3 bar.			Drift + Evap.	Working range		Too l

Check nozzle specifications and spray at the lowest pressu which will produce a droplet suited to the target. Larger Drop application methods should be used near sensitive areas, pesticide efficacy must be monitored.

Nozzle Height

Guidelines to consider:

a) Overall coverage - nozzle patterns must overlap bef reaching the target surface.
b) Nozzle outlets not more than 0.5m above the target.
c) Use of droppers and multiple nozzle configurations affect optimum boom height.

Lower nozzle outlet heights will reduce drift risk. Band spra possible to reduce boom height and chemical usage. Minim boom 'bounce', lift and movement and shut off the spray dur manoeuvring. Air assist and spray shields may reduce chemi losses and drift.

CALIBRATION

Calibration and optimal nozzle selection and performance are fundamental to best spraying practice and drift control. Refer to Spray Pak for additional information.

A few minutes preparation and/or calibration time will result in a more efficient, safer application.

Equipment required:

Calibrated jug or measuring cylinder (1 L), calculator, nozzle cleaning brush, stopwatch or wristwatch with a second hand, 100m tape measure.

Preparation

1. Obtain detailed charts of nozzle performance from the manufacturer or reseller.
2. Select nozzle type to suit the chemical, application type and conditions.
3. Check that all nozzles and filters are clean and intact.
4. Ensure that the unit has been decontaminated and refill it with clean water.

Equipment speed

1. Refer to equipment handbooks for gear selection and RPM for desired ground and PTO speed.
2. Measure time to travel 100m (Average of 4 runs).
   Speed (kph) = (100m x 3.6) ÷ Time (sec)

Nozzle output

1. Set the equipment RPM and spray pressures to meet the required spray job specifications.
2. Measure the output from every nozzle for 30 seconds (Use only clean water).
3. Calculate the output as litres per minute (L/min).

If a mixture of nozzles or specialist nozzles are being used, add the average output from each nozzle to obtain total output per minute. Replace any nozzles which vary more than 10% from manufacturers specifications.

Note the nozzle setup per row of cotton.

Record: Nozzle type, working pressure, application volume.

Ensure that the operator is aware of the data.

Overall application

i) Application rate per field hectare (L/ha) =
(Nozzle output (L/min) x No. nozzles per row x 600
(Speed (kph) x Effective row width (m))†

† Refer to SprayPak Section A2 (Page 18) for details on effective row width.

ii) Field area per tankful (ha) =
Tank capacity (L) ÷ Application rate per field hectare (L/ha

Band or directed application

i) Band factor. Calculate the % of the field area to be spray
(e.g. 30%= a band factor of 0.3)

ii) Sprayed area per tankful (ha) =
Field area per tankful x band factor

iii) Application rate per sprayed hectare (L/ha) =
Tank capacity (L) ÷ Sprayed area per tankful (ha)

Calibration completion

1. Recheck all calculations and spray output.
2. Record the date of calibration, nozzle type, pressu output application details and relevant notes in a w diary.
3. Conduct a final check of the equipment and nozzles.

SPRAY EQUIPMENT

It is essential that all spray equipment is maintained in proper safe working order, calibrated properly and setup to minimise drift. This ensures that application rates and patterns are accurate, and that risks associated to exposure or accidents are reduced.

Equally important is that spray units are maintained in professional and hygienic manner to project a responsible image to the public and to clients. Take a little extra time to wash down and decontaminate before moving out of the field or depot.

For example: A contaminated unit with a leaking spray vat with empty drums stacked on the tray, presents a negative image of groundrigs.

Refer to the manufacturers handbook for machinery maintenance instructions.

A daily checklist is shown, to provide assistance to ensure that the key elements of best practice have been checked and are being monitored on a daily basis.

SPRAY EQUIPMENT CHECKLIST

	✘	✔	Notes
Vehicle			
Service log	☐	☐	.....
Calibration	☐	☐	.....
Chemical tank	☐	☐	.....
Pump + intake	☐	☐	.....
Filters	☐	☐	.....
Spray lines	☐	☐	.....
Leaks	☐	☐	.....
Odours/residues	☐	☐	.....
Nozzles			
Type for job	☐	☐	.....
Condition	☐	☐	.....
Body assembly	☐	☐	.....
Spares	☐	☐	.....
Cleaning equip.	☐	☐	.....
Output test	☐	☐	.....
Droplet chart	☐	☐	.....
Air tubes/vanes	☐	☐	.....
GPS equipment	☐	☐	.....
Markers/dyes	☐	☐	.....
Decontamination	☐	☐	.....

	✘	✔	Notes
Communication			
UHF	☐	☐	.....
Telephone	☐	☐	.....
Maps and info.	☐	☐	.....
Records			
Job sheet	☐	☐	.....
Records	☐	☐	.....
Weather equip.	☐	☐	.....
Other			
Chem. storage	☐	☐	.....
PPE	☐	☐	.....
Drum wash unit.	☐	☐	.....

Operator:

Date:

Correctly levelled air-assist sprayer.

Be careful to avoid boom lift and bounce !

APPLICATION

Efficient, accurate spray application through well calibrated and maintained equipment, under suitable weather conditions, is essential to prevent drift and to optimize results from the pesticide.

Proper equipment maintenance and adherence to basic princples of good management will reduce drift and improve pesticide efficacy.

Refer to product labels for specific application directions.

Endosulfan has specific application restrictions (see information card in this booklet) and operators must adhere to the label directions which became effective on 1 July 1999.

The best decision relating to a spray application may be to **delay the spray.**

SPRAY APPLICATION CHECKLIST

Pre-application	✘	✔	Notes
Vehicle			
Service log	☐	☐	.....
Equipment check	☐	☐	.....
Client SDMP	☐	☐	.....
Written order	☐	☐	.....
Daily spray plan	☐	☐	.....
Weather			
Weather forecast	☐	☐	.....
Wind conditions	☐	☐	.....
Monitoring equip.	☐	☐	.....
Farm			
Crop details	☐	☐	.....
Target pest	☐	☐	.....
Applic. pattern	☐	☐	.....
Special caution	☐	☐	.....

	✘	✔	Notes
Chemical			
Label	☐	☐	.....
Formulation	☐	☐	.....
Additives	☐	☐	.....
MSDS	☐	☐	.....
Contact No.	☐	☐	.....

	✗	✔	Notes
During applic.			
Communication	☐	☐	.....
Smoke/windsock	☐	☐	.....
Weather cond.	☐	☐	.....
Equipment	☐	☐	.....
Boom height	☐	☐	.....
Job completed	☐	☐	.....

Delay details .....

Post application			
SDMP followed	☐	☐	.....
Post app. weather	☐	☐	.....
Job confirmation	☐	☐	.....
Decontamination	☐	☐	.....
Waste disposal	☐	☐	.....
Records done	☐	☐	.....

Operator: Date:

SAFETY

Everyone involved in spraying pesticides must take a pro-act approach to safety matters. Pesticide safety procedures are c tained in the SprayPak handbook.

Basic safety considerations are outlined below.

1. READ THE LABEL

Equipment setup

Mixing

Protection of livestock

Protection of wildli

Storage and dispo

Safety (PPE)

First Aid.

The label also contains emergenc contacts and notes for physicians (doctors)

2. WORKING WITH PESTICIDES:

Observe safety directions. Do not eat, drink or smoke witho first washing thoroughly and removing contaminated protecti equipment.

	✘	✔	Notes
During applic.			
Communication	☐	☐	.....
Smoke/windsock	☐	☐	.....
Weather cond.	☐	☐	.....
Equipment	☐	☐	.....
Boom height	☐	☐	.....
Job completed	☐	☐	.....

Delay details .....

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SDMP followed	☐	☐	.....
Post app. weather	☐	☐	.....
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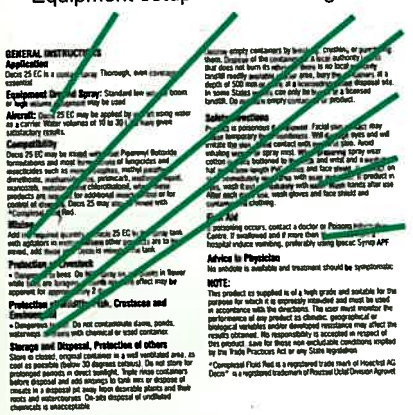

2. WORKING WITH PESTICIDES:

Observe safety directions. Do not eat, drink or smoke witho first washing thoroughly and removing contaminated protecti equipment.

PERSONAL PROTECTIVE EQUIPMENT

a) Storage areas 

b) Mixers and loaders 

c) Drivers and operators 

d) Other equipment 

(Refer to labels and MSDS)

Airconditioned cabs should be fitted with activated charcoal filter elements. Do not contaminate the cab interior after mixing or loading.

STORAGE AREAS.

Storage areas (including temporary stores) should be secure and constructed to contain a spill. Storage areas must be secure from unauthorised access and contain suitable warning notices.

Always store pesticides in their original containers and ensure that the containers are sealed after each use. Flammable materials should be stored separately. Refer to AS 2507 - 1998 for details.

TRANSPORT

Request reseller or authorised chemical handling agent to transport large quantities of chemicals. The transport vehicle should be up to the required standard and must display the relevant Dangerous Goods signs.

Refer to the Australian Dangerous Goods Code.

Smaller quantities should be transported in a truck or utility (ute) with the cab separate from the load area.

Always transport chemicals in original, undamaged and approved containers.

Secure the load properly and cover with a load net if items are likely to move.

Observe flammability warnings on the labels.

Do not transport chemicals in a sedan, station wagon, enclosed cab or closed luggage compartment.

Do not transport chemicals with people, livestock or foodstuffs.

Do not leave chemicals unattended or under the supervision of an unauthorised person.

For more details refer to:

Australian Standard 2507-1998

"The storage and handling of agricultural and veterinary chemicals"

Shaw, A. J., (1999) "Cotton Pest Management Guide" Agdex 151/680, NSW Agriculture.

LEGISLATION

New South Wales

Agricultural and Veterinary Chemicals (NSW) Act (1994)

Environmental Planning and Assessment Act (1979)

Occupational Health and Safety Act (1983)

Pesticides Act (1978)

Queensland

Agricultural Chemicals Distribution Control Act (1996)

Agricultural Chemicals Distribution Control Regulation (1998)

Agricultural and Veterinary Chemicals (Qld) Act (1994)

Chemical Usage (Agricultural & Veterinary) Control Act (1988)

Environmental Protection Act (1994)

Environmental Code of Practice for Agriculture

Workplace Health and Safety Act (1995)

Useful documents:

Spraying Herbicides-Commercial Operators Obligations DPI note Agdex 688 (1994)

Spray Right - Reduce Drift, CropLink Spray Guidelines. Peter Hughes, DPI Farming Systems Institute, 1998.

Contacts:

Cotton Australia Representative:.....

USEFUL INFORMATION

1. Ground speed calculation

Speed (kph)	Time (sec) to travel 50m	75m	100m	150
5.0	36	54	72	10
7.5	24	36	48	7
10.0	18	27	36	5
12.5	14	22	29	4
15.0	12	18	24	3
17.5	10	15	21	3
20.0	9	14	18	2
22.5	8	12	16	2
25.0	7	11	14	2

2. Pressure conversion **100 KPa = 1.0 Bar = 14.51 PSI**

KPa	200	250	300	35
Bar	2.0	2.5	3.0	3
PSI	29	36	44	5

3. RH (%) at various temperatures when ΔT = 10°C

Dry bulb temp °C	Minimum RH if ΔT=10°C
20°C	25%
25°C	30%
30°C	40%
35°C	45%
40°C	50%

ΔT = difference between the wet and dry bulb temperatures.

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Photographs

Cover

Top	L	Custom Ag Products, Inc.
	C	4T Consultants Pty. Ltd.
	R	Peter Hughes.
Centre	L	Spraying Systems Co.
	R	John Deere Limited.
Bottom		Spraying Systems Co.

Page

2	John Deere Limited.
10	Spraying Systems Co.
14	Custom Ag Products, Inc.
17	Peter Hughes.
18	Spraying Systems Co.

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