SPRAYING EFFICIENCY FACT SHEET

GRDC
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Fill-and-ferry savings optimise hectares sprayed on any given day

PHOTO: BILL CAMPBELL

A simple tanker and batching set-up for servicing spraying operations on multiple farms.

Introduction

Identifying the different elements of a spraying operation that influence efficiency, and understanding industry best practice, are key to successful spraying outcomes.

Spraying efficiency is about maximising the 'hectares sprayed in a day'. The sprayed hectares in a day is determined by the operation of the sprayer, getting it to and from the paddock and how efficiently the sprayer can be filled. The spraying capacity that can be achieved in a farming operation needs to be assessed while achieving ***the best spray application job and managing drift***. Every farming operation is different, so it is important to match spray capacity with the needs of your farming operation and to understand any limitations. There must be sufficient capacity to spray in a timely manner with the allowance of downtime due to weather conditions (wind, rain, heat), drift considerations or physical logistics (shifting sprayer or equipment, moving chemical, etc.).

Breaking down spraying operations into components

When reviewing the spraying efficiency of a farming operation, the daily spraying operations can be broken down into the various elements and processes involved. They can be grouped into components that can be improved or those that cannot be changed, but must be managed.

KEY POINTS

- The 'pit stop'– batching, filling and ferrying to and from the paddock – has the greatest influence on spraying efficiency
- Caution is required with the latest high-flow, high-capacity chemical handlers to avoid glugs, foam and horrible messes
- Correct mixing order and allowing sufficient time for dispersion and mixing must be followed
- Diligent use of handlers for dry products and direct induction of liquids in the sprayer gives the quickest fill times
- Ferry time to a water source adds wasted time

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TABLE 1: Components of a daily spraying operation that can be and cannot be managed.

	Factor	Fixed components or those that must be managed	Factors that can be modified or improved
1	Sprayer capacity	Boom width, tank size, SP, tow-behind	
2	Operational 'spraying' factors		Working speed, water volume, turning speed, hours worked
3	'Pit lane' filling and batching		Fill and ferry time logistics, supply of chemical
4	Paddock/topography dynamics	Topography, field length, shape, size, day-night 'spray' ability	
5	Meteorological, legislative	Weather conditions, product label requirements i.e. 2,4-D application	

The 'pit stop' – fill and ferry

The 'pit stop' (batching, filling and ferrying to and from the paddock) has the greatest influence on spraying efficiency. The following analysis shows minutes saved ferrying a sprayer to and from a fill point and the time taken to batch and fill the sprayer, which equates to many more hectares sprayed in a day.

Caution is required when using high-flow, high-capacity chemical handlers. There is a high risk of mixes going wrong due to rapid delivery of products into a relatively small volume of water, not allowing suffice time for dispersion and homogeneous mixing. The importance

Smarter, not faster

New sprayers and tractors have a greater ability to work faster with more horsepower, better suspension and pumping capacity. The temptation is to cut corners – to increase working speeds, use lower water volumes, spray when conditions are marginal or during periods of high-risk off-target drift. Until there is a complete spray failure, often the associated issues of poor efficacy and resistance development will continue unless addressed. The hidden cost of less-than-ideal application is a loss of production, particularly when managing fungal leaf diseases. Compromised spray coverage often leads to reduced protection periods. Effective and efficient spraying is a delicate balance.

Correct sprayer set-up and operation

The primary objective when setting up a sprayer is to achieve specific coverage requirements (i.e. water volume and spray quality) based on the crop situation, product mode of action and any drift considerations. This also defines how a sprayer should be operated, such as boom height, spraying speed and application volume to match the environmental conditions. Correct sprayer setup also depends on the spraying system, nozzle type, topography, crop canopy and any stubble loads. ***See GRDC Fact Sheet – In-crop herbicide use***. It is best to choose the coarsest spray quality that will provide efficacy to minimise potential drift issues. A good spray job and spraying efficiency comes back to the right water volume, nozzle set-up and an appropriate spraying speed.

TABLE 2a: Sprayed hectare efficiencies when spraying at 25km/h using a typical batching/filling and ferry times.

Spraying efficiency analysis		Base comparisons for 25 km/h standard working speed							
Operating configuration		Base at 25 km/h	Smaller 30 metre boom	V.Large 48 metre boom	Drive faster 30 km/h	Minimise ferry	Fill faster	Min ferry Fill faster	Low water rate
Boom width	metres	36.0	30.0	48.0	36.0	36.0	36.0	36.0	36.0
Tank size	litres	6100	6100	9000	6100	6100	6100	6100	6100
Work speed	km/h	25	25	25	30	25	25	25	25
Water volume	l/ha	75	75	75	75	75	75	75	60
	ha/load	**81**	**81**	**120**	**81**	**81**	**81**	**81**	**102**
OPERATIONAL TIMES – SUMMARY									
Loading time	min/load	30	30	38	30	30	20	20	30
Ferry time	min/load	15	15	15	15	5	15	5	15
Turning/headlands	min/load	4.4	3.4	5.4	4.4	4.4	4.4	4.4	5.4
Spraying time per load	min/load	54	65	60	45	54	54	54	68
Total spray time for Load	**min/ load**	**104**	**113**	**118**	**95**	**94**	**94**	**84**	**118**
OPERATIONAL EFFICIENCIES									
Loading time	%	29%	26%	32%	32%	32%	21%	24%	25%
Ferry time	%	14%	13%	13%	16%	5%	16%	6%	13%
Turning/headlands	%	4%	3%	5%	5%	5%	5%	5%	5%
Spraying time efficiency	**%**	**52%**	**57%**	**51%**	**48%**	**58%**	**58%**	**65%**	**57%**
Spray area efficiency	**ha/hr**	**47**	**43**	**61**	**52**	**52**	**52**	**58**	**52**
Target: Spray hours per day	hr	9	9	9	9	9	9	9	9
Tankloads per day		5.2	4.8	4.6	5.7	5.8	5.8	6.5	4.6
Spray hectares per day	ha	424	387	547	465	469	469	525	464
Net hectares/day compared with base		0	-37	123	41	45	45	101	40
Target: Tank loads per day		5	5	4	5	5	5	5	5
Time	hours	8.6	9.5	7.9	7.9	7.8	7.8	7.0	9.9
Spray hectares per day	ha	407	407	480	407	407	407	407	508
Net hectares/day compared with base		0	0	73	0	0	0	0	102

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of correct mixing order and allowing sufficient time for dispersion does not change with large pumping capacities and the ability to get a lot of product into a spray tank or batching unit quickly.

The key to mixing efficiency is a good process and good product formulation knowledge. There are many ways to improve mixing efficiencies. Formulations that require time for dispersion – granules, dry flowable (DFs) etc. – can be pre-batched in large handlers prior to filling the sprayer. Flowables, emulsifiable concentrates or aqueous concentrate liquids can be inducted directly into the spray tank. Some operators completely pre-batch tank loads so the sprayer has a minimal stop time. (Reference: GRDC Fact Sheet, Spray mixing requirements.)

Spray efficiency analysis examples

When analysing the spray efficiency of your operations, it is important to be realistic about how long each operation actually takes. Minimum times for the different operations can easily be exceeded, and time lost over a day and actual hectares can be lower than anticipated.

To cater for our different farm scale dynamics and ease of interpretation, this analysis is based on actual grower operations and looks at the main components influencing 'sprayed hectares'.

THE DATA IS PRESENTED IN TWO WAYS AS:

i) a targeted number of sprayed hours in a day which reflects the influences on hectares actually sprayed; and

ii) a targeted number of tank-loads in a day which shows the time required to spray.

The sprayer setup used for this exercise is for good coverage at a medium/coarse spray quality (i.e. knockdowns, small grass targets, grass selectives, post-emergents) based on 75litres/ha.

If targeting summer broadleaf weeds or higher volume foliar in-crop fungicide, a similar process can be applied but with a different spray quality and total application volume.

TABLE 2b: Sprayed hectare efficiencies when spraying at 18 km/h using a typical batching/filling and ferry times.

Spraying efficiency analysis		Base comparisons for 18 km/hr standard working speed							
Operating configuration		Base at 18 km/h	Smaller 30 metre boom	V.Large 48 metre boom	Drive faster 25 km/h	Minimise ferry	Fill faster	Min ferry Fill faster	Low water rate
Boom width	metres	36.0	30.0	48.0	36.0	36.0	36.0	36.0	36.0
Tank size	litres	6100	6100	9000	6100	6100	6100	6100	6100
Work speed	km/hr	18	18	18	25	18	18	18	18
Water volume	l/ha	75	75	75	75	75	75	75	60
	ha/load	**81**	**81**	**120**	**81**	**81**	**81**	**81**	**102**
OPERATIONAL TIMES – SUMMARY									
Loading time	min/load	30	30	38	30	30	20	20	30
Ferry time	min/load	15	15	15	15	5	15	5	15
Turning/headlands	min/load	4.4	3.4	6.4	4.4	4.4	4.4	4.4	5.4
Spraying time per load	min/load	75	90	83	54	75	75	75	94
Total spray time for load	**min/load**	**125**	**139**	**143**	**104**	**115**	**115**	**105**	**145**
OPERATIONAL EFFICIENCIES									
Loading time	%	24%	22%	27%	29%	26%	17%	19%	21%
Ferry time	%	12%	11%	11%	14%	4%	13%	5%	10%
Turning/headlands	%	3%	2%	5%	4%	4%	4%	4%	4%
Spraying time efficiency	**%**	**60%**	**65%**	**58%**	**52%**	**66%**	**66%**	**72%**	**65%**
Spray area efficiency	**ha/hr**	**39**	**35**	**50**	**47**	**43**	**43**	**47**	**42**
Target: Spray hours per day	hr	9	8	9	8	9	9	9	9
Tank loads per day		4.3	3.5	3.8	4.6	4.7	4.7	5.2	3.7
Spray hectares per day	ha	352	281	454	377	383	383	420	380
Net hectares/day compared with base		0	-71	102	25	31	31	67	27
Target: Tankloads per day		5	5	4	5	5	5	5	5
Time	hours	10.4	11.6	9.5	8.6	9.6	9.6	8.7	12.0
Spray hectares per day	ha	407	407	480	407	407	407	407	508
Net hectares/day compared with base		0	0	73	0	0	0	0	102

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The relativite spraying speed, batching/filling and ferry times for a typical spraying operation are presented in Table 2a at 25km/h and Table 2b at 18km/h.

If spraying at 25km/h, implementing a faster fill or minimum ferry time equates to a gain of 45ha per nine-hour spraying day, by combining both a fast fill and minimal ferry gains can be 101ha/day.

If spraying at 18km/h (Table 2b) implementing a faster fill or minimum ferry equates to a gain of 31ha per nine-hour spraying day, by combining both a fast fill and minimal ferry gains can be 67ha/day.

Broadacre base spraying comparisons working at 18 and 25 km/h

Batching and chemical handling units

Chemical handlers have improved significantly in recent years. They are a good investment for speeding up batching and the fill process. Inductors fitted to sprayers have been a limiting factor when using large volumes of dry or granular products. Now there is range of higher-capacity handlers that greatly improve handling large volumes of these products and for pre-batching mixes. These range in price from $2000 up to $12,000+. Medium and smaller farming

operations running tow-behind sprayers that do not have the financial ability to purchase a self-propelled sprayer can gain significant efficacies using a nurse truck and the larger-volume batching equipment for a relatively small spend.

Ferry time to and from a water source to a paddock adds a lot of wasted time. This can be managed with multiple filling points or using a nurse tanker. Purpose-built nurse tankers with batching set-ups are now standard equipment and can be relatively inexpensive to set up.

How best to use handlers

Diligent use of the handlers for dissolving and dispersing dry products and direct induction of liquids into the sprayers' tank gives the quickest fill times. The top-of-the-range handlers give additional spray tank fill pumping capacity of 600 to 1000L/min. A seven-minute saving in fill time for each load/tank for a nine-hour day can save more than an hour and result in 20 to 40 hectares' productivity gain.

The larger batching units with 600 to 1000L tanks and 75mm pumps aid in quicker hydration and better dispersion of granular products. These systems are advantageous when using high rates of DFs and granular fertilisers as it is possible to have a pre-batch agitating while spraying. This way, it can go into the spray tank with minimal water while directly filling the sprayer with water. With an additional labour unit mixing product, whole tankloads can be pre-batched for swift pit stops. The ability to rapidly induce chemicals into a small volume of water can lead to compatibility and dispersion problems so care needs to be taken. Glugs, foam and horrible messes easily occur so care with mixing order and time to disperse is required. (Two 50mm pumps can get rid of glugs and other problems (***see Other Resources – GRDC GrowNotes Module 7: Mixing and decontamination.***)

Safe chemical handling

All handlers have safety features to minimise the risk of direct chemical contact and dust from DF products. Some chemical handlers have separate clean water circuits for rinsing, flushing and sprayer tank filling to avoid contamination.

A Goldacres top of the range batching plant. A number of manufacturers make these high-capacity 'super' batchers.

FREQUENTLY ASKED QUESTION

How quickly can I induct chemical into the sprayer tank or batching plant?

Correct chemical formulation mixing order must be followed; this does not change. With dry or granular products these can be pre-hydrated and dispersed into a smaller water volume in the batcher/handler and then inducted into the sprayer. There still needs to be enough water for complete dispersion. Be careful to avoid adding too many different dry products to a batcher, such as large volumes of ammonium sulfate and DFs. Each product must be completely dissolved and dispersed before additional products are added via the induction into the spray.

OTHER RESOURCES

***GRDC GrowNotes – Spray Application Manual for Grain Growers* – https://grdc.com.au/resources-and-publications/grownotes/technical-manuals/spray-application-manual**

GRDC GrowNotes Module 9: Mixing, filling and transfer systems.

GRDC GrowNotes Module 5: Spray plans – planning for how each product needs to be applied.

MORE INFORMATION

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