Warm and cool season mixed cover cropping for sustainable farming systems in south eastern Australia – seed treatment information sheet

Factors to consider beyond the economic cost of seed treatments

Agrochemicals are commonly applied to seed prior to sowing to protect crops from diseases and invertebrate pests. Use of these seed treatments is increasing as the economic cost decreases, e.g. imidacloprid. Threats to seedlings are thought to be increasing due to novel pests and changes in farming practices. By providing a green bridge, cover crops may increase threats, e.g. turnip yellows virus spread by green peach aphid. The application of fungicides and insecticides to seed is already seen as a cost-effective approach to protect cash crops. Information on the side effects of seed treatments is presented here to help management assess their usage, which may counteract the intended benefits of cover crops.

Grazing withholding periods

Diverse farm enterprises often include livestock. Cover crops can provide a valuable additional source of feed for livestock, along with benefits to soil biology and biodiversity. If cover, or cash, crops are intended for grazing it is vital to consider grazing withholding periods for seed treatments as they can be long (Table 1). Sowing a cover crop including pulses treated with Gaucho® on February rains can not be grazed until July, whereas a monocrop of canola can be grazed late April. Hence, grazing intervals will influence species choice when sowing treated crops for quick feed. Not applying seed treatments allows grazing at any time after sowing.

Non-target impacts on beneficials – insecticides

Insecticides applied to seed to protect seedlings have some residual activity; especially those insecticides registered for use in Australia. Environmental effects can be determined by lethal dosage values based on a 50% probability of death (LD_{50}) of reference species, e.g. imidacloprid 3.7 ng/bee. The amount of Gaucho® seed dressing applied to canola at a 3 kg/ha seeding rate equates to 8.4 g a.i./ha imidacloprid. The amount of imidacloprid applied is an order of magnitude higher on wheat where a seeding rate of 100kg/ha equates to 120 g a.i./ha.

Australia does not undertake baseline environmental residue testing, so the amount of pesticide accumulating in soil is unknown. Increased pesticide usage is known to disrupt beneficial invertebrate communities. Evidence of non-target impacts due to seed treatments is scant. A 2006 Australian study suggested a negative effect of fipronil applied to control termites on soil micro-organisms. Evidence is available for insecticide impacts on natural enemies' ability to limit pests (Table 2).

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Non-target impacts on beneficials – fungicides

Beyond bees and a few long-standing active ingredients (e.g. in Table 2), very little data exists regarding non-target impacts of fungicides on beneficial species. Synergies *may* exist between fungicide and insecticide to the detriment of bees.

To limit the environmental Australia has a stewardship program in place for seed treatments https://www.croplife.org.au/wp-content/uploads/2014/08/CropLife-Seed-Treatment-Stewardship-Strategy-LOW-RES.pdf (accessed 11/4/2020). Given a likely disruption to beneficial species the question is posed: Should pesticides be applied to seed if no yield benefit is observed?

Case study: Canola IPM in SW Victoria

To protect crops, Integrated Pest Management (IPM) is considered a more holistic approach that includes biological, cultural and, lastly, chemical options. On some farms, insecticide and seed treatments are not applied to control red legged earth mite as chemical control is not needed. Only a border spray is applied to canola areas adjacent pasture. IPM is compatible with cover crops where management aims to avoid unstable invertebrate communities by having a diversity of plants growing throughout the year. At present monocultures grown each winter support low numbers of predatory carabid beetles that reduce slugs below damage thresholds. Improving canola establishment has seen seedlings grow faster when less slugs are feeding, reaching 6 leaf stage before wet conditions that favour pest activity. These small changes to agronomic practices have increased damage thresholds:

- time of sowing – shift from May to mid-April into warm soils, i.e. > 15 °C
- new cultivars that allow earlier sowing – longer season, seedling vigour, Roundup Ready
- grading for larger TT OP seed > 2mm = increases canola biomass
- reduce stubble (burning) to increase light interception, warmer soil and reduce damping off
- fungicides that help control *Pythium* etc.
- improved seedbed due to modern seeders – improved depth control, separation of seed
- micro-nutrients with seed and higher rates of N & P placed below the seed
- avoiding herbicides and seed treatments that reduce seedling vigour –
  e.g. replace Jockey (fluquinconazole) with fungicides that don't retard establishment (Fig. 1).

In theory, cover crops provide resources that support increased natural enemy communities that limit pests. Cover crops could provide another management tool as part of a holistic approach to pest control where the negative impacts of seed treatments are avoided.

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Table 1. Grazing withholding periods (weeks) of some commonly applied seed treatments to various crops. Second value in brackets is when grazed for milk production. Blank cells indicate not registered. Nil = Do not graze, I = insecticide, F = fungicide. Data sourced from product labels Apr 2020. Please check individual product labels for specific crop registration and WHPs. *ILeVO® has a slaughter interval of 35 days.

Product		brassica (e.g. canola)	winter cereal (e.g. wheat)	winter grass (e.g. pasture)	winter pulse	sunflower	summer grasses (e.g. sorghum)
Cosmos® or Legion®	I	9				3	5
Poncho© plus	I	8		6			4
Gaucho® 600	I	6	9		16 (bean)		
Senator® 600	I	6	9	6	6 (lupin)		4
Picus®	I	6	9	6	9 (lupin)		4
Hombre® Ultra*	I & F		9				
Pontiac*	I & F		9				
Cruiser®	I & F		8 (350 FS)			Nil (600 FS)	8 (600 FS)
Cruiser® Opti	I & F	6	8				
Foliarflo®*	I & F		5				
Veteran®C* or Vincit®C	I & F		4				
EverGol® Extend	F	6		4			
Jockey® Stayer®	F	8 (12)	6				
ILeVO®*	F	6 (12)					
Impact® Endure	F	4	4				
Maxim® XL	F	6					4
Saltro®	F	8					
Systiva®	F	4					
Vibrance®	F	6					

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Table 2. Products commonly applied as seed treatments and their impacts on beneficials; based on highest application rates registered**.** Scores are based on IOBC (International Organization for Biological and Integrated Control - Pesticides and Beneficial Organisms) ratings that relate to reduction in the tested species' ability to provide pest control, and range from 1 to 4, where 1= harmless < 25%, 2 = 25%-50%, 3 = 50%-75%, 4 = > 75%. Some rates are based on specific references as listed in notes below. LD_{50} values < 2 µ g/ bee are considered toxic, 2-11 moderately toxic, 11-100 slightly toxic and >100 not toxic. Data compiled Mar 2020.

Product example	Active compound	Target	Ants	Ground Beetles	Bugs	Predatory Mites	Wasp	Overall Rating	oral LD_{50} µg/bee
Cosmos®	fipronil 500 g/L	broad	4[a] †	4	ND	4	4	**4**	0.004
Poncho© plus*	Clothianidin 360 g/L	broad	ND	4	ND	ND	ND	**4**	0.004
Gaucho®	Imidacloprid 600 g/L	aphids mites	1[a]- 4†	3[b]	1	3[c]	4[d]	**3**	0.004
Cruiser® FS	thiamethoxam 350 g/L	beetles earwigs	4†	3	ND	2	3	**3**	0.005
Jockey® Stayer®	fluquinconazole 167 g/L	black leg	ND	1	ND	4?	2	**2**	>100
Impact®	flutriafol 250 g/L	black leg	ND	1	1	1	2	**2**	>100
Maxim®	fludioxonil 100 g/L	black leg	ND	1	1	1	4?	**1**	>100
Apron XL	metalaxyl-M 350 g/L	Damping off	ND	1	1	3?	4?	**2**	97.3

Notes: *Poncho© plus also contains 200 g/L imidacloprid, ratings are based on both actives Leslie et al. 2009 Env. Ent. Other references are [a] Wilson *et. al.* 1998 Proc. Australian Cotton Conference, [b]Douglas *et al*., 2014 J. of App. Ecol., [c]Albajes *et al.* 2003 J. of Econ. Ent., [d]Frewin *et al.* 2014 J. of Econ. Ent. 4† has been assigned as registered for control. ND = No Data available. ? indicates initial toxicity test data only.
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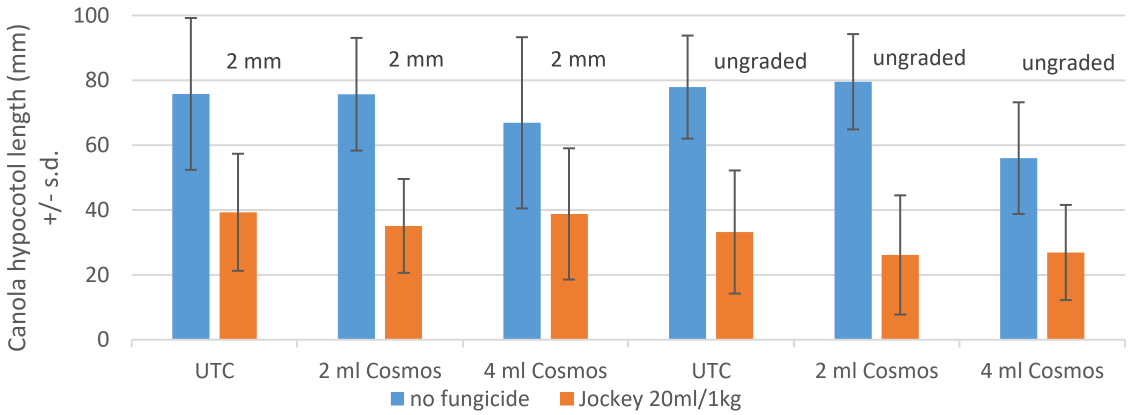

Figure 1. Laboratory experiment (2019) under limited light conditions to test the effects of seed treatments and seed size on hypocotyl growth on germinating Wahoo canola. Labels indicate seed size. The effect of Jockey was significant: $F_{1,108} = 136$ $P < 0.001$.

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