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Weed hygiene practices in NSW: Knowledge and practices of landholders, public land managers, weed contractors and agricultural transport operators

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Weed hygiene practices in NSW: Knowledge and practices of landholders, public land managers, weed contractors and agricultural transport operators

Abstract

Weeds cost the NSW economy over \$1.8 million each year through weed control costs, productivity losses, expenditure by public agencies and value lost due to price responses in agricultural markets (NRC, 2014). Good weed hygiene supports weed control efforts and can prevent weed spread. The importance of weed hygiene is reflected in the plethora of policies and guidelines on weed hygiene practices that exist for different sectors. Despite the presence of numerous weed hygiene guidelines, the 2013 National Landcare Survey (de Hayr, 2013) indicated that very few resources were being expended on weed hygiene; only 11% of agricultural businesses surveyed incurred weed hygiene costs. To date there has been limited research into the extent to which weed hygiene is being undertaken in NSW and the reasons it is or is not being implemented. The aim of this research was to explore the extent to which private landholders, public land managers, weed contractors and agricultural transport operators know about and implement best practice hygiene.

Keywords

public, weed, land, hygiene, managers, contractors, agricultural, transport, operators, practices, nsw, knowledge, landholders

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Authors

Sonia Graham, Nicholas J. Gill, Rebecca Cross, Viveka Simpson, Eli Taylor, and Sarah Rogers

Weed hygiene practices in NSW

Knowledge and practice by private landholders, public land managers, weed contractors and agricultural transport operators

Never Stand Still

Arts & Social Sciences



Project team: Sonia Graham, Nicholas Gill, Rebecca Cross, Viveka Simpson, Eli Taylor and Sarah Rogers

NEW SOUTH WALES
WEEDS ACTION PROGRAM

Weed hygiene practices in NSW: Knowledge and practices of landholders, public land managers, weed contractors and agricultural transport operators

This research project was funded by the NSW Government funding under the NSW Weeds Action Program Innovation Grants 2014-2015.

The research team involves:

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We would like to thank the members of the steering committee for their contributions to the project as well as all the people who participated in the phone interviews, we really appreciate your time.

Associated publications

The following fact sheets provide additional results arising from this project:

- 🌿 Weed hygiene practices in NSW: Private landholders' success stories
- 🌿 Weed hygiene practices in NSW: Public land managers' success stories
- 🌿 Weed hygiene practices in NSW: Weed contractors' success stories
- 🌿 Weed hygiene practices in NSW: Agricultural transport operators' success stories
- 🌿 Weed hygiene practices in NSW: Recommendations for future research

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EXECUTIVE SUMMARY

INTRODUCTION

Weed hygiene supports weed control efforts and prevents the spread of weeds.

Weed management guidelines emphasize the importance of weed hygiene. However, little is known about the weed hygiene knowledge and practices among private landholders, public land managers, weed contractors and agricultural transport companies in NSW.

This research explores the extent to which these key weed management stakeholders know about and implement weed hygiene practices.

METHODS

Telephone interviews were conducted with 54 individuals: private landholders (17), public land managers (15), weed contractors (12) and agricultural transport operators (10).

Interviews comprised open and closed response questions about weed hygiene practices and motivations. The questions were based on a list of weed hygiene best practices compiled from existing industry policies and guidelines (Appendix E). Closed response questions asked about knowledge and implementation of best practices to establish the state of weed hygiene in NSW.

This report presents responses to the closed response questions, some open responses have been provided for additional context.

WEED HYGIENE PRACTICES IN NSW:

The most widely implemented practices across all respondents were:

- Use wash bays to wash down vehicles
- Use wash bays to wash down machinery
- Check all machinery and equipment is clean and dry before a job
- Provision of weed identification for staff (public land managers and weed contractors)

The practices that were least likely to be implemented were:

- Use wash baths to wash down boots, clothing, and hand-held tools
- Include a weed hygiene clause in contracts
- Train staff in weed hygiene with the exception of public land managers.

Private landholders (17 interviews):

All landholders reported weed problems and currently undertake weed management activities on their land.

Knowledge: Private landholders were knowledgeable about the weed hygiene practices mentioned (Appendix A), with the exception of: restricting access to the farm (9 did not know); avoiding vehicle and machinery movements during wet periods (7 did not know); and use of wash baths (6 did not know).

Implementation: Private landholders were most likely to implement the following weed hygiene practices: wash bays for machinery (11 always or very often), cleaning borrowed equipment (10 always or very often), minimising lending and borrowing of equipment (10 always or very often) and provide weed hygiene supplies for personnel (10 always or very often). Graziers and croppers frequently requested vendor declarations for new stock and bought seed, respectively.

Public land managers (15 interviews):

Almost all (14) public land managers interviewed believed weed hygiene is important for their organization. Most public land managers used a combination of in-house resources and contractors for their weed control work. For those who use contractors, weed hygiene was an important consideration in their choice of contractors.

Knowledge: Public land managers were highly knowledgeable about weed hygiene practices.

Implementation: Overall, public land managers were more likely to implement a range of weed hygiene practices when conducting weed control work in-house than when outsourcing work to contractors. For both in-house and outsourced work, public land managers were most likely to provide weed identification guides to staff (13 always or very often) and contractors (11 always or very often).

Weed contractors (12 interviews):

Almost all (11) weed contractors interviewed believed weed hygiene is important for their organization. The majority (7) of weed contractors were from small companies (less than 10 employees). Weed contractors typically undertook weed management work for public land managers and farmers.

Knowledge: Weed contractors were knowledgeable about the range of weed hygiene practices mentioned, with the exception of weed hygiene clauses in contracts (3 did not know) and the avoidance of felt-soled boots and waders in waterways (4 did not know).

Implementation: The most commonly implemented practices included: use of wash bays for machinery (7 always), use of wash bays for vehicles (6 always), checks to ensure machinery is free of debris and dry before use (10 always or very often) and the provision of weed identification guides (10 always).

Agricultural transport operators (10 interviews):

Half of the agricultural transport operators interviewed indicated that they did not think weed hygiene was important for their businesses; the majority indicated that land managers did not request weed hygiene standards or activities.

Knowledge: Agricultural transport operators had limited knowledge of weed hygiene practices, with the exception of using wash bays for vehicles (9 know) and checks to ensure machinery is free of debris and dry (8 know). The inclusion of a weed hygiene clause in contracts was the least well known practice (7 did not know).

Implementation: Agricultural transport operators implemented few weed hygiene practices with the exception of: implementation of wash bays for vehicles (8 always or very often) and checks to ensure machinery is free of debris and dry (7 always or very often).

CONCLUDING REMARKS

There was a high level of awareness of weed hygiene practices among private landholders, public land managers and weed contractors, but limited knowledge among the agricultural transport operators interviewed. Implementation of weed practices was not always consistent with the level of knowledge and awareness. When weed hygiene practices were implemented it was often for non-hygiene reasons, such as maintaining machinery in good working order. Weed hygiene practices were often not undertaken because these practices are seen to be too time consuming and costly to implement compared to their perceived benefits.

INTRODUCTION

Weeds cost the NSW economy over \$1.8 million each year through weed control costs, productivity losses, expenditure by public agencies and value lost due to price responses in agricultural markets (NRC, 2014).

Good weed hygiene supports weed control efforts and can prevent weed spread. The importance of weed hygiene is reflected in the plethora of policies and guidelines on weed hygiene practices that exist for different sectors.

Despite the presence of numerous weed hygiene guidelines, the 2013 National Landcare Survey (de Hayr, 2013) indicated that very few resources were being expended on weed hygiene; only 11% of agricultural businesses surveyed incurred weed hygiene costs. To date there has been limited research into the extent to which weed hygiene is being undertaken in NSW and the reasons it is or is not being implemented.

The aim of this research was to explore the extent to which private landholders, public land managers, weed contractors and agricultural transport operators know about and implement best practice hygiene.

METHODS

Telephone interviews with 54 stakeholders were conducted between November 2015 and March 2016 with private landholders (17), public land managers (15), weed contractors (12) and agricultural transport operators (10). Respondents were asked a series of open and closed response questions about their views on weeds, weed control and weed hygiene. Specific questions were asked to benchmark weed hygiene knowledge and practice. These weed-hygiene specific questions were based on a list of weed hygiene best practices compiled from existing industry policies and guidelines (Appendix E). Appendices A - D contain details of the practices raised with each type of respondent.

For each weed hygiene practice, participants were asked if they knew about the practice and how often they implemented it. The response from each respondent type is presented next. Data from the closed-ended questions regarding weed hygiene practices is contextualized and enriched by the inclusion of data drawn from the open-ended questions. The final section of the report compares responses from each respondent type.

DATA ANALYSIS

The data presented focuses on frequency counts because of the small number of respondents in each category. Percentages are only used to present data that compared responses across each respondent type (in the last section of the report). In instances where respondents did not answer specific questions missing data are omitted from the analysis.

PRIVATE LANDHOLDERS

BACKGROUND:

Seventeen private landholders were interviewed from across NSW.

Just over half of the private landholders interviewed owned or operated properties between 100 and 500 ha, and over one quarter operated properties larger than 500ha (Figure 1). The dominant enterprise types were grazing, mixed enterprises and dairy (Figure 2).

All private landholders indicated that they had a problem with weeds on their property and that they were engaged in weed control activities (including traditional activities such as spot spraying, slashing and manual clearing as well as strategic grazing, pasture improvement and crop rotation).

While over half (9) of the private landholders indicated that they thought weed hygiene was an important part of weed management, almost half (7) indicated that they did not undertake weed hygiene practices on their land.

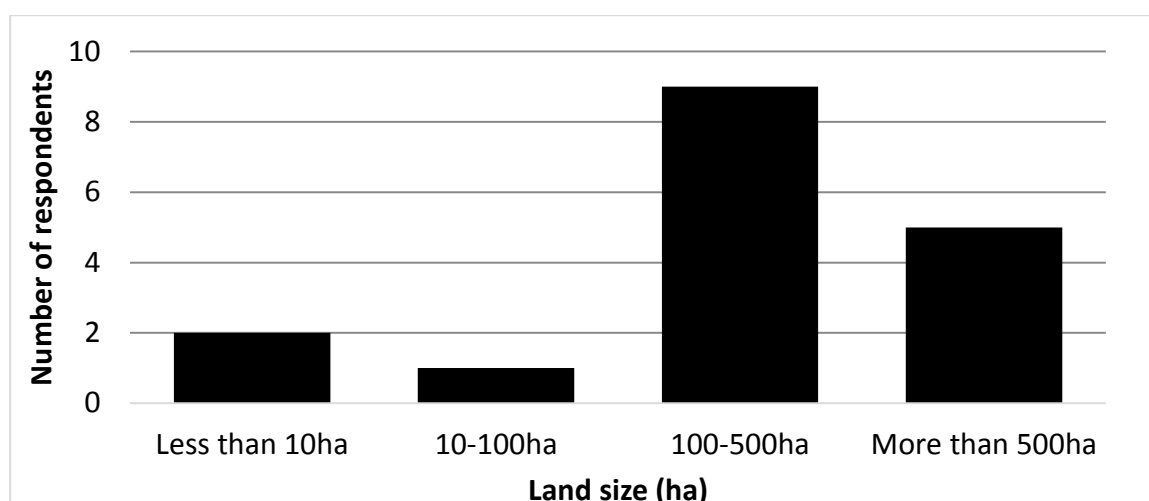


Figure 1. Size of land owned by private landholders interviewed.

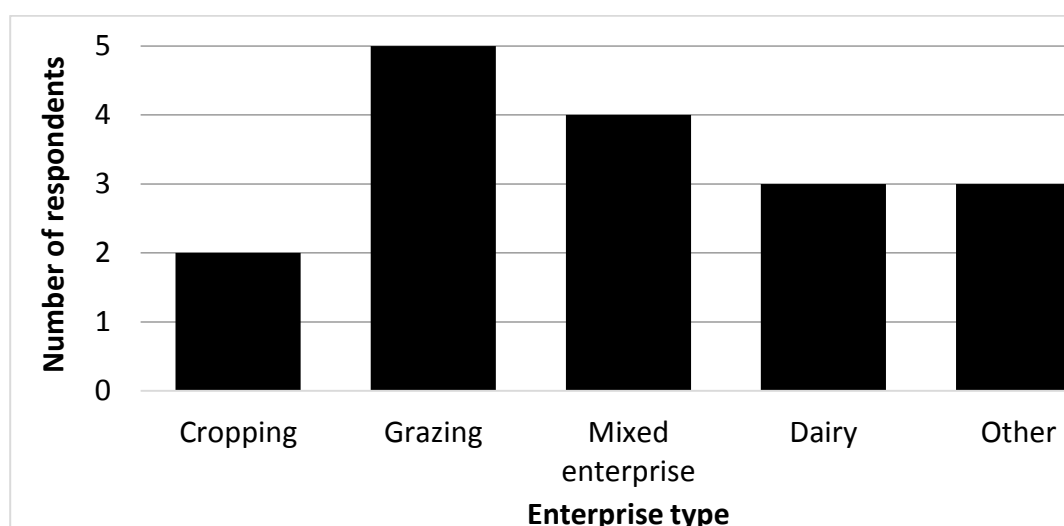


Figure 2. Private landholder – type of enterprise operated by private land holders interviewed.

KNOWLEDGE OF WEED HYGIENE PRACTICES

Most private landholders interviewed were knowledgeable about most of the weed hygiene practices mentioned during interviews (Figure 3). A number of the weed hygiene guidelines were deemed non-applicable by private landholders, particularly in regard to the purchasing of inputs on farms. This reflects the diversity of the production systems investigated. For example, businesses that solely bred livestock or bought young calves did not engage with practices associated with quarantining new stock to 'empty' out digested weed seed. Some graziers relied solely on pasture feed and did not purchase stock feed. Similarly, some croppers graded and sowed their own seed.

Most well-known practices for private landholders

Using wash bays to wash down machinery and vehicles was recognised as a weed hygiene practice by 14 and 13 private landholders, respectively. However, many private landholders indicated that they washed machinery and vehicles for maintenance reasons, with weed hygiene being a secondary benefit:

"Cleaning machinery... I guess to some extent it would be [for weed hygiene] but only minimally" (Interviewee 40)

"We wash down vehicles but not because of hygiene... just to keep them clean and just to keep them tidy" (Interviewee 42)

"Not for a weed reason, more for...maintenance" (Interviewee 45)

Minimising the lending and borrowing of equipment was also a well-known weed hygiene practice with 13 private land holders indicating awareness of the practice.

Least well-known practices for private landholders

The practice of restricting farm access to limit introduction of weed species was not recognised as a weed hygiene practice (9 did not know). Many private landholders indicated that they restricted farm access for other reasons:

"I do [restrict access] to other people and I'm not aware that that's the requirement but I do that anyway because [of] insurances" (Interviewee 12)

"Restricting access is more from a security point of view, I'd say, rather than from a weeds point of view" (Interviewee 28)

"I'd restrict access as a safety thing but not considering about weed hygiene" (Interviewee 45)

"We do it [restrict access] by default. I probably don't openly consider it but all the properties would have minimal access." (Interviewee 26)

Avoiding movements of machinery and vehicles while the ground is muddy was not well-known (7 did not know). Some private landholders explained that they avoided movements during muddy periods to avoid bogging machinery and vehicles rather than for weed hygiene. Finally, the use of wash baths to clean personal equipment, boots and clothes was not well-known (6 did not know) or was deemed to be not applicable (5 landholders).

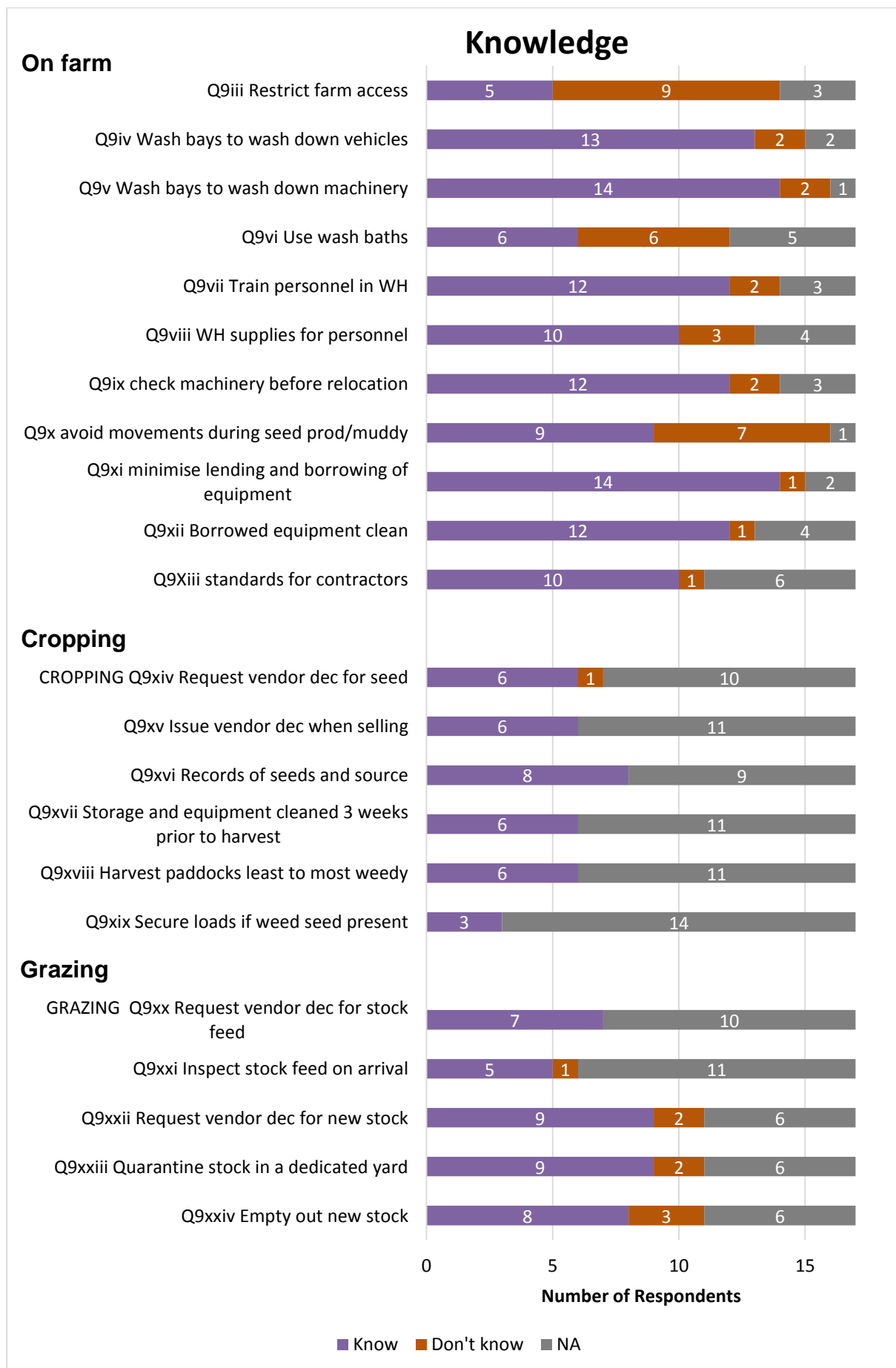


Figure 3. Private landholders - knowledge of weed hygiene practices

IMPLEMENTATION OF WEED HYGIENE PRACTICES

The least well-known weed hygiene practices were also the least likely to be implemented by private landholders (Figure 4). However, knowledge of weed hygiene guidelines and practices did not necessarily mean that private landholders implemented those practices.

Most implemented practices by private landholders

The use of wash bays to wash down machinery was the most implemented weed hygiene guideline, twelve private landholders routinely (12 always or very often) implemented the practice. This was in line with the reported knowledge of the practice.

While most landholders implemented this practice, croppers specifically mentioned the need to clean certain machinery, namely headers and seeders:

“[Machinery is] cleaned on a regular basis... the head is all cleaned down after the winter cereals, and cleaned down after the summer program.” (Interviewee 42)

The following croppers explain that machinery is blown down instead of being washed:

“If we know we’ve got a trouble weed somewhere we will blow our gear off as we shift paddocks with the air compressor. Our header gets blown down every morning... we actually have a property [elsewhere] where we share a harvester, so the header is thoroughly cleaned before it comes up and it’s stripped down and cleaned before it goes back... we’ll pull the sibs out and blow it out with an air compressor and take all guards off and then we’ll give it a wash” (Interviewee 45)

“The machine gets washed after each planting and it’s put away so it’s cleaned out. And then every time we swap seeds over, well it doesn’t actually get washed but it gets cleaned out, like cleaned right out.” (Interviewee 43)

Landholders also discussed the need to wash machinery during relocations:

“The actual cleaning of machinery would be undertaken more so than not from one property to a next property. So depending on the harvest period it could be every couple of days to go through that process.” (Interviewee 47)

“[We wash machinery] on a needs basis, as things happen as far as cropping goes. Washing machinery, it’s when you go into paddocks and you load and receive cattle.” (Interviewee 26)

Private landholders also washed down vehicles (10 always or very often), but to a lesser extent than machinery.

“You do wash down the vehicles... particularly when barley grass is in season... wash the front of ute... Anywhere where it grabs and you’re trying to lessen the spread of it.” (Interviewee 16)

While most private landholders washed or cleaned down machinery and/or vehicles, most explained that their ‘wash bay’ was just a spot where they commonly hosed down machinery, vehicles and equipment.

“Well it’s probably not a wash bay but it’s an area by our shed where we always wash. It’s on a granite – like it’s not on dirt, it’s on a hard granite base, so nothing grows there. So we tend to just wash everything there” (Interviewee 45)

“I use the dairy yard, which is probably not ideal.” (Interviewee 7)

“You wouldn’t sort of I suppose call it a wash bay... that’s washed down near a shed so those weeds are sort of controlled around that shed.” (Interviewee 43)

“We have a hose next to the shed that’s like a big industrial type hose and vehicles do get washed down there, it’s just not something that we do as a regular practice, which we should.” (Interviewee 29)

As the previous quote indicates, some landholders did not implement this practice consistently, while for others, this practice had become a habit;

“We’re able to take the machinery back to our wash bay and just clean it down at our wash bay so it’s not a – it can be time consuming but once you get into the habit of doing it it’s pretty good.” (Interviewee 51)

Other commonly implemented practices involved requesting or being supplied with a vendor declaration for new stock (grazing enterprises) and maintaining records of seeds and their source (cropping enterprises). This is common practice and a legal requirement for moving stock, often for the purposes of disease and quality control rather than weed hygiene (by comparison, in Queensland a specific ‘weed hygiene declaration’ is deployed).

Landholders explained that they purchased inputs from reputable sources as a strategy to avoid weed and disease contamination. Previous experiences with contaminated hay motivated vigilance among two landholders in particular:

“The 1984 drought was when we had to really start introducing protocols into the weed content of our introduced fodder. Yes we certainly do [inspect feed] because we have had imported hay with exotic weeds for our area. It had Patterson’s curse and saffron thistles and spear grass.” (Interviewee 40)

“I’m very careful about selecting where I get my hays from because you often get Bathurst burr or something else that’s undesirable... [I] bought some hay ages ago and you know what I got out of it was poison [Hemlock].” (Interviewee 12)

More than half of the private landholders minimized the borrowing and lending of equipment between properties (7 always, 3 very often). More than half of the landholders also reported that borrowed equipment was cleaned before and after use (6 always, 4 very often). Some landholders explained that this was implemented more as a common courtesy rather than for weed hygiene purposes.

Least implemented practices by private landholders

Most (12) landholders were aware of the need to clean machinery before relocation but only six landholders regularly (5 always, 1 sometimes) implemented this practice. Some explained that relocations only occurred between their own properties and so they did not deem this practice necessary.

Putting in place weed hygiene standards for contractors was also well known (10) or not applicable (6) but inconsistently implemented (3 always, 1 sometimes). The following landholders explained their reluctance to implement this practice:

“If you said to a contractor I want you to wash down before you come, he’d go ‘listen [mate], I’m so busy I haven’t got time to be doing that. You either want me to come and do it or not’.” (Interviewee 41)

“I’m lucky enough to just get the operation ticking over and if I get a contractor on site I’m thrilled to see them and I’m not going to start... going you [can’t] do that, you have to do this... so there might even be a bit of peer pressure... when you’ve got front up and meet that local contractor at the school [parents] association... the tennis club or whatever you’re into... it’s a small community thing.” (Interviewee 52)

The use of wash baths was never implemented by the majority of landholders (15). The following landholder explains why:

“I like the idea of dipping your feet in a wash before you come on a farm... But I don’t want to do it here because I don’t want to poison my dogs.” (Interviewee 30)

Additional weed hygiene practices used by private landholders

Private landholders, specifically graziers, mentioned managing livestock movements as an additional weed hygiene practice that they implemented. This practice was not included in the interview checklist.

“Probably the only other one I think is limit stock movement in and out of bad areas, particularly with Parramatta grass or if it’s a paddock that’s got it in there in it. I mainly do paddocks that have Parramatta grass all together and then usually have a spray system in the yard to actually – somewhere where you can wet the cows down and wash any excess seeds off, wash them off them before they go to other areas.” (Interviewee 7)

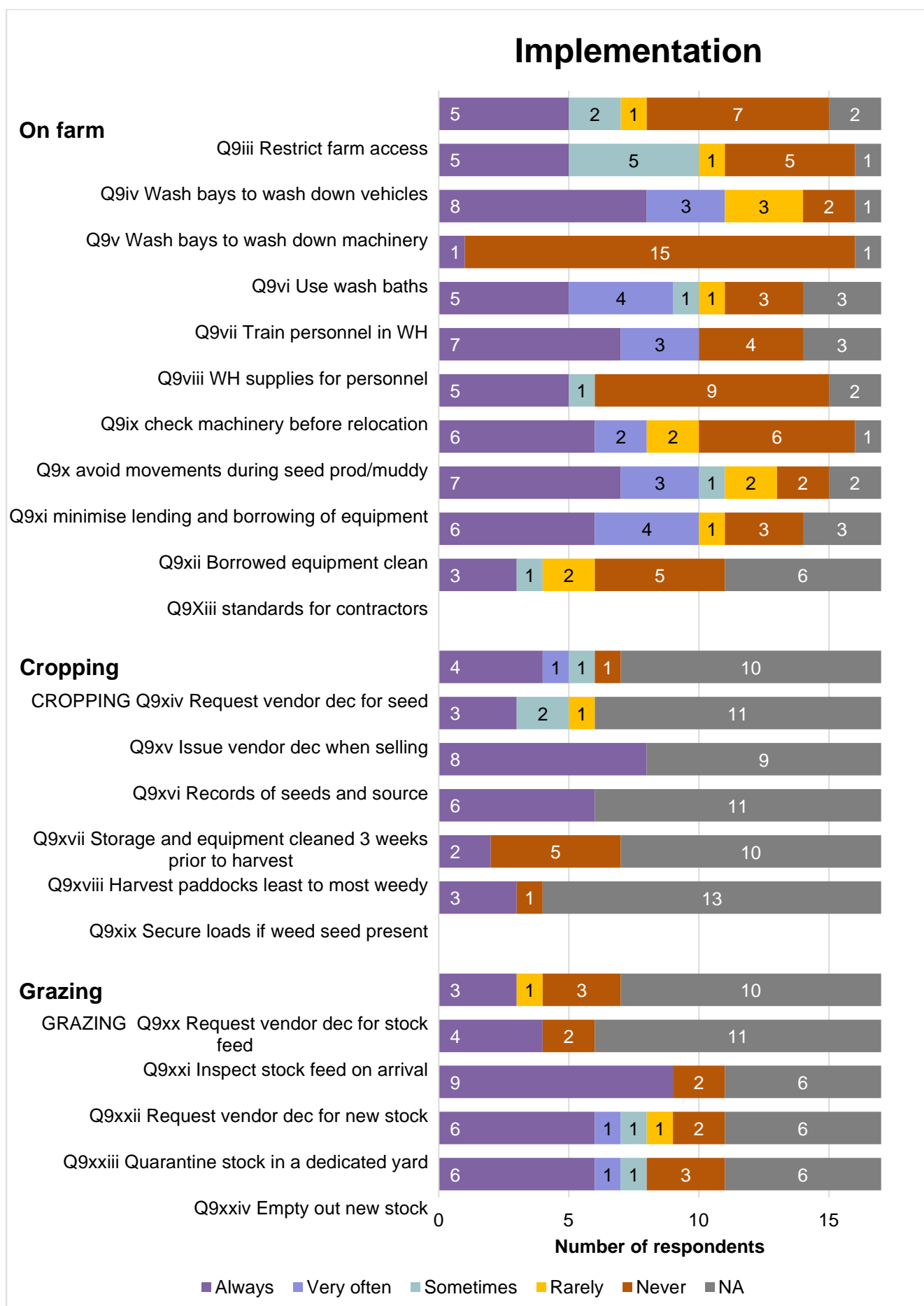


Figure 4. Private landholders - implementation of weed hygiene guidelines and practices
NSW Weed Hygiene Knowledge and Practices

PUBLIC LAND MANAGERS

BACKGROUND

Public land managers (mostly comprising local government weed officers as well as some park managers) typically employed a mix of in-house resources and contractors to carry out weed control (Figure 5). Almost all public land managers reported that weed hygiene was an important consideration in contractor choice.

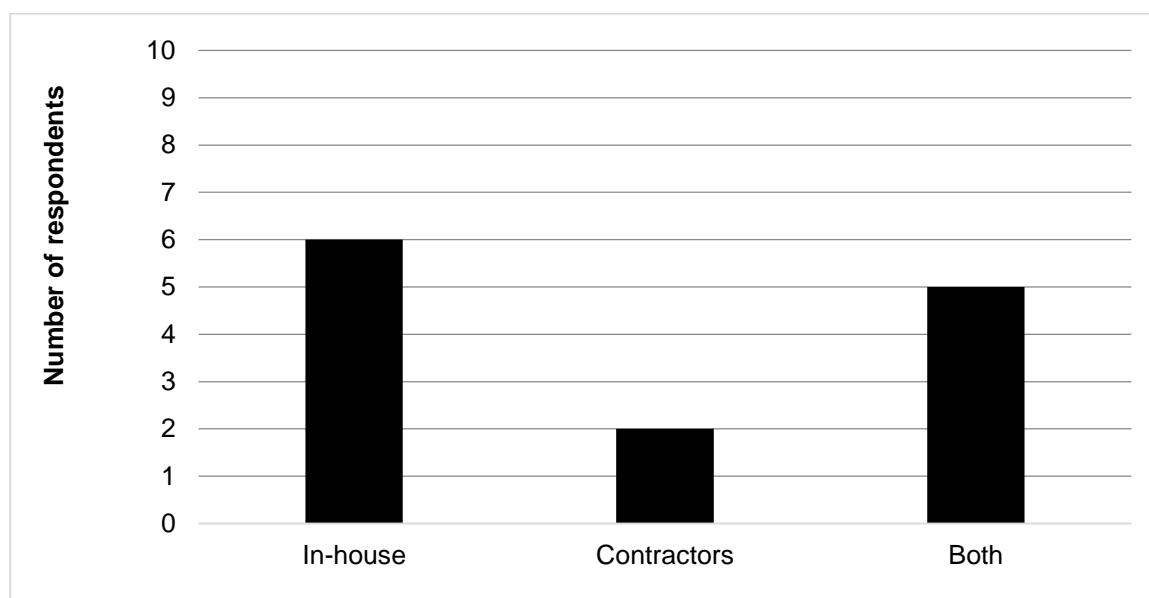


Figure 5. Public land managers - who carries out the majority of weed control work

Interviews were conducted with 15 public land managers; however not all land managers answered each question, where this occurred the actual respondent number has been specified in the figures.

KNOWLEDGE OF WEED HYGIENE PRACTICES

The 15 public land managers interviewed were generally aware of all the recommended weed hygiene practices that apply to in-house staff and external contractors (Figure 6). This was also reflected in their open-ended responses where they demonstrated a holistic understanding of weed hygiene. For example, one public land manager explained:

“The following points are incorporated in the contracts. They [contractors] must demonstrate high or how high levels of machine hygiene will be maintained, in other words, submit a vehicle hygiene plan with a tender... Machinery must be cleaned prior to and after entering the designated areas - that would be infestation zones or private properties. Contractors must undertake clean downs at nominated points around roadsides where it is - and they're all specified within the contract. Must provide proof of clean down procedures, i.e. bag clean material left at nominated sites if required - generally what I do is if it's there on the ground there, it stays on the ground there. Contractors must gradually work from clean areas to infested areas - that's one of the big changes we made. So for instance, if we're doing table drains, we work from the outside into the infested area and the infested area is done last. Lastly it says, contractors must be able to identify Chilean needle grass.” (Interviewee 17)

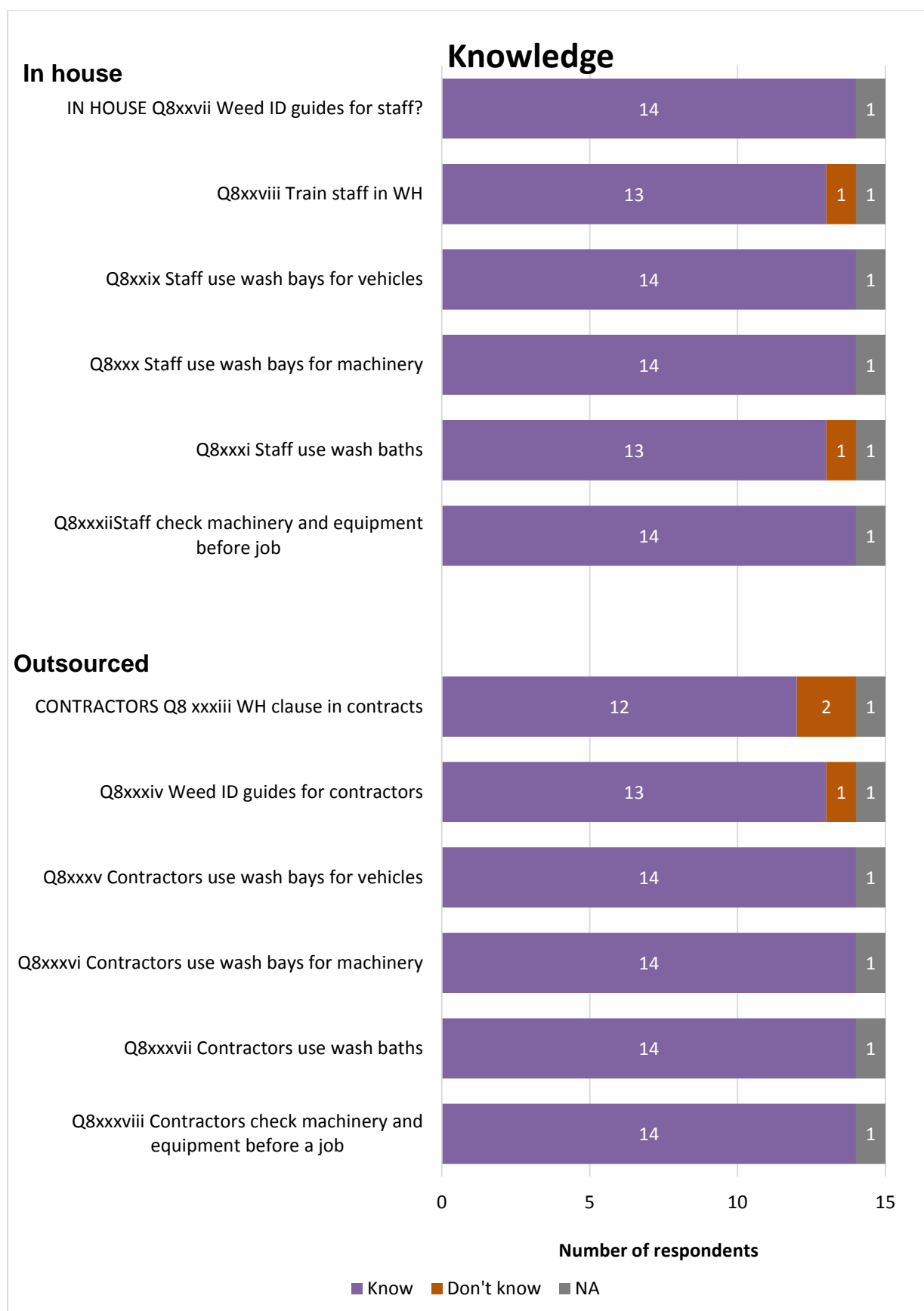


Figure 6. Public land managers - knowledge of weed hygiene guidelines and practices

IMPLEMENTATION OF WEED HYGIENE PRACTICES

The implementation of weed hygiene practices by public land managers is shown in Figure 7. As per private landholders, knowledge of weed hygiene practices does not always translate into practice implementation (as can be seen by comparing Figures 6 and 7).

Most implemented practices by public land managers

The most commonly implemented practices were the provision of weed identification guides for staff (13 always or very often) and to contractors (11 always or very often). Making weed identification guides available to on-ground weed controllers was a long-term practice amongst public land managers:

“[Staff have] always got all the brochures and the DPI bag facts and stuff. They’ve got a little folder in their vehicles so they have access to all of that and if we ever come across anything new, you know, source some brochures or factsheets on that particular weed, and they have them in their vehicles because they also keep a stock to give out to landholders as well so they’re both for their reference as well as the landholders” (Interviewee 5)

“We provide them [contractors] with all the weed ID information they’ll need for everything that they’re likely to encounter on that site and... if we didn’t believe they had sort of 99 percent weed ID skills for that area, we wouldn’t employ them there” (Interviewee 2)

Additionally, public land managers regularly (8 always, 2 very often) implemented checks of their own machinery and equipment prior to commencing a job. Public land managers also explained that often they checked machinery and equipment *after* a job so that they were ready for the next job, as opposed to just checking machinery/equipment *before* a job.

Least implemented practices by public land managers

Public land managers had excellent knowledge of weed hygiene practices overall but infrequently required the practices be implemented by contractors. Responses indicated that public land managers infrequently required contractors to: use of wash baths (8 never and 1 rarely), wash bays for vehicles (8 never) and wash bays for machinery (7 never).

Lack of weed hygiene requirements for contractors is a reflection of the lack of weed hygiene included in formal contracts. The following public land manager explained his reluctance to enforce any conditions on his contractors:

“What actually happens is if we make our provisions too onerous we don’t get the contractor’s return work. They say ‘why should I do all these things for the money that you want to pay me when I can go onto the farmer’s place and do the same but without all your restrictions’.” (Interviewee 36)

Instead some public land managers explained that they rely on ‘tool-box talks’ or verbal agreements. The weed hygiene practices discussed with contractors depended on the size or type of the job and the weed/s being dealt with:

“we do subcontracting for some alligator weed work where they use a boat, so we’ll talk to them about making sure that they clean their machinery and equipment down

before they go off site, particularly when contractors are doing some work on properties either for us or even on private property. If I know a contractor is doing some work, you know, if it's giant Parramatta grass or something like that, we'll request that they do some clean down before they – if they're moving from an infested area into a clean area.” (Interviewee 46)

Most public land managers cited a lack of time and staff or other impracticalities associated with ensuring contractors complied with these requirements:

“Unfortunately we're not always there to make sure that they do it. That's one of the things, that it's fine to have some sort of policy in place but unless you're there, you don't know whether they're doing it... time and resources [constrain compliance] particularly when you're dealing with contractors, you've got a little bit of oversight and make sure that they are doing the right thing. But we've also got inspections and all this other work that we need to do and there's only really two of us covering the whole area so we're not flush with resources where we can have someone sort of go out and check that Joe Smith has done his machinery at the end of the day... a lot of it does rely on voluntary adherence to the policy.” (Interviewee 5)

With regard to in-house weed hygiene practices, 14 public land managers indicated that they knew about wash baths for boots, clothing and hand-held tools, but only 5 public land managers regularly implemented the practice (2 always, 3 very often). While the use of wash baths was limited, public land managers described other methods they used to decontaminate clothing:

“We're not really doing it [using wash baths], I mean we started being legitimately conscious of if you're picking up weed seeds on your clothing because it sticks to your clothing to remove them before you leave the site... the staff are pretty good on that side of things but then when it comes to cleaning mud off boots and tools, that's something that we really need moving on. I mean the gloves we wash every so often because – we'll have a volunteer where we'll have 30 or 40 volunteers come in and give them all gloves and they use them and then at the end of the day we collect them back and they all go in the washing machine to get washed.” (Interviewee 20)

One public land manager described having a spare set of boots, which negated the need for a wash bath.

Additional weed hygiene practices used by public land managers

Public land managers implemented a number of practices that were not included in the interview checklist. For example, one public land manager described conducting walking inspections of properties to limit the spread of weeds by vehicles.

“[When] doing property inspections my mantra is ‘don't ever drive through Giant Parramatta grass’ because... I do all walking inspections [instead]. I drive to the house so they know I'm there to help them and then I'll walk around the properties.” (Interviewee 2)

Although the majority of public land managers used wash bays to clean vehicles and machinery (see Figure 7), those who did not use wash bays explained their practice of on-site cleaning:

“So we can clean equipment but if it’s onsite there’s the ability for field staff to have maintenance equipment they can quickly blow down or they can quickly use the pump with water and hose down plant and equipment before they leave a site but it’s leaving that seed load at the site, so to be marked as a future infestation point” (Interviewee 36)

“We’re quite cognizant of the fact that as inspectors as well we do have the potential to move weed seed across the landscape fairly widely. So what we do is ... [we] both have spray units so we usually fill up you know, if we’re going to a property and know it’s got a heavy loads of fireweed we’re going to be driving through that fireweed. And when we’ve filled up the tanks to our truck just with pure water and then at the farm gate we wash our vehicles down.” (Interviewee 3)

“Salvinia, which an aquatic, when we remove booms or canoes etcetera they’re always clean down before you leave the site.” (Interviewee 2)

Many public land managers also discussed adapting weed hygiene practices to the type of weed they were dealing with, the season and the level of potential contamination on clothes and vehicles/machinery:

“In our context for our shire, our council area, a wash bay wouldn’t serve much purpose in weed hygiene for us because we don’t have those types of weeds here. Like we don’t have the types that will sort of just be sticking underneath the vehicle if you like... Spiny burrgrass is about the only one that we would accidentally drive through a bit and we’d have to manually remove it. Like a pressure cleaner probably wouldn’t even take them off. We’ve got to scrape them off” (Interviewee 13)

Finally, some public land managers mentioned the Red Guidepost Strategy – an initiative of the Eastern and Western Riverina Noxious Weeds Advisory Groups and other local agencies – a tool for visually marking the ‘start’ and ‘end’ of roadside weed infestations. The following public land managers described the facility of these guideposts with regards to communicating weed hygiene to council roadside slashers and travelers:

“They put in place a Red Guide Post Scheme and they put that all up and down the highways and byways out that way so their slasher operators are moving along a road corridor, they stop at one red guide post and they lift their decks up, they move through that area without slashing then they put their decks back down again at the next red guide post.” (Interviewee 3)

“When [council slashers] are working, like they do have to do work in the red zone, we go out and we’ll have a good look around the area they’re working in. Establish turning points for them that are placed. Mark those for them as well. So they can carry on with their work and be able to turn their vehicles without driving through infestation. Try to make sure that is a continuous practice in the council... It’s where there’s been weed incursions along roadside and we don’t really want people working there or people pulling off the road there.” (Interviewee 13)



Figure 7. Public land managers - implementation of weed hygiene guidelines and practices

WEED CONTRACTORS

BACKGROUND

Half (6) of the weed contractors interviewed typically worked in businesses with between 1-5 employees (Figure 8). Four weed contractors indicated that contracting was only one part of their business. Some of these contractors worked in businesses that employed at upwards of 20 employees.

Weed contractors interviewed were typically owner operators, owners or managers of their respective weed contracting business. Weed contractors indicated that they typically worked for public institutions land managers and farmers.

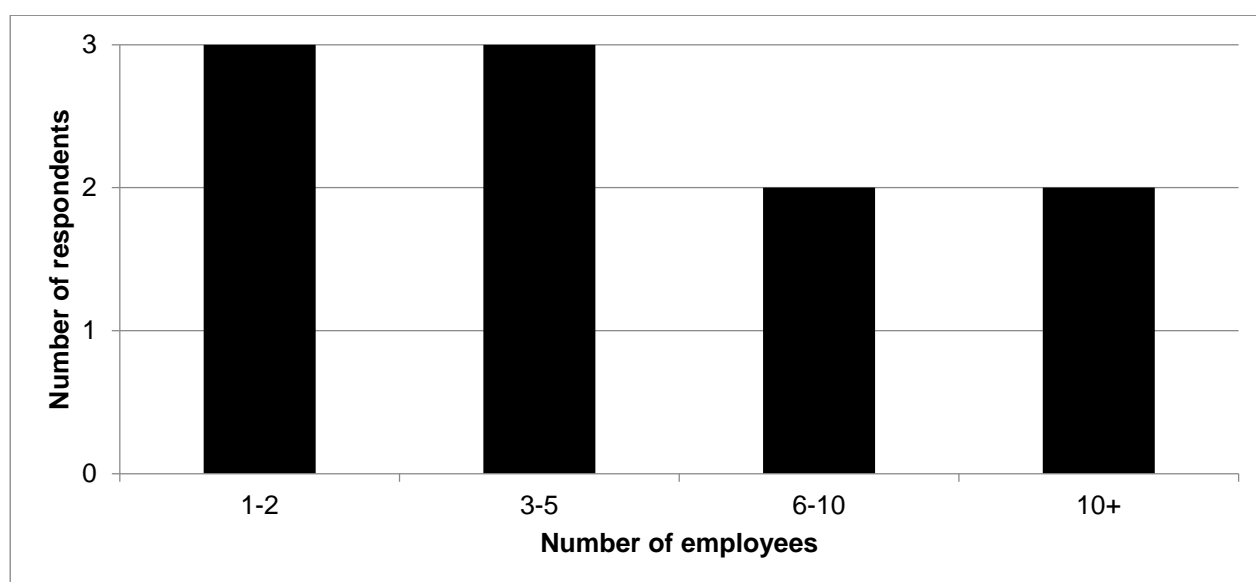


Figure 8. Weed contractors - number of staff in their business. Note: two weed contractors did not report the size of the businesses that they work for.

Interviews were conducted with 12 weed contractors; however in some cases not all respondents answered each question. Where this occurred the relevant number of respondents has been specified in the figures.

KNOWLEDGE OF WEED HYGIENE PRACTICES

Weed contractors were knowledgeable about the range of weed hygiene practices mentioned during the interviews, particularly those that pertained to in-house and on-farm practices (Figure 9). Knowledge of practices associated with roadsides and waterways was slightly lower by comparison; the least well known practice was the avoidance of felt-soled boots and waders (4 did not know). Three weed contractors indicated that they did not know about the inclusion of weed hygiene clauses in contracts.

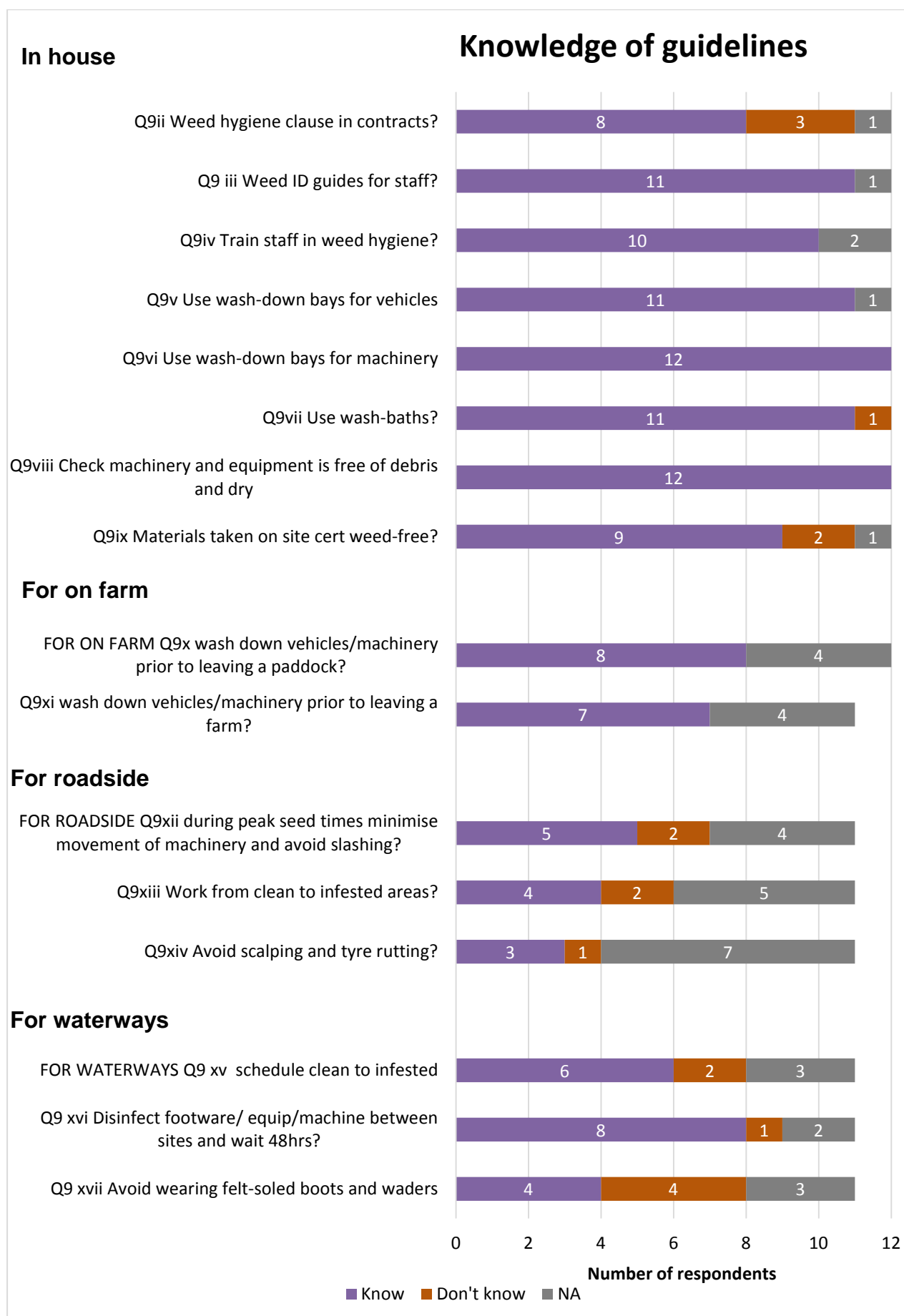


Figure 9. Weed contractors - knowledge of weed hygiene guidelines and practices

IMPLEMENTATION OF WEED HYGIENE PRACTICES

Despite being knowledgeable about weed hygiene guidelines and practices, weed contractors' implementation of these practices was less consistent (Figure 10).

Most implemented practices by weed contractors

Weed contractors' knowledge about weed hygiene practices involving the washing of machinery and vehicles was matched by implementation; the use of wash bays for machinery (7 always, 2 sometimes) and vehicles (6 always, 2 sometimes) was frequently implemented by weed contractors.

"Everything's washed down or sprayed down or blow down at the end of every day depending on the job that they're doing and then it gets a thorough clean at the end of every week, again depending on what they're doing" (Interviewee 21)

"all you can do is try and wash down your trucks when you leave a job. I did St John's wort yesterday and there's only a little bit of St John's wort in the shire here... There's no facility to wash the truck down there so I've got to drive straight from there straight over to a treatment plant which is only a kilometre and wash it out there" (Interviewee 6)

"We do try and wash the cars down as much as possible and we do encourage the guys to getting mud or dirt out of their feet – out of their boots" (Interviewee 31)

Similarly, the practice of checking machinery and equipment is free of debris and dry before use is consistently implemented (10 always or very often):

"[I] make sure it's [the trucks] all good before I go to any other jobs. I'd feel guilty if I dragged something to someone else's property" (Interviewee 6)

Finally, providing staff with weed identification guides was consistently implemented (8 always, 2 sometimes).

"We've got all plant identification books and if there's something we don't know we'll look it up and see what it is" (Interviewee 4)

"It's an expectation when we employ people that they've got very good skills of weed identification because it's critical to the job but whenever there's a new weed or something comes out from council or authorities I always have it available. I send it out on email to all staff" (Interviewee 23)

Least implemented practices by weed contractors

The practice of ensuring that all materials taken onto a site are certified free of weeds was infrequently implemented (1 rarely and 5 rarely), despite 9 weed contractors indicating that they knew about the practice. Similarly, the practice of using wash baths for footwear, clothing and hand-held tools was infrequently implemented (5 rarely, 1 never).

The inclusion of a weed hygiene clause in contracts was not frequently implemented (1 rarely and 5 never), reflecting the relative lack of knowledge of the practice (Figure 9).

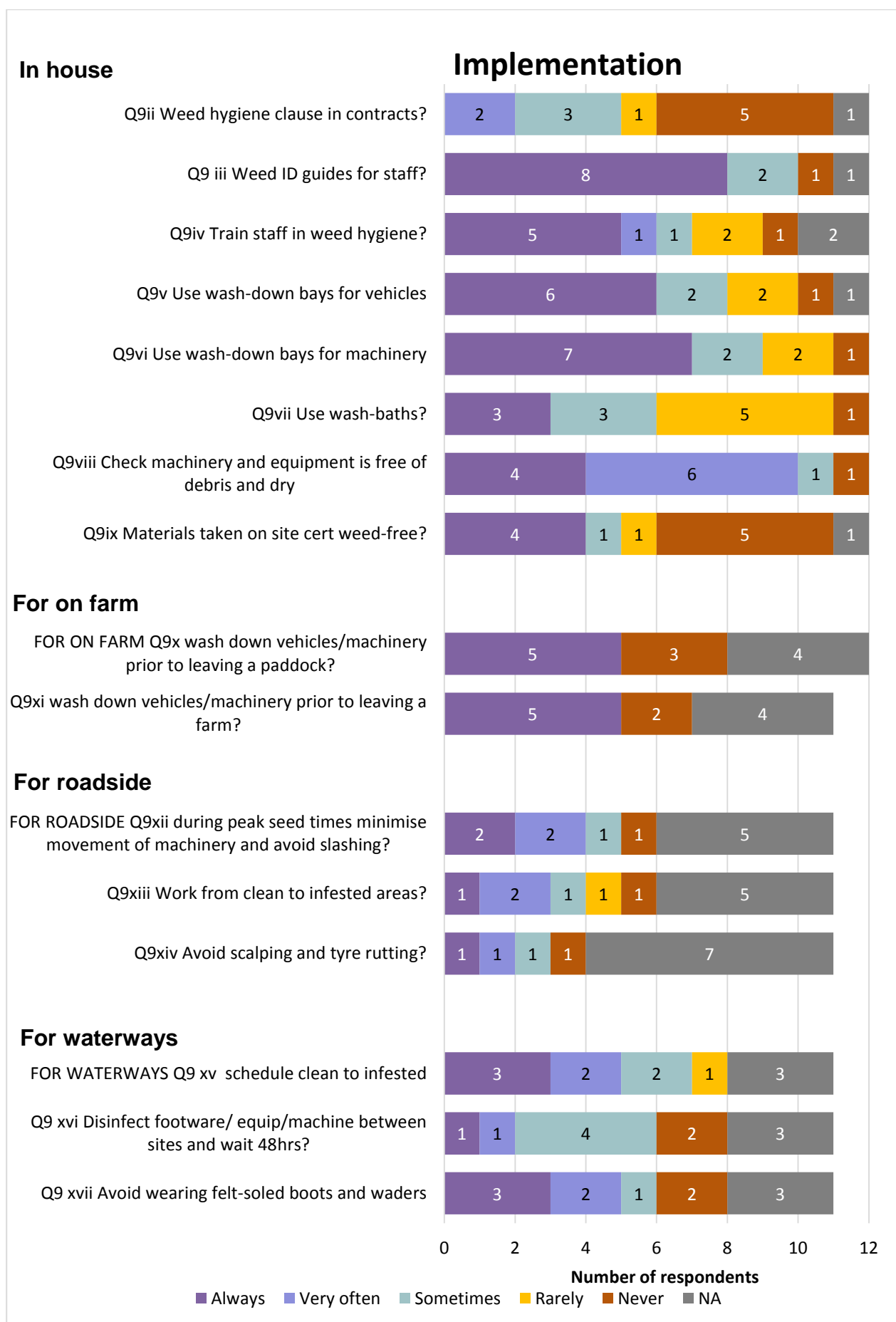


Figure 10. Weed contractors - implementation of weed hygiene guidelines and practices

AGRICULTURAL TRANSPORT OPERATORS

BACKGROUND

Half (5) of the agricultural transport operators interviewed employed at least 20 staff (Figure 11). Agricultural transport operators interviewed were typically of a managerial level; however a number of owner operators were also interviewed.

More than half of the agricultural transport operators indicated that they transported grain. Other goods transported included agricultural fertilizers and chemicals as well as livestock and other types of agricultural products.

Half of the transport operators indicated that they did not think weed hygiene was important and seven transport operators indicated that land managers did not request that they meet hygiene standards, nor did they request that they undertake weed hygiene activities.

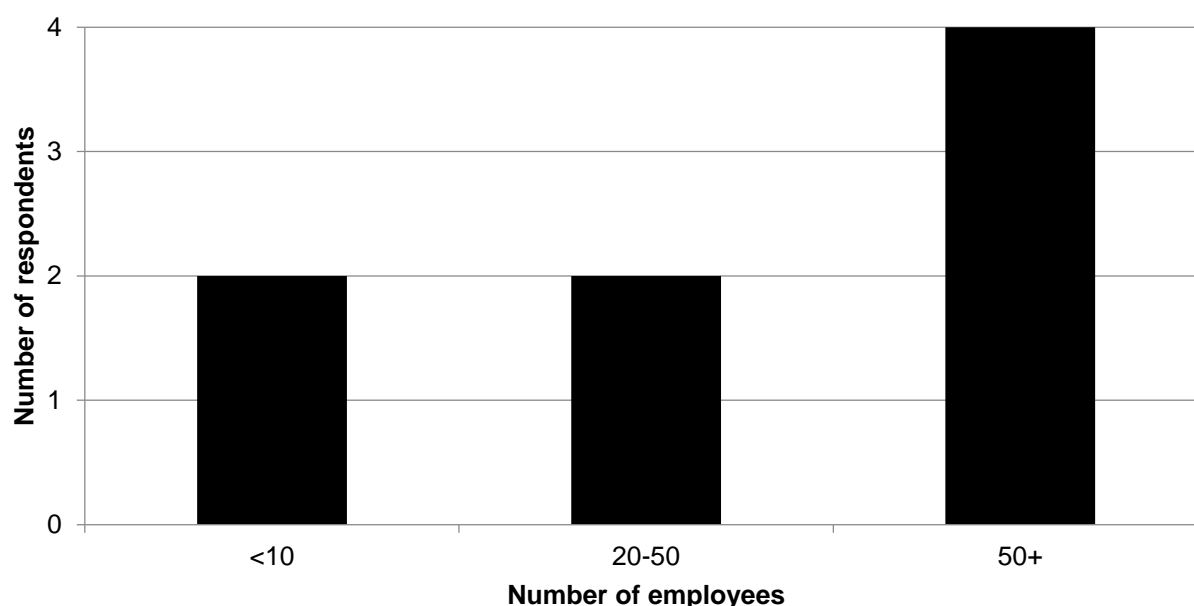


Figure 11. Agricultural transport operators – number of staff in organisation or business. Note: two agricultural transport operators did not report the size of the businesses that they work for.

Interviews were conducted with 10 agricultural transport operators; however in some cases not all respondents answered each question. Where this occurred the relevant number of respondents has been specified in the figures.

KNOWLEDGE OF WEED HYGIENE PRACTICES

Most well-known practices among agricultural transport operators

Agricultural transport operators were most knowledgeable about weed hygiene practices associated with cleaning vehicles (Figure 12). Nine transport operators were aware of the use of wash bays for vehicles. Eight transport operators knew to check machinery and equipment was free of debris and dry before use.

Least well-known practices among agricultural transport operators

Knowledge about weed hygiene clauses in contracts, weed identification guides, and wash baths for footwear, clothing and hand-held tools was low, at most half of the agricultural transport operators knew about these weed hygiene practices (Figure 12).

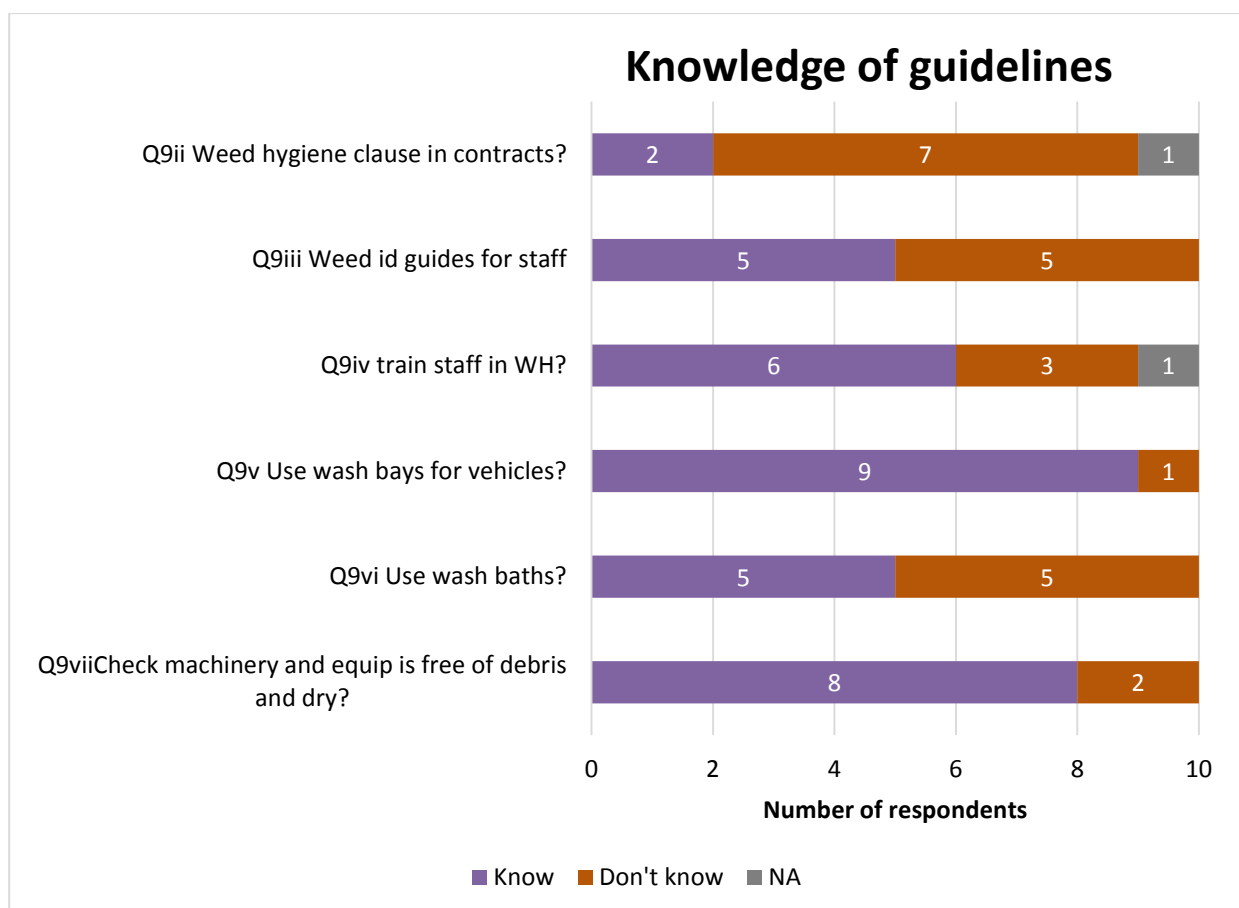


Figure 12. Agricultural transport operators – knowledge of weed hygiene guidelines and practices

IMPLEMENTATION OF WEED HYGIENE PRACTICES

Most implemented practices by agricultural transport operators

The most commonly implemented weed hygiene practice among agricultural transport operators was the use wash bays for vehicles (8 always or very often).

“We do use wash bays to wash down vehicles. Most of our heavy equipment is returned to our mechanical workshops and during that they get serviced over a wash bay which has appropriate biodegradable detergent, as well as water with the appropriate water facilities capturing grease and waste grain and things like that.” (Interviewee 39)

Interviewee 50: The stock crates are washed out on a regular basis... generally after a load of cattle they wash out and put in a new – will head off again with a clean crate.

Interviewer And they wash those out at the sale yards is that right?

Interviewee 50: Yes, sale yards, abattoirs, wherever there's a wash out facility.

“If we load fertiliser with that chemical in and then we go and load grain, it actually affects the grain. At lot of the time our grain could be going export, so we've always got to make sure we wash our bins out between doing this fertiliser and grain.” (Interviewee 38)

Checking machinery and equipment is free of debris and dry before use was also frequently implemented (7 always or very often).

“I've been to a place that may have some foot rot or some other... disease or stuff that you had to wash out, if you've ever been to a place that has that so you always wash down your trailer clean and dry.” (Interviewee 19)

“Our storage facilities are an important part of our business. Our customers depend on us to deliver a clean product to them to make sure – we're dealing with food products, so they want it clean. So we have to meet the Grain Trade Australia standards for weed seeding in our products, so our site is meant to be clean of any plants so we don't contaminate our own products.” (Interviewee 39)

Least implemented practices by agricultural transport operators

The weed hygiene practices that were least likely to be implemented among agricultural transport operators corresponded with those that were least well-known (Figure 12), i.e. including weed hygiene clauses in contracts, providing weed identification guides for staff, and using wash baths for footwear, clothing and hand-held tools (Figure 13).

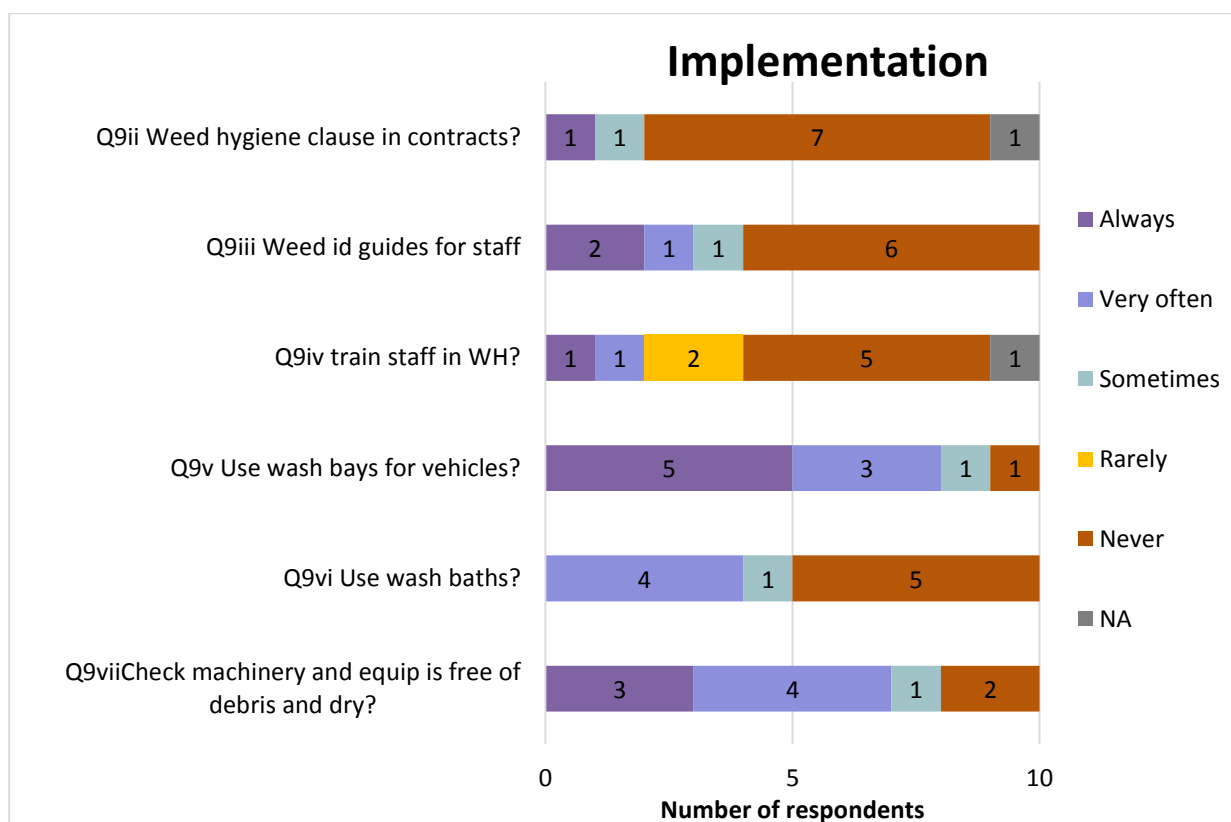


Figure 13. Agricultural transport operators - implementation of weed hygiene guidelines and practices

COMPARISON OF RESPONDENT TYPES

Only a subset of the weed hygiene practices is relevant to multiple respondent types. This section of the report provides insight into differences in weed hygiene knowledge and practices among private landholders, public land managers, weed contractors and agricultural transport operators.

Importance of weed hygiene

Prior to exploration of specific weed hygiene practices, public land managers, weed contractors and agricultural transport operators were asked whether they considered weed hygiene to be an important part of weed management (Figure 14). Almost all public land managers (93%) and weed contractors (91%) believe weed hygiene is important to their operations, compared to half (50%) of agricultural transport operators.

Putting in place a weed hygiene policy or protocols

70% of public land managers, 58% of weed contractors and 30% of agricultural transport operators indicated that they knew about putting in place weed hygiene protocols for their business or organisation, yet implementation of the practice was low. Implementation of weed hygiene policy or protocols was reported at 60% by public land managers, 45% by weed contractors and 20% by agricultural transport operators.

KNOWLEDGE OF WEED HYGIENE PRACTICES

Most well-known weed hygiene practices across respondent types

As can be seen in Figure 14, utilisation of wash bays for machinery was the most well-known practice across respondent types (weed contractors 100%, public land managers 93%, private land managers 82%), closely followed by use of wash bays for vehicles (agricultural transport operators 90%, weed contractors 92%, public land managers 93% and private land managers 76%). Respondents were also highly aware of the need to ensure machinery was clean and dry before use (weed contractors 100%, public land managers 93%, agricultural transport operators 80%).

Least well known weed hygiene practices across respondent types

The practice of including a weed hygiene clause in contracts was not known by 70% of agricultural transport operators, 25% of weed contractors and 13% of public land managers. The practice of using wash baths for footwear, clothing and hand-held tools was not known by 50% of agricultural transport operators and 35% of private land managers.

Knowledge of guideline

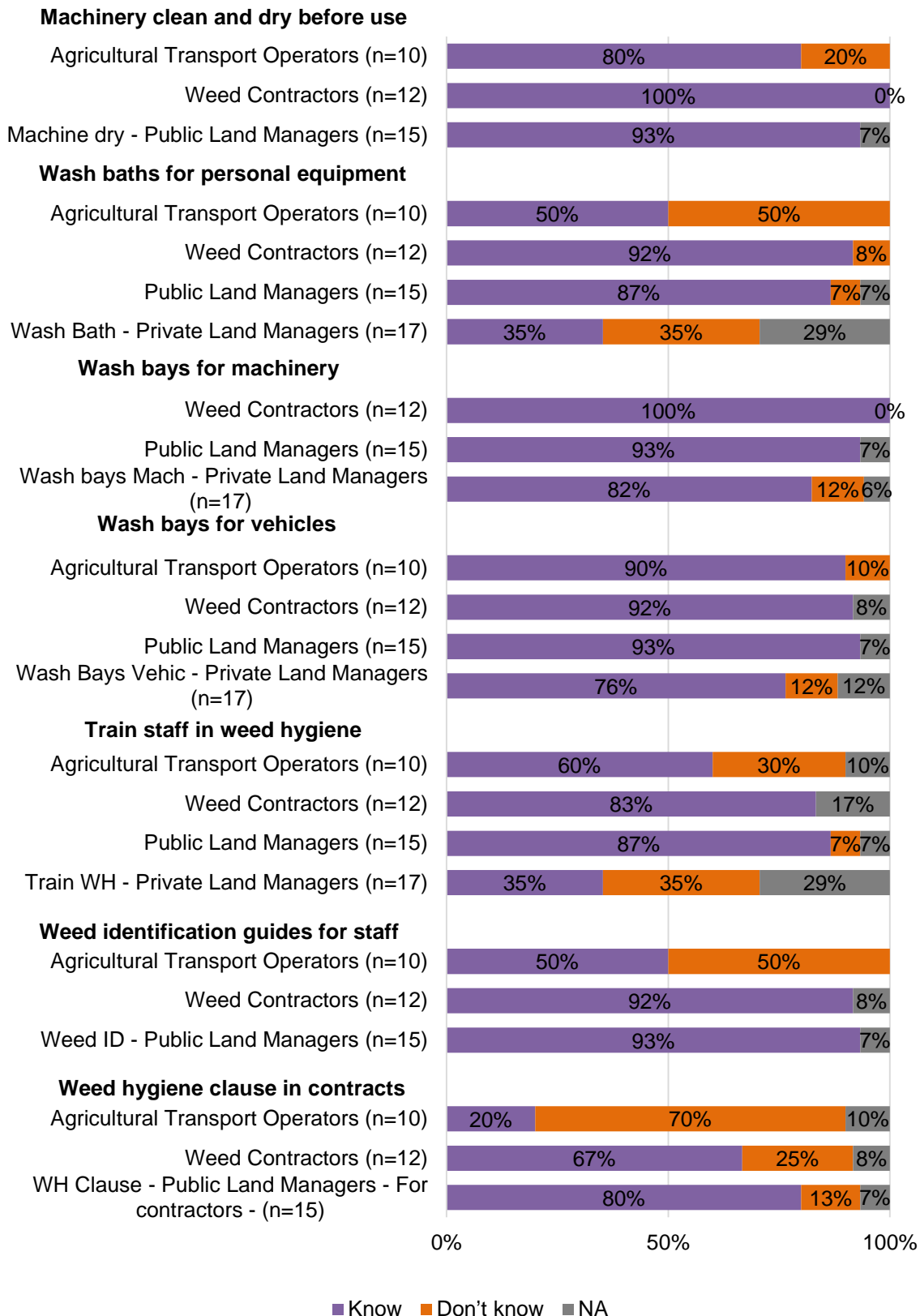


Figure 14. Respondent overview - knowledge of weed hygiene guidelines and practices

IMPLEMENTATION OF WEED HYGIENE PRACTICES

For all respondent types, knowledge of weed hygiene practices does not translate directly into implementation (comparison of Figure 14 with Figure 15).

Most implemented weed hygiene practices across respondent types

All respondent types reported the highest levels of implementation for the following practices.

1. Use wash bays for vehicles
2. Use wash bays for machinery
3. Machinery and equipment clean and dry before use

With the exception of agricultural transport operators, the provision of weed identification guides for staff was well implemented by public land managers (80% always) and weed contractors (67% always).

Least implemented weed hygiene practices across respondent types

The use of wash baths for footwear, clothing and hand-held tools as well as the inclusion of weed hygiene clauses in contracts were the least well-known and the least implemented practices.

Only 6 of the 54 interviewees reported always using wash baths for footwear, clothing and hand-held tools; 88% of private land managers, 53% of public land managers, 50% of agricultural transport operators and 50% of weed contractors rarely or never used wash baths.

The inclusion of a weed hygiene clause in contracts was also infrequently implemented by all respondents. 70% of agricultural transport operators, 50% of weed contractors and 40% of public land managers rarely or never include weed hygiene clauses in contracts.

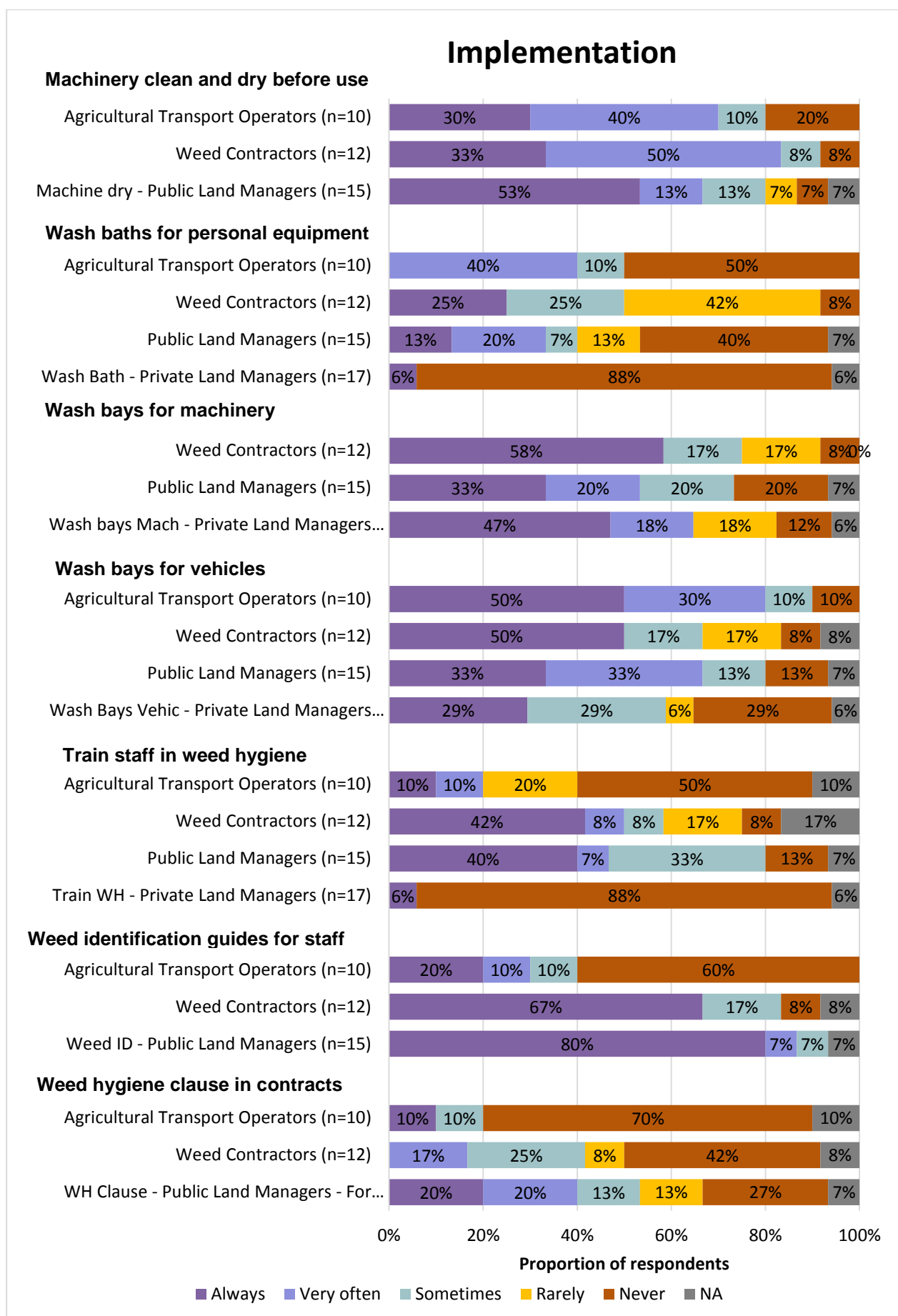


Figure 15. Respondent overview – implementation of weed hygiene guidelines and practices

CONCLUSIONS

This project began with an analysis of weed management and weed hygiene literature. The analysis revealed that there has been considerable research and management effort to understand pathways for weed spread and to develop weed hygiene guidelines and policies. However, little is known about knowledge and practice of weed hygiene by key stakeholders. The few studies that sought to understand weed hygiene uptake among landholders suggested that implementation and knowledge of weed hygiene practices are limited.

The research in this report confirms that implementation of weed hygiene practices is patchy at best, that implementation varies across and within sectors and across weed hygiene practices, but that this is not simply due to a lack of knowledge. Participants provided a large range of explanations for not prioritising weed hygiene in their day-to-day activities. These included resource availability, inter and intra-organisational coordination, economics, and farm risk assessment. We recommend further research be based around the themes of the knowledge-action gap, lack of knowledge in the transport industry, incentives and disincentives, and inter and intra-organisational coordination.

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APPENDIX A: PRIVATE LANDHOLDERS - WEED HYGIENE PRACTICES

Note: numbering of weed hygiene practices has been incorporated into each figure to allow reference to the original interview schedule.

- i. Have a wash down station at your farm gate
- ii. Minimise the number of entry points
- iii. Restrict access to the farm
- iv. Use wash bays to wash down vehicles (wash down includes interior, boot, engine bay, underside, tray)
- v. Use wash bays to wash down machinery (wash down includes cabin, engine bay, tyres, chassis, front end, buckets/blades/scoops etc)
- vi. Use wash baths to wash down boots, clothing, and hand-held tools
- vii. Train farm personnel in weed hygiene
- viii. Provide weed hygiene supplies for farm personnel
- ix. Clean all farm machinery before it is relocated
- x. Avoid vehicle and machinery movements when road conditions are wet and muddy
- xi. Minimise the lending and borrowing of equipment between properties
- xii. Ensure borrowed equipment is cleaned before and after use
- xiii. Enforce machinery cleaning standards for all contractors

For cropping

- xiv. Request a Vendor Declaration or other certificate for bought seed
- xv. Issue a Vendor Declaration when selling produce
- xvi. Maintain records of seed and its source
- xvii. All grain storage and handling equipment thoroughly cleaned out at least three weeks before harvest
- xviii. Harvest paddocks in order from least weedy to most weedy
- xix. Secure loads if suspected of containing weed seeds

For grazing

- xx. Request a Vendor Declaration or other certificate for stock feed
- xxi. Inspect stock feed on delivery for evidence of contaminants
- xxii. Request a Vendor Declaration or other certificate for new stock
- xxiii. Quarantine new stock in a dedicated holding yard and monitor this area for weeds
- xxiv. Empty out introduced stock before returning to pasture
- xxv. Do you use any other practices in place to prevent weed spread that I haven't mentioned?

APPENDIX B: PUBLIC LAND MANAGERS - WEED HYGIENE PRACTICES

Note: numbering of weed hygiene practices has been incorporated into each figure to allow reference to the original interview schedule.

- i. Put in place a weed hygiene policy or protocols for your organisation

For in-house expertise

- ii. Have weed identification guides or other information available to staff
- iii. Train staff in weed hygiene
- iv. Require staff to use wash bays to wash down vehicles (wash down includes interior, boot, engine bay, underside, tray)
- v. Require staff to use wash bays to wash down machinery
- vi. Require staff to use wash baths to wash down boots, clothing, hand-held tools
- vii. Require staff to check all machinery and equipment is free of debris and dry

For contractors

- viii. Include a weed hygiene clause in contracts
- ix. Have weed identification guides or other information available to contractors
- x. Require contractors to use wash bays to wash down vehicles (wash down includes interior, boot, engine bay, underside, tray)
- xi. Require contractors to use wash bays to wash down machinery
- xii. Require contractors to use wash baths to wash down boots, clothing, hand-held tools
- xiii. Require contractors to check all machinery and equipment is free of debris and dry before a job
- xiv. Do you use any other practices in place to prevent weed spread that I haven't mentioned?

APPENDIX C: WEED CONTRACTORS - WEED HYGIENE PRACTICES

Note: numbering of weed hygiene practices has been incorporated into each figure to allow reference to the original interview schedule.

- i. Put in place a weed hygiene policy or protocols for your business
- ii. Include a weed hygiene clause in contracts
- iii. Have weed identification guides or other information available to staff
- iv. Train staff in weed hygiene
- v. Use wash bays to wash down vehicles (wash down includes interior, boot, engine bay, underside, tray)
- vi. Use wash bays to wash down machinery
- vii. Use wash baths to wash down boots, clothing, hand-held tools
- viii. Before a job, check all machinery and equipment is free of debris and dry
- ix. Ensure all materials taken onto a site are certified free of weeds

For on-farm operators

- x. Wash down vehicles and machinery prior to leaving a paddock
- xi. Wash down vehicles and machinery prior to leaving a farm

For roadside operators

- xii. During peak seed production times minimise movement of machinery and avoid slashing
- xiii. Undertake works in clean areas and gradually work towards infested areas
- xiv. Avoid scalping and tyre rutting

For waterway operators

- xv. Plan your field schedule, moving from clean to infested areas
- xvi. Disinfect footwear, equipment, vehicles and machinery between sites and wait 48 hours before using equipment in another waterway
- xvii. Avoid wearing felt-soled boots and waders

APPENDIX D: AGRICULTURAL TRANSPORT OPERATORS - WEED HYGIENE PRACTICES

Note: numbering of weed hygiene practices has been incorporated into each figure to allow reference to the original interview schedule.

- i. Put in place a weed hygiene policy or protocols for your business
- ii. Include a weed hygiene clause in contracts
- iii. Have weed identification guides or other information available to staff
- iv. Train staff in weed hygiene
- v. Use wash bays to wash down vehicles (wash down includes interior, boot, engine bay, underside, tray)
- vi. Use wash baths to wash down boots, clothing, hand-held tools
- vii. Before a job, check all machinery and equipment is free of debris and is dry

APPENDIX E: WEED HYGIENE – EXISTING GUIDELINES

One of the first tasks undertaken in this project involved compiling a list of weed hygiene practices from the existing literature. Below are the weed hygiene practices recommended in the existing literature, who they are intended for, and the source of the recommendations. This list was used to inform the questions asked during the telephone interviews.

Practice	Responsibility	Source
On-farm		
Sow weed-free seed: check the Seed Analysis Certificate for bought seeds (or request a Weed Hygiene Declaration); demarcate seed paddocks and ensure weed numbers are very low	Farmers	(GRDC 2014, Plant Health Australia 2012)
Set aside containment areas if hand-feeding stock with imported feed; empty out stock before returning to pasture	Farmers	(Sindel and Coleman 2010, Sindel and Coleman 2012, GRDC 2014)
Harvest paddocks in order from least weedy to most weedy; clean all farm machinery before relocation	Farmers	(GRDC 2014)
Enforce machinery cleaning standards with all harvest, baling, windrowing and grain transporting contractors	Farmers, contractors	(GRDC 2014, Plant Health Australia 2012)
Train farm personnel in biosecurity and farm hygiene practices; supply personnel hygiene supplies where appropriate	Farmers	(Plant Health Australia 2012, Plant Health Australia 2011)
Quarantine livestock exposed to plants for 5-8 days prior to transport to a new destination; use dedicated weed-free holding paddocks	Farmers, agricultural transport companies	(Department of Natural Resources 2004, GRDC 2014)
Secure loads (i.e. grain, fodder) if suspected of containing weed seeds	Farmers	(Biosecurity Queensland 2014)
Avoid vehicle and machinery movements when road conditions are wet and muddy; do not drive through infested paddocks; visiting consultants to use vehicle supplied by farmer	Farmers	(ACCRC 2000, Biosecurity Queensland 2014)
Washdowns and decontamination		
Vehicle/machinery wash-down and decontamination (on and off- farm) There are specific procedures for cars, trucks, 4WDs; compactors; cotton pickers; dump trucks; excavators; headers and harvesters; mini tractors; PTO rotary hoes; track-type dozers; wheeled loaders; wheeled tractors	Farmers, contractors	(Anderson 2011, Biosecurity Queensland 2014, ACCRC 2000, Department of Primary Industries 2015, Department of the Environment 2015, Rudman, Tucker and French 2004)
Personal and small tool wash-down using portable washbaths	Contractors and field workers	(Rudman et al. 2004)

Roadside/construction sites		
Conduct a site assessment to determine if there are noxious weeds or plant disease present; chemically treat or manually remove weeds before commencing work; plan the disposal method to be used	Roadside managers, contractors	(Civil Contractors Federation 2011)
Minimise movement of machinery and avoid slashing during peak seed production times	Roadside managers, contractors	(Baldyga 2006, Biosecurity Queensland 2014, Civil Contractors Federation 2011)
Undertake works in clean areas then gradually work toward infested areas	Roadside managers, contractors	(Baldyga 2006)
Incorporate machinery hygiene into contracts	Roadside managers, contractors	(Baldyga 2006)
Ensure that roadside material such as soil and gravel is seed-free (vendor declaration); locate stockpiles in weed-free areas and regularly inspect	Roadside managers, contractors	(Baldyga 2006, Civil Contractors Federation 2011)
Locate staging grounds (work depots) in weed-free areas; undertake regular inspections and control works	Roadside managers, contractors	(Baldyga 2006)
Nominate areas for clean-down procedures for roadside slashing and establish wash-bay for long-term projects; include on site plan; avoid sensitive vegetation and wildlife; ensure run-off will not enter any watercourse (30m buffer)	Roadside managers, contractors	(Baldyga 2006, Civil Contractors Federation 2011, Department of Primary Industries 2015)
Avoid scalping and tyre rutting	Roadside managers, contractors	(Baldyga 2006)
Field workers		
Ensure all materials taken onto a site (seedlings, mulch, soil, gravel, rock and sand) are certified free of weeds (AS3743-2003 and AS4454-2012)	Field workers	(Department of the Environment 2015)
Avoid use of felt-soled boots, waders	Field workers and contractors in waterways, wetlands, riparian zones, boggy areas	(Allen and Gartenstein 2010)
Check all equipment is free of debris and dry	Field workers & contractors in waterways, wetlands, riparian zones, boggy areas	(Allen and Gartenstein 2010)

Check all machinery (tractors, mowers, slashers, bulldozers, graders, excavators), vehicles, boats and trailers are clean and dry	Field workers & contractors in waterways, wetlands, riparian zones, boggy areas	(Allen and Gartenstein 2010)
Disinfect (with Phytoclean or F10) footwear, equipment, vehicles and machinery between sites; wait 48 hours before using equipment in another waterway	Field workers & contractors in waterways, wetlands, riparian zones, boggy areas	(Allen and Gartenstein 2010)
Other		
Dispose of garden waste appropriately; ensure seeds are not dropped in transit	Gardeners	(Blood 2002)
Clean fishing/boating gear, watercraft, trailers and vehicles	Boaters and fishers	(Department of Primary Industries n.d.)

