Survey of invertebrate pests and beneficials harbouring in harvest weed seed control system

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Key Messages

Both invertebrate pests and beneficials are found in association with chaff in paddocks. Paddocks located in the Albany port zone are more likely to have higher densities of pests associated with chaff, whereas paddocks located in the Kwinana East port zone had the least pest densities and highest numbers of seed-harvesting ants associated with chaff.

The most abundant beneficials were weed seed harvesting ants which were found in close association with chaff. This trend presents an opportunity to investigate in greater detail whether seed-harvesting ants provide an economic benefit to growers by consuming weed seeds from HWSC systems left to rot-in-situ.

Leaving chaff to rot-in-situ does not affect abundances of pests such as desiantha weevil. However, other pests do use chaff as refuges. For instance, pest beetles, Rutherglen bugs, European earwigs were found in association with chaff. It is unlikely these species are feeding on chaff, but rather are using chaff as a refuge. This survey was not able to determine if long term retention of chaff will increase abundances of these pests.

Background

There are three non-burning and non-mechanical techniques most commonly employed in harvest weed seed control (HWSC) systems: chaff dumping, chaff lining and chaff tram-lining. The highest adoption of HWSC is in the GRDC western region with an estimated 67% of all farmers undertaking at least one HWSC strategy in 2014.

Chaff dumping is the collection of the chaff fraction using a cart towed behind the harvester. The chaff in the cart is then dumped, usually in piles in the paddock. The chaff is then either burnt, grazed or left to decompose.

For chaff lining, the chaff and weed seeds are confined to a row directly behind the harvester using a narrow chute. The chaff and weed seeds are then left to decompose over time. To promote decomposition, the chaff lines need to be placed in the same location year after year by running the harvester on a controlled traffic system (CTF).

Chaff tramlining is a similar concept to chaff lining, but the chaff fraction is diverted from the chaff deck onto permanent wheel tracks in a CTF system. Wheel traffic creates a hostile environment that inhibits weed seed germination.

There has been a recent system change with more growers opting for leaving chaff in-situ to rot, whether in dumps or in lines, rather than burning. This investigation aimed to better understand invertebrate species and mice associated with these HWSC systems, which to date are poorly understood, in each of the five port zones: Albany, Esperance, Geraldton, Kwinana's East and West.

Aim

To determine whether there is a difference in invertebrate populations across different HWSC systems over the WA grain belt, specifically if there is a species change with accumulating chaff within paddocks and the impact on the following crop.

Trial Details

A total of 87 paddocks were surveyed during 2019-2020. An effort was made to identify a similar number of HWSC systems per port zone for this study. However, some HWSC systems are under-represented in certain zones. For instance, chaff tram lining is more common in the Esperance port zone than in the Kwinana port zones (Figure 1).

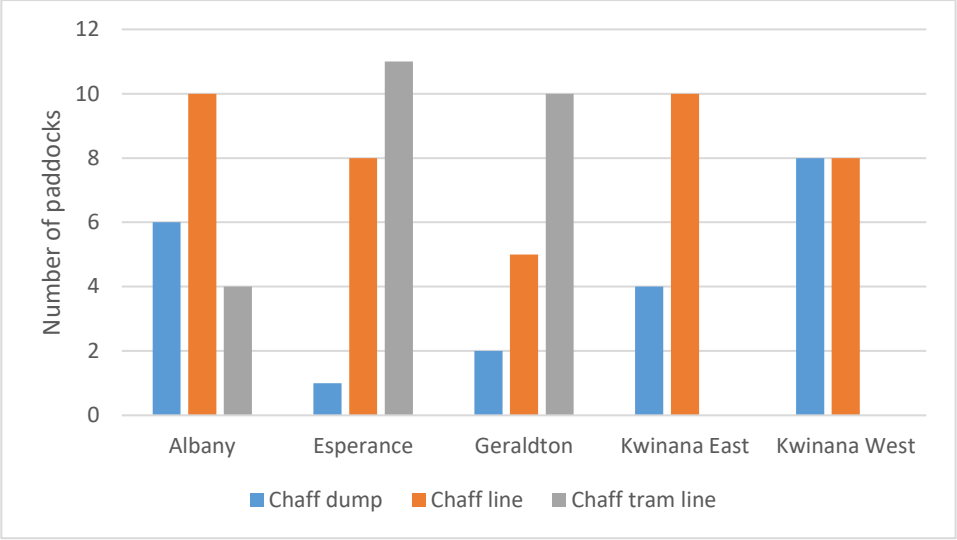

Figure 1: Number of paddocks with a harvest weed seed control (HWSC) system per port zone

Two times of sampling occurred: prior to planting and post planting when crops were at the seedling stage

Pitfall traps were placed at least 50 metres from any fence line or vegetation. These consisted of 250 mL containers, dug into the ground so the top lip was level with the surface. Pitfall traps were placed in two rows and kept open for 7 days. Each row consisted of 10 pitfall traps placed at least 10 metres apart.

One row was placed adjacent to chaff (near), at a distance of 5 cm from chaff; the second row (far) was placed parallel to the first at a distance of 20 metres away. In paddocks with chaff lines or tram-lines, the chaff lines are spaced at least 6 m apart. The 'far from chaff' pitfall trap rows were located between chaff lines and were at least 3 m from a chaff line.

In paddocks with chaff dumps, the second row was located 20 m from any chaff. Due to paddock variation, most chaff dumps were less than 100 metres in length. In this case, pitfall traps were placed 10 metres apart 5 cm from the chaff (close) and at least 20 m away from chaff (far) on the same side of multiple chaff dump.

Results

Pitfall traps captured invertebrates in every paddock including crop pests. However, significant differences in invertebrates captured between the different HWSC systems were not found.

Overall paddocks with tram-lined paddocks had 30% less pests than other HWSC systems and However, the presence of chaff can lead to increases in some pests; pitfall traps adjacent to chaff on average ($P>0.05$) captured 70% more Rutherglen bugs and 40% more pest beetles, than pitfall traps located in standing stubble. Pest beetles, comprised of vegetable beetle, bronzed field beetle and its larvae, African black beetle; and weevils: vegetable weevil, Fuller's rose weevil, sitona weevil, lucerne weevil (Figure 1).

Desiantha weevil was not included in analysis with pest beetles, as this species was more likely to be found in standing stubble. Pitfall traps located in standing stubble on average captured 30% more ($P>0.05$) desiantha weevil than those adjacent to chaff (Figure 1).

Similarly, an association with chaff was not found for slaters or snails, with low numbers of these pests being captured in pitfall traps (Figure 1). If only the paddocks in which these pests were found are analysed ($P>0.05$), 30% more slaters and 70% more small pointed snails were found in pitfall trap catches located in standing stubble; whereas no differences in round snail captures were found in relation to the location of the pitfall trap.

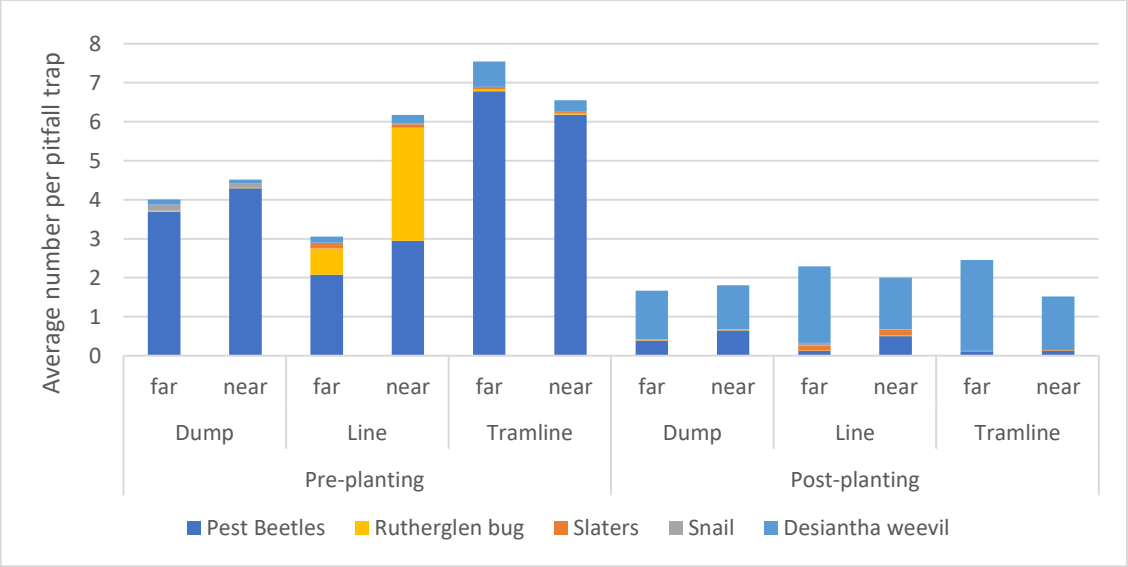

Figure 1: Average number of pests found in pitfall per pitfall trap located 5 cm from chaff (near) or at least 3 m away from chaff (far) in paddocks with HWSC systems of either dumps, chaff lining or chaff tram-lining, sampled at two different times.

Another pest, the European earwig, is not shown due to very low numbers being captured in pitfall traps as it was only found in 10% of paddocks (9 paddocks) surveyed. Even so, if only the paddocks in which it was found are analysed, 50% more European earwigs were found in pitfall traps located near chaff than in standing stubble.

Unlike European earwigs, native earwigs did not show a preference for chaff. Native earwigs are predatory and were found in 45% of all paddocks surveyed in very low numbers ie an average of <1 per pitfall trap. Even so, pitfall trap located near chaff captured similar numbers of predatory earwigs as those in standing stubble.

Similarly, the location of the pitfall trap did not influence catches of other predatory species such as ants, assassin bugs from family Reduviidae and centipedes. Like predatory earwigs these were found in low numbers and in order to be graphically represented are denoted as other predatory invertebrates in figure 2.

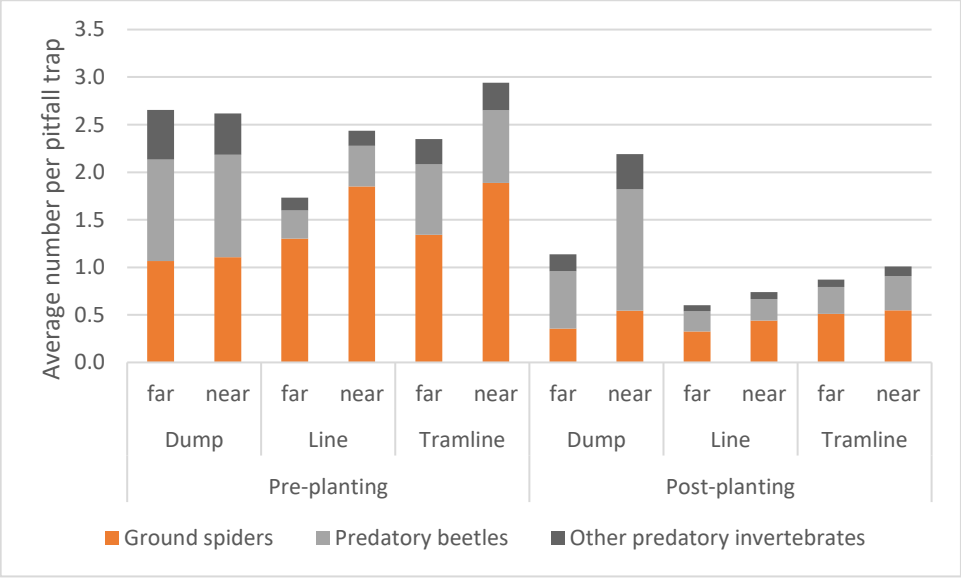

Figure 2: Average number of beneficials per pitfall trap located 5 cm from chaff (near) or at least 3 m away from chaff (far) in paddocks with HWSC systems of either dumps, chaff lining or chaff tram-lining, sampled at two different times

Other beneficial species were found in association with chaff. Pitfall traps located near chaff captured on average 25% more ground beetles, spiders and weed seed harvesting ants, than traps in standing stubble. Weed seed harvesting ants comprise of ants from the genus Pheidole, Rhytidoponera, Monomorium or Melophorous that predate on weed seeds. This group was the most plentiful comprising of 80% of all pitfall trap (Figure 2).

Timing of the deployment of the pitfall traps also influenced invertebrate catches. Before planting, pitfall traps captured on average 90% more beneficials invertebrates and pest beetles, and only Rutherglen bugs were found in catches before planting occurred. However, 90% more desiantha weevils were in pitfall traps after planting had occurred (Figures 1, 2).

The location of paddocks also influenced the diversity of invertebrates that were captured in pitfall traps. Pitfall traps located in paddocks in the Albany port zone on average captured 90% more pests compared to pitfall traps located in other port zones. In this port zone pitfall trap 80% of catches were comprised of pest beetles (Figure 3).

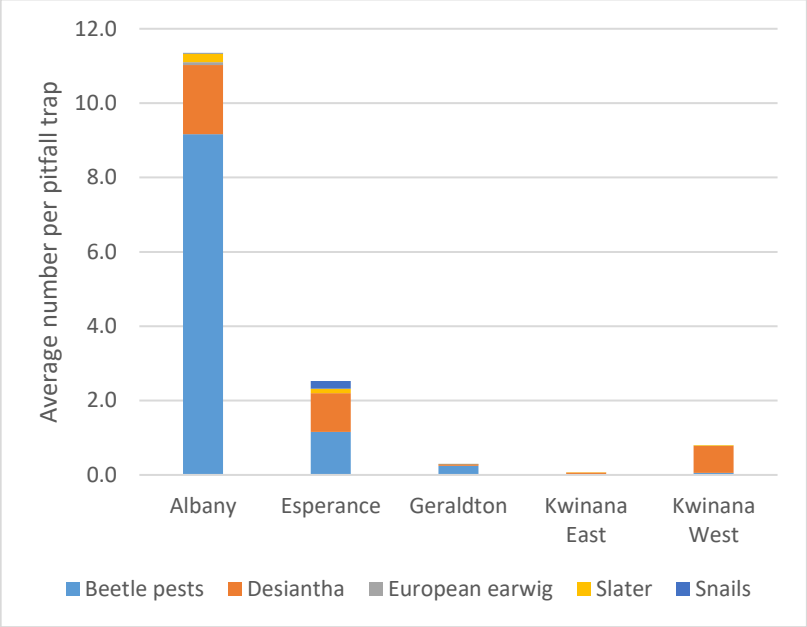

Figure 3: Average number of pests found in paddocks per pitfall trap by port zones.

Whereas, the dominant group of beneficials captured were weed harvesting seed ants, with an average of 70% more of these ants captured in pitfall traps located in the Kwinana East Port Zone (Figure 4).

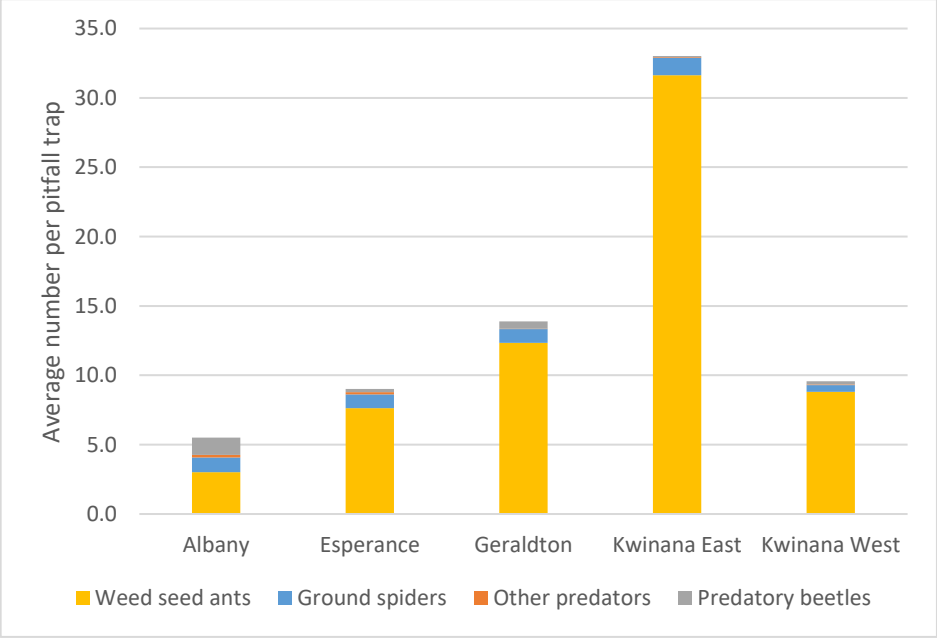

Figure 4: Average number beneficials per pitfall trap by port zones.

Comments

Both invertebrate pests and beneficials are found in association with chaff in paddocks. However, the species composition depends on the location of the paddock. Paddocks located in the Albany port zone are more likely to have higher densities of pests associated with chaff, whereas paddocks located in the Kwinana East port zone had the least pest densities and highest numbers of seed-harvesting ants associated with chaff.

The most abundant beneficials were weed seed harvesting ants which were found in close association with chaff. As these ants predate on weed seeds and live in holes in the ground, it is unlikely they are using chaff as a refuge, it is more probable that they are foraging in the chaff. This trend presents an opportunity to investigate in greater detail whether seed-harvesting ants provide an economic benefit to growers by consuming weed seeds from HWSC systems left to rot-in-situ.

Pitfall trapping was able to capture a higher diversity of invertebrate species than direct sampling of chaff. As pitfall trapping did not rely on samplers locating an invertebrate, it is more likely to be a more accurate representation of species presence and diversity in a paddock. However, this technique does rely on invertebrates moving and falling into a pitfall trap.

Leaving chaff to rot-in-situ does not affect abundances of pests such as desiantha weevil. However, other pests do use chaff as refuges. For instance, pest beetles, Rutherglen bugs, European earwigs were found in association with chaff. It is unlikely these species are feeding on chaff, but rather are using chaff as a refuge. This survey was not able to determine if long term retention of chaff will increase abundances of these pests.

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