

Weed seed management at harvest

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A survey across 1400 transects in 70 paddocks assessed the weed distribution, density and seed production at harvest time in wheat, chickpea and sorghum crops in four cropping zones of the northern grain region. In brief, seventy weed species were identified, of which 12 were found in 7 – 45 paddocks. The survey identified value in investigating harvest weed seed management options, including the Harrington Seed Destructor (HSD), to greatly reduce seed-bank replenishment of problem weeds.

Background

This article provides an overview of results from a recent (2011/12) survey of weed seed production in northern region winter and summer crops. The survey was a joint effort between Queensland's Department of Agriculture, fisheries and Forestry (QDAFF), Queensland's Alliance for Agriculture and Food Innovation (QAAFI) and the Australian Herbicide Resistance Initiative (AHRI).

The focus of this project was to identify the potential for harvest weed seed management in the northern grain region of northern NSW, southern and central Queensland.

At present, harvest weed seed management is not practiced as a weed control option in the northern crop production regions. The potential for this approach has not been evaluated in the summer or winter cropping systems across these regions. To address this situation, surveys were conducted in northern NSW, southern and central Queensland summer and winter crop production zones.

The approach was to identify weed species with upright seed bearing plant parts that will potentially be collected during the harvest of the dominant crops of these regions. These surveys provide a comprehensive set of data allowing the accurate determination of the potential for successful use of at-harvest weed seed management systems for the northern region.

Approach

A random survey was conducted on 70 paddocks of wheat, chickpea and sorghum in the four main cropping zones of the northern grain region (Table 1).

Within each paddock 20 transects of 10m² (1m x 10m) were selected using a zigzag pattern to be representative of weed infestations across the paddock (which is the same protocol as used in previous published NR weed surveys).

The following measurements were made in each transect:

- ❖ weed species present
- ❖ weed species density using the rating scale of 1 = 1-9 plants per 10m², 2 = 10 - 49 plants per 10m², 2.5 = 50 – 100 plants per 10m², and 3 = >100 plants per 10m²
- ❖ visual estimation of % of each species seeding.

For every species seeding, three representative samples were collected from each paddock and the following measurements made:

- ❖ visual estimation of % of seeds or seed heads above potential harvest height (nominated as 5cm for chickpea, 15cm for wheat and 30cm for sorghum)
- ❖ visual estimation of % total seed retained at time of sampling
- ❖ number of seeds or seed heads (and number of seeds in 5 representative seed heads) per plant above harvest height
- ❖ total seed production, number of seed retained and % potential for harvest management.

Table 1. Extent of northern region weed seed at harvest survey

| Region and crop | Number of paddocks | Number of species present at harvest | Number of species retaining seed at harvest |
|-------------------------------|--------------------|--------------------------------------|---|
| <i>Central Highlands, QLD</i> | | | |
| Chickpea | 5 | 8 | 6 |
| Wheat | 5 | 5 | 4 |
| Sorghum | 10 | 12 | 11 |
| <i>Darling Downs, QLD</i> | | | |
| Chickpea | 5 | 11 | 7 |
| Wheat | 5 | 12 | 10 |
| Sorghum | 10 | 15 | 11 |
| <i>South-west Down, QLD</i> | | | |
| Chickpea | 5 | 15 | 11 |
| Wheat | 5 | 8 | 3 |
| Sorghum | 10 | 25 | 19 |
| <i>Liverpool Plains, NSW</i> | | | |
| Chickpea | 5 | 22 | 16 |
| Wheat | 5 | 18 | 12 |
| Sorghum | - | - | - |
| Total | 70 | 70 | |

Results

The weed flora was very diverse with a total of 70 different species found, with 37 species in chickpea crops, 33 in wheat, and 38 in sorghum (Table 1). Fifteen species were found in both winter and summer crops. Of these species 70% had seed retained at harvest time.

Twelve weed species were commonly found across the cropping zones and crops in 7-45 paddocks (Table 2). The most prevalent were the weeds with wind-blown seed – sowthistle and fleabane. There were three common grasses – barnyard grass, wild oat and feathertop Rhodes grass; three Brassicas – turnip weed, mustard and African turnip weed; plus five other broadleaf weeds – bladder ketmia, pigweed, native jute, Australian bindweed and wild gooseberry. Caustic weed was also present in 10 paddocks but not seeding.

For sowthistle and fleabane, a substantial number of seed had already dropped from the plants, particularly for sowthistle in chickpea and fleabane in sorghum. However a very large number of seeds remained on the plants, ranging from 770 to 14,660 seeds per sowthistle plant and from 4885 to 46,255 seeds per fleabane plant, the majority of which were above the potential harvest height. Thus, these weeds are a priority for harvest weed seed management.

Barnyard grass was the third most prevalent weed with a substantial number of seeds remaining in all three crops, although there were more seed dropped in sorghum (3520-4350) than winter crops (0-200). A substantial portion of feathertop Rhodes grass seed had dropped in chickpea (370-9905) and sorghum (0-21,940), although large numbers remained on the plant above harvest height.

Several hundred seed remained on wild oat in wheat (155-294) and chickpea (180-220) but a large portion of wild oat seed had already dropped in wheat paddocks.

The Brassica weeds produced substantial numbers of seeds in chickpea (150-112,075) but much less in wheat (0-995). The majority of the seeds were above the potential harvest height, and thus these weeds are a priority for harvest weed seed management.

For bladder ketmia, pigweed, native jute, Australian bindweed and wild gooseberry, these had either no seed above harvest height or small numbers, except for wild gooseberry in sorghum with 11625 seed remaining.

Some less common weeds identified with large seed production above potential harvest height were:

- ☀️ cudweed (2500-22645 seeds)
- ☀️ climbing buckwheat / bindweed (1400-9420 seeds)
- ☀️ dock (30,060)
- ☀️ mallow (6765 seeds)
- ☀️ malvastrum (1115)
- ☀️ Mexican poppy (15970)
- ☀️ New Zealand spinach (1125)
- ☀️ paradoxa grass (1040)
- ☀️ sida (1725)
- ☀️ St Barnaby's thistle (11045)
- ☀️ stink grass (18995)
- ☀️ sweet summer grass (1660)
- ☀️ wild sunflower (2750)
- ☀️ windmill grass (6225 seeds)
- ☀️ wireweed (820-4000 seeds).

Annual ryegrass and barley grass were only found in one paddock in the Liverpool Plains region.

Implications

This survey has shown there is a clear and urgent need for growers to manage weeds better to prevent large annual replenishments of the seed-bank. A potential tactic is to use one of the harvest weed seed management options, such as the HSD. These could be potentially useful to greatly improve management of many weeds particularly the summer and winter grasses, brassica weeds, some climbing weeds, and possibly sowthistle and fleabane if the technique is capable of capturing and destroying wind-blown seeds.

Table 2. The most common weed species seeding at harvest time in wheat, chickpea and sorghum, and data on seed loss, seed remaining and percentage of remaining seed above potential harvest height (averaged across each of 4 cropping zones) for each species. Seed data for each species are listed in order of wheat, chickpea and sorghum.

| Weed | Scientific name | Number of paddocks infested | Number of paddocks seeding | Seeds dropped per plant | Seeds remaining per plant | % above harvest height |
|------------|---------------------------|-----------------------------|----------------------------|-------------------------|---------------------------|------------------------|
| Sowthistle | <i>Sonchus oleraceus</i> | 45 | 38 | 150-10,150 | 770-2040 | 80-100 |
| | | | | 2010-18,680 | 4470-14,660 | 100 |
| | | | | 1290-3750 | 1070-8690 | 65-85 |
| Fleabane | <i>Conyza bonariensis</i> | 28 | 17 | 0-3180 | 4885-13,950 | 40-100 |
| | | | | 0-14,230 | 17,790-46,255 | 90-100 |
| | | | | 30,210-130,060 | 28,710-33,430 | 55-60 |

| | | | | | | |
|-------------------------------|-------------------------------|----|----|-----------|----------------|--------|
| Barnyard grass | <i>Echinochloa spp</i> | 20 | 17 | 200 | 3585 | 100 |
| | | | | 0 | 2865 | 60 |
| | | | | 3520-4350 | 730-14,040 | 20-25 |
| Bladder ketmia | <i>Hibiscus trionum</i> | 19 | 15 | 10 | 45 | 25 |
| | | | | - | - | 0 |
| | | | | 55-325 | 175-215 | 30-100 |
| Wild oat | <i>Avena spp</i> | 14 | 13 | 55-195 | 155-295 | 100 |
| | | | | 8-24 | 180-220 | 100 |
| | | | | - | - | - |
| Turnip weed | <i>Raphanus raphanistrum</i> | 10 | 9 | - | - | 0 |
| | | | | 0 | 150-28,170 | 95-100 |
| | | | | 25 | 455 | 20 |
| African turnip weed / mustard | <i>Sisymbrium spp</i> | 9 | 8 | 0 | 995 | 100 |
| | | | | 0 | 33,130-112,075 | 100 |
| | | | | - | - | - |
| Pigweed | <i>Portulaca oleracea</i> | 8 | 3 | - | - | 0 |
| | | | | - | - | 0 |
| | | | | - | - | 0 |
| Native jute | <i>Corchorus capsularis</i> | 8 | 6 | - | - | 0 |
| | | | | - | - | 0 |
| | | | | - | - | 0 |
| Australian bindweed | <i>Convolvulus erubescens</i> | 7 | 3 | 0 | 320 | 0-80 |
| | | | | - | - | 0 |
| | | | | - | - | 0 |
| Feathertop Rhodes grass | <i>Chloris virgata</i> | 7 | 7 | - | - | 0 |
| | | | | 370-9905 | 2485-11,610 | 100 |
| | | | | 0-21,940 | 13,640-31,040 | 60-75 |
| Wild gooseberry | <i>Physalis minima</i> | 7 | 5 | - | - | - |
| | | | | - | - | - |
| | | | | 210 | 11,625 | 15 |