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# Estimating Seed Bank of Weed in Wheat-Wheat and Wheat-Fallow Rotations in Rainfed Winter Wheat Farms

Soleiman Jamshidi [1 +], Somayye Ahmadifard [2]

[1] Department of Plant Protection, Miyaneh Branch, Islamic Azad University, Miyaneh, Iran
[2] Department of Graduate Agronomy, Miyaneh Branch, Islamic Azad University, Miyaneh, Iran

**Abstract.** Soil samples were taken in autumn 2010 from wheat farms in Miyaneh region, Iran. Weed species composition and seed numbers in 0-10 and 10-20 cm of soil depths in wheat-wheat (ww) and wheat-fallow (wf) cropping systems were investigated. On the whole, we found 19 plant species of 10 families as dominant weed species in these systems. Weed populations were higher in superficial soil depths (62%) but partially was the same in both cropping systems. About 97% of collected seeds belonged to dicotyledonous plants. In both systems, Asteraceae, Brassicaceae, Caryophyllaceae and Ranunculaceae were dominating families. Totally, 17 di- and two mono-cotyledonous species were found. The most frequent species were *Stellaria media*, *Silene conoidea* and *Alyssum hirsutum* in ww *Silene conoidea*, *Centurea depressa*, *Vaccaria pyramidata* and *Stellaria media* in wf cropping systems. There was no *Acroptilon repens* in ww and no *Alhahi pseudalhagi*, *Rezeda lutea* and *Hordeum murinum* in ww cropping systems.

**Keywords:** weed population, seed collection, *Triticum aestivum*

## 1. Introduction

The soil seed bank refers to the natural storage of seeds, often dormant, within the soil of most ecosystems and it is important to gain knowledge about the soil weed seed bank (Forcella *et al.,* 2004). Seed bank represents the main source of annual weed infestation and constitutes a weed seed reservoir in agricultural production systems (Caroca *et al*., 2011). Soil seed banks are important for vegetation management because they contain propagules of species that may be considered desirable or undesirable for site colonization after management and disturbance events (Gulden and Shirtliffe, 2009). Knowledge of seed bank size and composition before planning management activities facilitates proactive management by providing early alerts of exotic species presence and of abilities of seed banks to promote colonization by desirable species (Albela and Springer, 2008). Tillage, weed management and crop rotation are major variables that affect weed seed banks in the soil. In many parts of the world, the most popular technique for reducing weed seed bank size has been some form of following combined with cultivation (Ranjit *et al.,* 2007). YaLi *et al.* (2009) investigated weed seed banks in winter wheat fields in Tianshui and Qingyang in China and found 20 species of 9 families in Qingyang soil samples and 13 species of 10 families (1964-2520 plants/m$^2$) in Tianshui. They found *Echinochloa crus-galli*, *Cyperus iria*, *Cyperus difformis, Breea arvensis* and *Arenaria serpyllifolia* as predominant species in studied wheat farms. Caroca *et al.* (2011) found within soil in wheat and maize fields, some weeds such as *Poa annua*, *Cichorium intybu, Sonchus* sp., *Euphorbia helioscopia* and *Echinochloa crus-galli*. Shaghaghi (2007) studied the weed seed bank in rotations based on wheat and found different compositions in each rotation in Miyaneh region. Around 60% of total weed seeds is found between 0 and 5 cm soil depth, and weed seed concentration decreases logarithmically with soil depth (Chauhan *et al.*, 2006). This study examined the seed densities and composition in both rotations

+ Corresponding author. Tel.: + 98 9143232270; fax: + 98 4232227290.
*E-mail address*: s.jamshidi@m-iau.ac.ir

comprising of wheat-wheat and wheat-fallow and the influence of soil depths on weed seeds composition and frequence with the aim to develop more effective management strategies.

## 2. Material and Methods

The current study was performed in the locality Miyaneh in Azaebaijan-e Shraghi province, Iran (48˚ 04′E and 37˚ 14′ N, 1600 m.a.s.l.) in rainfed winter wheat farms which was under wheat cultivation or fallow in previous year during 2010 fall. All studied parcels comprising of three farms of each wheat-wheat and wheat-fallow cropping systems were nearby. Weed management was performed using Granstar® and 2,4-D® herbicides in both types of fields in last year. Soil sampling from the plots was made in zigzag fashion, with 20 replications in each plot by earth auger with 7 cm internal diameter. Samples weighted in average 550 g and 385 $cm^2$ in volume were taken separately from depths of 0-10 cm and 10-20 cm, were extended, air-dried, and shaded from direct sunlight at room temperature, then smashed finely to remove rough clods. After sieving of the soil samples through copper sieves (5, 20, 40, 50, 60 and 70 mesh) the seed manually separated from the soil particles, as well as their determination by stereo-microscope. The identification key offered by Aghabeigi and Termeh (2000) for cereals weeds was used for species determination. The obtained data were statistically processed in Microsoft Excel 2010 and SPSS 16.

## 3. Results and discussion

Totally, we found 4397 seeds belonged to 19 species of 10 families in 240 soil samples weighted about 132 kg (33 seeds/kg of soil). Generally, weed seed population was higher in superficial soil part (0-10 cm depth) than in superficial parts (10-20 cm), 62 and 38%, respectively, but partially equal in two rotations (48% in ww and 51% in wf rotations). Weed seeds were more frequent in deeper parts in wf system (Fig. 1). About 97% of the found seeds were dicotyledone. The most and least frequent monocotyledonous weeds were found in superficial soils in both systems comparing the deeper parts. The most number of di-cotyledonous seeds were similarly found in superficial parts of soil (Fig. 2). The most dicotyledonous seeds were obtained in continuous wheat system.

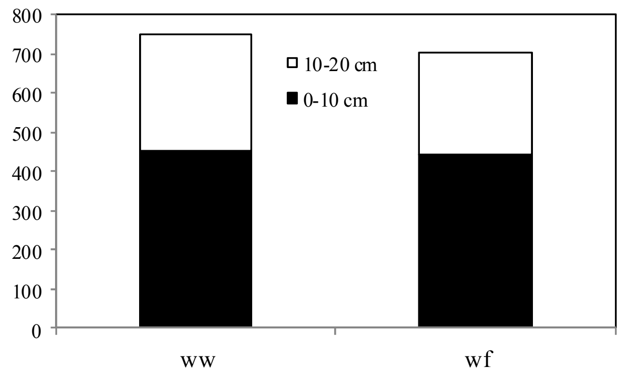


Fig. 1. Comparosion of weed seeds frequency in wheat-wheat and wheat-fallow rotations in different deths

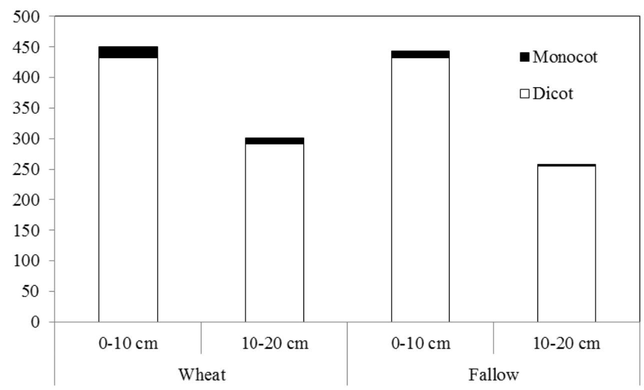

Fig. 2. Distribution of weed seeds in wheat-wheat and wheat-fallow rotation systems in different deths

The seeds beloned to 10 families included nine dicotyledonous and one monocotyledonous families including Asteraceae, Brassicaceae, Caryophyllaceae, Chenopodiaceae, Fabaceae, Papaveraceae, Ranunculaceae, Resedaceae and Rubiaceaea as dicots and Poaeae as monocots. In both rotations, dominant weeds belonged to Asteraceae, Brassicaceae, Caryophyllaceae and Ranunculaceae. The other families had more or less share in weed seeds proportion in both rotations. Nothing of weed seeds was found in wf systems from Fabaceae and Resedaceae families. Caryophyllaceae and Asteraceae were the most frequent families in ww and wf systems, respectively. Asteraceae and Caryophyllaceae seed numbers were significantly more in wf system than in ww system, while wf had more Brassicaceae seeds (Fig. 3).

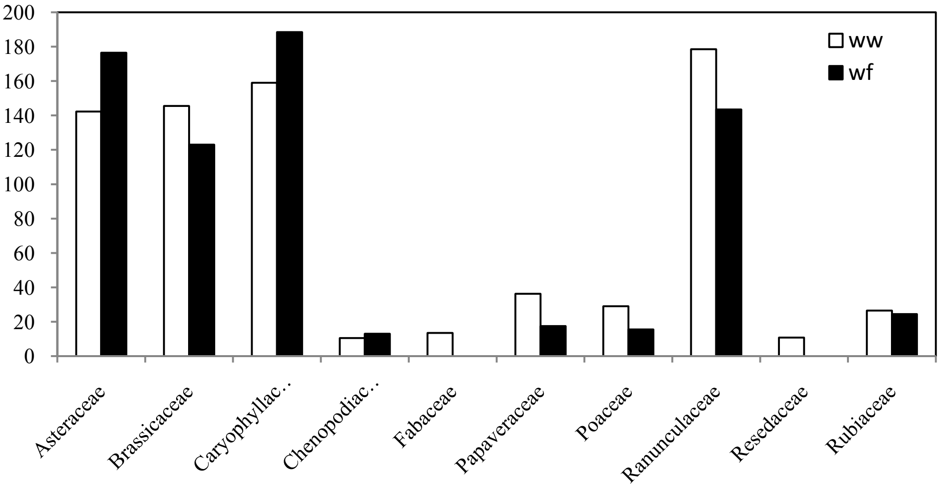


Fig. 3. Plant families frequencies in the ww and wf systems in each field

In superficial and deeper soils all families could be found but superficial soils were more than of deeper parts in Fabaceae case. There was equal number of Resedaceae seeds in both depths. The most frequent family in superficial parts was Ranunculaceae and in deeper part Asteraceae and Caryophyllaceae. Families comprising Poaceae and Papaveraceae were found almost in the same proportion and number in superficial and deep parts of the soil (Fig. 4).

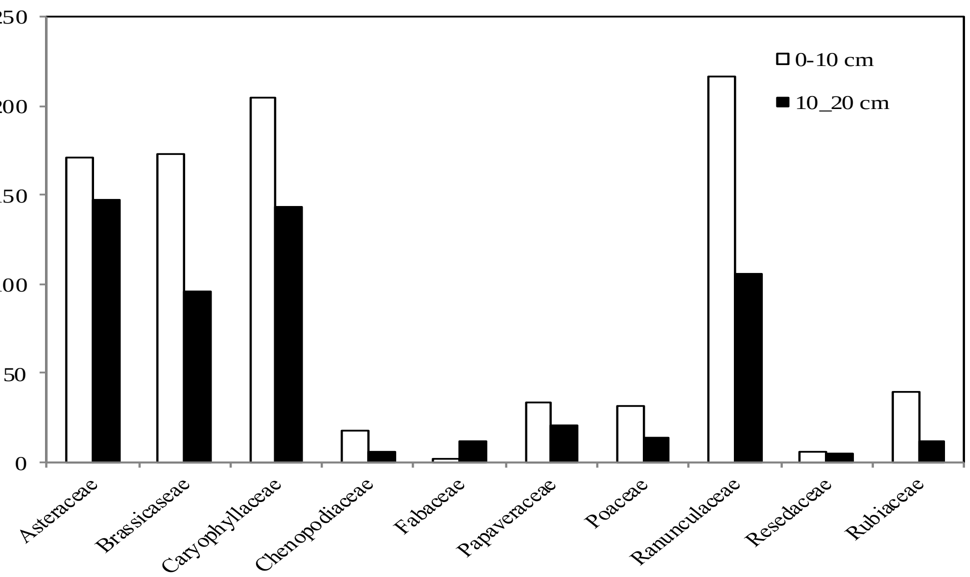


Fig. 4. Plant families frequencies in 0-10 and 10-20 cm depth in each field

Collectively, 17 di- and two monocotyledonous species were found. The most frequent species were *Stellaria media*, *Silene conoidea* and *Alyssum hirsutum* in ww *Silene conoidea*, *Centurea depressa*, *Vaccaria pyramidata* and *Stellaria media* in wf cropping systems. There was no *Acroptilon repens* in ww and no *Alhahi pseudalhagi*, *Rezeda lutea* and *Hordeum murinum* in ww cropping systems (Table 1).

Weed seed banks are an important component of the weed life cycle. There are many fates and processes that occur in the weed seed bank, many of which are not very well understood. The sheer difficulty of monitoring a process that occurs mostly underground has deterred weed scientists from gaining a full understanding of the weed seed bank.

Table 1 - Inventory of weed seeds occurring a at three depths in a 6-year cropping system study in the semi-arid region of the Pacific Northwest, USA

| Weed species | Sieve (mesh)* | Size (mm) | 100 kernels weight average (gr) | mean of seed number per field | | | |
|---|---|---|---|---|---|---|---|
| | | | | Wheat | | Follow | |
| | | | | 0-10 cm | 10-20 cm | 0-10 cm | 10-20 cm |
| **Dicotyledones** | | | | 432 | 291 | 432 | 255 |
| Asteraceae | | | | 79 | 63 | 93 | 84 |
| *Achillea millefolium* | 40 | 1.32 ± 0.15 × 0.47 ± 0.05** | 0.04 | 9 | 1 | 2 | 0 |
| *Acroptilon repens* | 20 | 3.84 ± 0.28 × 1.48 ± 0.32 | 0.78 | 0 | 0 | 7 | 3 |
| *Anthemis arvensis* | 40 | 1.71 ± 0.24 × 0.52 ± 0.03 | 0.05 | 43 | 25 | 43 | 24 |
| *Centaurea depressa* | 20 | 1.77 ± 0.16 × 0.81 ± 0.07 | 1.05 | 28 | 37 | 42 | 58 |
| Brassicaceae | | | | 92 | 54 | 81 | 42 |
| *Alyssum hirsutum* | 20 | 1.59 ± 0.11 × 1.31 ± 0.19 | 0.07 | 57 | 33 | 39 | 19 |
| *Descurainia sophia* | 70 | 0.88 ± 0.07 × 0.44 ± 0.04 | 0.03 | 7 | 4 | 19 | 11 |
| *Lipidium draba* | 5 | 2.06 ± 0.13 × 1.31 ± 0.21 | 0.24 | 29 | 17 | 24 | 13 |
| Caryophyllaceae | | | | 93 | 67 | 112 | 77 |
| *Silene conoidea* | 20 | 1.39 ± 0.14 × 1.26 ± 0.16 | 6.85 | 57 | 36 | 60 | 34 |
| *Vaccaria pyramidata* | 5 | 1.57 ± 0.09 | 0.52 | 35 | 31 | 52 | 43 |
| *Stellaria media* | 50 | 0.63 ± 0.07 × 0.58 ± 0.0 2 | 0.03 | 69 | 35 | 60 | 23 |
| Chenopodiaceae | | | | 6 | 4 | 11 | 2 |
| *Salsola kali* | 5 | 1.35 ± 0.9 × 1.36 ± 0.11 | 0.16 | 6 | 4 | 11 | 2 |
| Fabaceae | | | | 2 | 12 | 0 | 0 |
| *Alhagi pseudalhagi* | 20 | 2.08 ± 0.26 × 1.61 ± 0.16 | 0.34 | 2 | 12 | 0 | 0 |
| Papaveraceae | | | | 18 | 18 | 16 | 2 |
| *Papaver dubium* | 50 | 0.59 ± 0.06 × 0.46 ± 0.03 | 0.02 | 18 | 18 | 16 | 2 |
| Ranunculaceae | | | | 118 | 61 | 99 | 45 |
| *Ranunculus arvensis* | 20 | 1.25 ± 0.27 × 1.02 ± 0.24 | 0.10 | 49 | 26 | 39 | 17 |
| *Ceratocephalus falcatus* | 5 | 4.59 ± 0.96 × 2.12 ± 0.27 | 0.52 | 0 | 1 | 0 | 5 |
| Resedaceae | | | | 6 | 5 | 0 | 0 |
| *Reseda lutea* | 40 | 1.42 ± 0.6 × 1.06 ± 0.10 | 0.09 | 6 | 5 | 0 | 0 |
| Rubiaceae | | | | 19 | 8 | 21 | 4 |
| *Galium aparine* | 20 | 1.6 ± 0.13 | 1.01 | 19 | 8 | 21 | 4 |
| **Monocotyledones** | | | | 19 | 10 | 12 | 4 |
| Poaceae | | | | 19 | 10 | 12 | 4 |
| *Bromus tectorum* | 20 | 7.01 ± 0.71 × 1.13 ±0.21 | 0.25 | 11 | 3 | 12 | 4 |
| *Hordeum murinum* | 20 | 3.67 ± 1.52 × 1.05 ± 0.07 | 0.27 | 9 | 7 | 0 | 0 |

* the sieve that weed seeds were trapped in.

** length mean ± standard deviation × width mean ± standard deviation

Nevertheless, current knowledge about weed seed banks has shown some potential management options. Reducing the numbers of seeds entering the seed bank is an important component of seed bank management, while other strategies, like using a no-till cropping system, can be used to directly affect germination, persistence and mortality of weed seeds. Managing weed seed banks should be an important component of integrated weed management, but more often than not, seed bank management is not being exploited to its fullest potential. It is recommended to intensify control of weeds at roadsides and ridges and to apply fermented manures

## 4. Acknowledgements

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