

# MONITORIZAREA STĂRII DE CONSERVARE A BIODIVERSITĂȚII FLOREI ÎN PLANTAȚIILE POMICOLE

## MONITORING THE CONSERVATION STATE OF FLORA BIODIVERSITY IN ORCHARDS

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### Abstract

Monitoring and identifying the weed species in the cultivated flora offers important indications regarding the nature and characteristics of the agro-ecosystem, useful to farmers for the ecological control of the weeds in order to ensure the stability of the ecosystem. The monitoring was carried out in the apple and pear field trials from RIFG Pitești. The inventory of the weeds species in the analyzed area was achieved by mapping the flora with a frame of one square meter and includes systematic data of species, phenology, abundance, dominance and different biodiversity indices. The dominant species with ecological interest in the field trials were: repellent species (*Thlaspi arvense* L., *Achillea millefolium* L., *Solanum nigrum* L., *Taraxacum officinale* L.) with role in pests control, such as aphids, mites; good pollination species (*Melilotus officinalis* L. Pall, *Taraxacum officinale* L., *Lamium purpureum* L., *Polygonum convolvulus* L.); species that improve soil in nitrogen (*Vicia sativa* L., *Trifolium repens* L., *Festuca rubra* L., *Echium vulgare* L.). All these species can contribute to the creation of a sustainable ecosystem, which is why special attention should be paid to the control of them.

**Cuvinte cheie:** ecosistem, specii de buruieni, cartare, abundență, dominanță, indici de biodiversitate.

**Key words:** ecosystem, weed species, mapping, abundance, dominance, biodiversity indices.

### 1. Introduction

In the orchard ecosystem, considered an energy-intensive system, the amplification of biocenotic imbalances with the explosions of diseases and pests, represents a problem and at the same times a proof of the destruction of biodiversity. The main causes of the destruction of agrobiodiversity are: excessive use of chemical fertilizers and pesticides; reduction or even elimination of useful fauna; excessive development of invasive species, performing mechanized technological works with an impact on soil degradation, air pollution, climate change etc. In this context, fruit-growing researchers were concerned about the development of eco-efficient technological sequences that will contribute in the future to protection of the environment in general and the conservation of agro-biodiversity in particular (Tomoiaga et al., 2018).

The grass cover between the rows in orchards can be an important management practice that provides different ecological services, reducing the risk of agrobiodiversity decline, improving the soil fertility, increasing soil organic matter, increasing the total nitrogen, available phosphorus and available potassium contents of the soil, to fixation of soils exposed to erosion and compaction, to conservation of soil resources; to improving the soil microbial communities and soil properties (Hoagland et al., 2008; Simoes et al., 2014; Singh et al., 2016; Xiaozhu et al., 2016; Li et al., 2022 Răduțoiu et al., 2023; Ma et al., 2024).

Natural grass, clover (*Trifolium repens* L.), alfalfa (*Medicago sativa* L.), perennial ryegrass (*Lolium perenne* L.), villous wild pea (*Vicia villosa* Roth.), raitail fescue (*Vulpia myuros* L.), tall fescue (*Festuca arundinacea*) are commonly cultivated species between the rows in the orchards, depending on the pedo-climatic conditions of the area (Răduțoiu et al., 2023; Ma et al., 2024). The types of cover crops have different influences on the soil and trees. For example, alfalfa has a higher degradation capacity of C and N than grasses. Also, alfalfa increase soil organic matter, the C and N fractions and soil enzyme activities more than grasses (Ma et al., 2024). Combinations of legumes (e.g. villous wild pea or alfalfa) with natural grasses increase the abundance and diversity of beneficial microorganisms and soil nutrient levels which provide positive influence on the development of the fruit trees (Wang et al., 2014, 2023; Ma et al., 2024). In addition, *Vulpia myuros* L. species can suppress the growth of other weeds (Răduțoiu et al., 2023).

In addition to improve soil characteristics, the grass cover can positively influence the fruits quality (color, sugar content, mineral composition), it can contribute to develop a better habitat for beneficial insects, thus influencing the processes of pollination and fruits set, and also contributing to the suppression of pests (Martinez et al., 2020; Giacalone et al., 2021).

The aim of this paper is monitoring and identifying the vascular flora in the apple and pear field trials which offers important indications regarding the nature and characteristics of the agro-ecosystem, useful to farmers for the ecological control of the weeds in order to ensure the stability of the ecosystem.

The objectives of this paper aim to support the eco-schemes (an important element in Common Agricultural Policy – PAC 2023-2027) regarding the grassy cover in orchards and to offer viable solutions to the active farmers, who practice a modern fruit growing, but at the same time friendly with the environment.

## 2. Material and methods

### Field trial, plant material and climatic conditions

The study was conducted in the apple and pear field trials established in 2022 at the Research Institute for Fruit Growing Pitesti, Romania, where three soil maintenance variants have been applied between the rows of trees: V1 - clean soil; V2 - spontaneous grass cover; V3 - artificial grass cover (*Lolium perenne* L., *Festuca rubra* L., *Lotus corniculatus* L. and *Medicago sativa* L.).

The average multi-annual temperature was 10.1°C, the maximum temperature 38.8°C, whereas the minimum temperature -24.4°C; total annual rainfalls recorded was 673.2 mm. Regarding precipitation, there is a rainfall exceeding in winter (119 mm) and a rainfall deficit in summer (156 mm) (Fig. 1). Compared to the baseline for 55 years period, the agricultural year, 2023-2024, was the hottest in the last 55 years, with 3.1°C over normal (13.2°C compared to 10.1°C as normal), following the multiannual climatic tendencies, but also much poorer in precipitation, with 193.2 mm below normal (480.0 mm compared to 673.2 mm as it represents the normal interval October - September). Also, the annual average of the maximum temperatures of 20.7°C was the highest of the last half century, with 4.1°C above the multiannual average of 16.6°C, but also the average of the minimums (6.6°C compared to 4.9°C) it had a probability ≤ 98.4%, higher values registering only every 62 years (Fig. 2).

### Measurements

The inventory of the weeds species was achieved by mapping of the vegetations from the apple and pear field trials with a frame of one square meter. The method of the metric frame (Daget and Poisson, 1971; Păcurar and Rotar, 2014) is useful for both determining abundance and dominance. This is a very accurate method for monitoring the vegetation with which the degree of soil coverage with weeds is established, by determining the surface covered with each species. The method of the metric frame is used especially in experimental works, in order to establish the changes that occur under different anthropic influences. Within the experiences, 3 readings were executed in each experimental variant from June to August. The readings were executed on the same places, picked, to observe exactly, over time, the changes produced during a year or a vegetation period.

Weeds mapping was carried out within the three experimental variants: V1 - clean soil; V2 - spontaneous grass cover; V3 - artificial grass cover: V3.1 – *Lolium perene* L.; V3.2 – *Festuca rubra* L.; V3.3 – *Medicago sativa* L.; V 3.4 – *Lotus corniculatus* L.; V3.5 - mixture.

In the apple and pear field trials, the number of samples was 3 for each experimental variant.

The following observations and determinations were made: weeds identification, systematic classification, phenology, abundance - the total number of weeds in the experimental version, dominance or relative abundance - the ratio between the plants number of one species and the sum of the plants number of other species in the studied area, expressing the influence exerted by a species in studied phytocenosis. In addition to the abundance and dominance, four biodiversity indices have also been calculated (Păcurar and Rotar, 2014; Bulimaga and Portărescu, 2019):

1. The *similarity index* after the *Jacard* which determines the number of species common to the three experimental variants:

$l_{ja} = 100 \times d/a+b+c$ , where:

$l_{ja}$  = index of similarity after Jacard

$a$  = the number of species in the variant 1 – clean soil;

$b$  = the number of species in the variant 2 - spontaneous grass cover;

$c$  = the number of species in the variant 3 - artificial grass cover;

$d$  = the number of species common to the 3 variants.

2. The *flora diversity index* (*Margalef*) which determines the biodiversity of weed species from the 3 experimental variants:

$D_{mg} = S-1/\ln N$ , where:

$D_{mg}$  = Margalef diversity index

$S$  = the number of species in the variant

$N$  = the total plants number of all species.

3. The *diversity index Simson* (D) used in the estimation of the diversity of agricultural systems. This index is not influenced by the sample surface; it is slightly influenced by the number of species and strongly influenced by the abundance of species:

$$D = \sum p_i^2, \text{ where:}$$

- $p_i = n_i/N$
- $p_i$  = the proportion of the species
- $n_i$  = the plants number of a species
- $N$  = the total plants number in the analyzed perimeter

4. *Shannon (H) diversity index* based on the principle of entropy and takes into account the number of species and relative abundance. The value of the index can increase both due to the presence of species and the high abundance of certain species (Sărățean et al., 2011). The values of the Shannon index are between 1.5 and 3.5, where 1.5 means a low diversity, 2.5 - a medium diversity and 3.5 - high diversity. A great disadvantage of this index is the dependence on the surface of the samples because it does not capture the rare species (Cristea et al., 2004) and therefore is not used in the case of comparing uneven samples. However, the Shannon index was adapted even for the evaluation of the spatial biodiversity of the agroecosystem (Smale et al., 2003) or the diversity of cultivated species (Di Falco and Chavas, 2008):

$$H = - \sum_{i=1}^s (p_i \ln p_i)$$

- $p_i = n_i/N$
- $p_i$  = the proportion of the species
- $n_i$  = the plants number of a species
- $N$  = the total plants number in the analyzed perimeter

### 3. Results and discussions

For the correct application of the maintenance work of the soil between the rows of fruit trees, it is necessary to know the floristic spectrum which enters in the competition with the fruit trees, but also of ecological interest (Ionescu et al., 2016).

Following the research carried out on the grassy cover in apple and pear field trials, it was found that the floristic composition includes valuable species that can be successfully used to improve the soil in nitrogen and other elements (*Vicia sativa* L., *Trifolium repens* L., *Festuca rubra* L., *Echium vulgare* L.), to control the pests, such as aphids, mites (*Thlaspi arvense* L., *Achillea millefolium* L., *Solanum nigrum* L., *Taraxacum officinale* L.), to ensure good pollination (*Melilotus officinalis* L. Pall, *Taraxacum officinale* L., *Lamium purpureum* L., *Polygonum convolvulus* L.).

The weed species from the apple and pear field trials in all three experimental variants have been distributed on five groups: Group I - 15-50 plants/m<sup>2</sup>; Group II - 10-15 plants/m<sup>2</sup>; Group III - 5-10 plants/m<sup>2</sup>; Group IV - 1-5 plants/m<sup>2</sup>; Group V-0.1-1 plant/m<sup>2</sup>.

In the V1 - clean soil the average number of weeds species identified was 42.4 plants/m<sup>2</sup>. The predominated species were *Echinochloa crus-gali* L. (15.6 plants/m<sup>2</sup>), *Chenopodium album* L. (11.3 plants/m<sup>2</sup>) and *Convolvulus arvensis* L. (7 plants/m<sup>2</sup>) (Table 1.1). 10 plants species were identified, the total number of plants / surface unit, respectively 630 square meters (the area of the clean soil interval), being 26,712 plants (Table 1.2).

The dominance or relative abundance (the ratio between the plants number of one species and the sum of the plants number of other species in the studied area) had values between 0.368 (*Echinochloa crus-gali*) and 0.024 (*Amaranthus retroflexus* L., *Senecio jacobaca*, *Vicia sativa*, *Echium vulgare*) (Table 1.2). The *Shannon* (H) index had a value of 1.725, which indicates a low biodiversity in the apple and pear fields - the clean soil variant (Table 1.2). The value of the *Simson* index, of 0.239, also indicates a low biodiversity (Table 1.2).

In the V2 – spontaneous grass cover, the average weeds species identified was 61.4 plants/m<sup>2</sup> predominating species *Trifolium repens* L. (15 plants/m<sup>2</sup>), *Poa pratensis* L. (12.3 plants/m<sup>2</sup>) and *Echinochloa crus-gali* L. (10.6 plants/m<sup>2</sup>) (Table 2.1). There were identified 16 plants species, the total number of plants at the surface unit being 38,682 plants (Table 2.2).

The dominance had values between 0.2443 (*Trifolium repens* L.) and 0.0163 (*Rumex crispus* L., *Melilotus officinalis* L. Pall, *Plantago major* L., *Potentilla reptans* L., *Hypochaeris radicata* L., *Prunella vulgaris* L., *Solanum nigrum* L.) (Table 2.2). The average values of *Shannon* and *Simson* indices were low, which indicate a low biodiversity, but much larger than in variant 1 – clean soil (Table 2.2).

In the variant 3 – artificial grass cover, the weeds species were included in group I with 45.0 plants/m<sup>2</sup> in variant 3.1 - artificial grass cover with *Lolium perenne* L., 51.0 plants/m<sup>2</sup> in variant 3.2 -

artificial grass cover with *Festuca rubra* L., 56.0 plants/m<sup>2</sup> in variant 3.3 - artificial grass cover with *Medicago sativa* L., 58.0 plants/m<sup>2</sup> in variant 3.4 - artificial grass cover with *Lotus corniculatus* L. and 76.0 plants/m<sup>2</sup> in variant 3.5 - artificial grass cover with mixture. The predominant species were: *Lolium perenne* L. (38 plants/m<sup>2</sup> in variant 3.1 and 19 plants/m<sup>2</sup> in variant 3.5), *Festuca rubra* L. (34 plants/m<sup>2</sup> in variant 3.2 and 14 plants/m<sup>2</sup> in variant 3.5), *Medicago sativa* L. (33 plants/m<sup>2</sup> in variant 3.3 and 13 plants/m<sup>2</sup> in variant 3.5), *Lotus corniculatus* L. (41 plants/m<sup>2</sup> in variant 3.4 and 15 plants/m<sup>2</sup> in variant 3.5 (Table 3.1).

The number of species identified in this variant was smaller than in the other two variants (9 species), but the total number of plants was much higher (180,180 plants/surface unit) (Table 3.2).

The dominance or relative abundance had values between 0.1329 (*Lolium perenne*) and 0.0070 (*Plantago major* L., *Convolvulus arvensis* L., *Taraxacum officinale*) (Table 3.2).

The Shannon (H) index had a value of 2.6583, and the Simson index had a value of 0.0865, which indicates a low biodiversity in the apple and pear field trials - the artificial grass cover variant (Table 3.2).

The values of the Simson and Shannon indices obtained in our study are much lower than those reported by Li et al., in 2022, in a China's apple orchard.

The taxonomic analysis of the weeds species from the apple and pear field trials shows that 28 weeds species were identified, belonging to 15 botanical families. The family with the numerous species was *Asteraceae* (6 species), followed by *Fabaceae* (5 species), *Poaceae* (4 species) and *Polygonaceae* (2 species). A significant percentage is occupied by families that have only one representative (Fig. 3).

Radutoiu et al. (2023), analyzing the floristic composition of apple, plum and sweet cherry orchards, reported similar data on systematic weeds, with the predominance of weeds from *Asteraceae*, *Poaceae*, *Fabaceae* and *Polygonaceae*.

Analyzing the floristic biodiversity in field trials regarding flowering periods shows that most weed species bloom during the vegetation period of the fruit trees, from spring to autumn (Tables 1, 2, 3; Fig. 4). A small part of the weed species bloom in the spring, at the same time with the fruit trees, being attracted to the bees and contributing to a good pollination in the orchard. Very few species bloom in summer.

In order to know the number of common weeds species in the three experimental variants, the index of similarity after Jacard has been calculated. Only two weed species were common to the 3 experimental variants, the index of similarity having the value 5.71, which indicates a low diversity (Table 4).

Another index for monitoring the floristic diversity is the *Margalef* diversity index, which has maximum values if all plants belong to different species ( $S = N$ ), and minimal or equal to zero when plants belong to a single species ( $S = 1$ ) (Bulimaga și Portărescu, 2019). In the 3 experimental variants, the values of the *Margalef* diversity index are small, which indicates a low floristic diversity (Table 4).

#### 4. Conclusions

The floristic composition in the apple and pear field trials is variable depending on the management of soil between the rows of trees.

The diversity indices calculated had small values, indicating a low diversity.

In the field trials studied the most weeds species belong to *Asteraceae*, *Fabaceae*, *Poaceae* and *Polygonaceae* families.

The dominant species of ecological interest in the apple and pear field trials were:

- repellent species: *Thlaspi arvense* L., *Achillea millefolium* L., *Solanum nigrum* L., *Taraxacum officinale* L. - with a role in control pests, such as aphids, mites;

- attractive species: *Melilotus officinalis* L. Pall, *Taraxacum officinale* L., *Lamium purpureum* L., *Polygonum convolvulus* L., *Medicago sativa* L., *Trifolium repens* L., *Achillea millefolium* L. – species which attract the bees and contribute to a good pollination in the orchard;

- nitrogen fixing species that can contribute to improving the chemical composition of the soil: *Vicia sativa* L., *Trifolium repens* L., *Festuca rubra* L., *Echium vulgare* L., *Medicago sativa* L..

These weeds species can contribute to increase biodiversity and create a sustainable ecosystem, which is why special attention should be paid to the control of them.

Such studies are necessary because when establish an orchard, the right method must be chosen for management the space between the rows of trees to ensure an optimal and efficient production.

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Tables and Figures

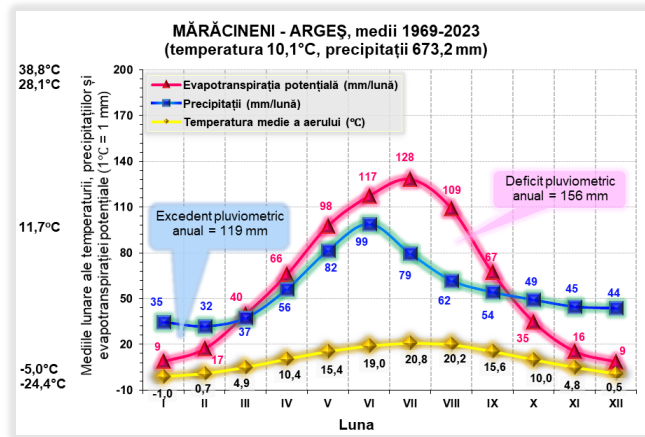


Fig. 1. The values of the main meteorological parameters (1969-2023)

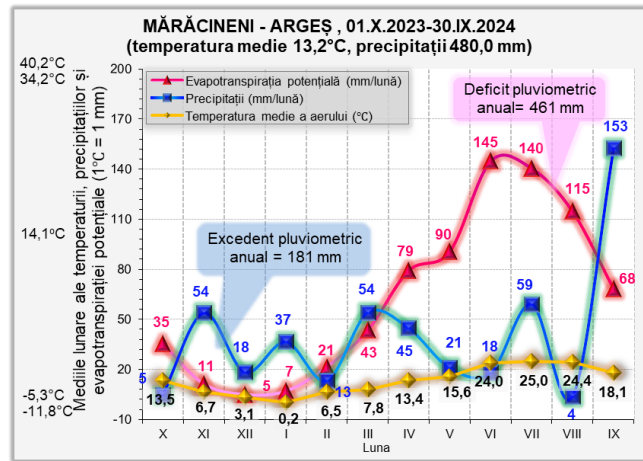


Fig. 2. The values of the main meteorological parameters in agricultural year 2023-2024

Table 1.1. Weed species identified in apple and pear field trials ( V1, clean soil)

Weed species	Family	Flowering period	No. of plants /m <sup>2</sup>	No. of. plants / 3 determination
<i>Echinochloa cruss-gali</i> L.	Poaceae	July-October	15.6	47
<i>Chenopodium album</i> L.	Chenopodiaceae	Summer-Autumn	11.3	34
<i>Convolvulus arvensis</i> L.	Convolvulaceae	Almost all the vegetation period	7.0	21
<i>Polygonum convolvulus</i> L.	Polygonaceae	June-August	1.3	4
<i>Amaranthus retroflexus</i> L.	Amaranthaceae	June-September	1.0	3
<i>Stellaria media</i> L. Vill	Caryophyllaceae	Almost all the vegetation period	1.6	5
<i>Senecio jacobaca</i> L.	Asteraceae	Spring-Autumn	1.0	3
<i>Vicia sativa</i> L.	Fabaceae	May-September	1.0	3
<i>Equisetum arvense</i> L.	Equisetaceae	June-August	1.6	5
<i>Echium vulgare</i> L.	Boraginaceae	June-August	1.0	3
<b>Total no. of plants/m<sup>2</sup></b>			<b>42.4</b>	<b>128</b>

**Table 1.2. Biodiversity indices in apple and pear field trials (V1, clean soil)**

Weed species	Abundance/ Surface unit	Dominance	Simpson Index (D)	Shannon Index (H)
<i>Echinochloa cruss-gali</i> L.	9,828	0.368	<b>0.239</b>	<b>1.725</b>
<i>Chenopodium album</i> L.	7,119	0.266		
<i>Convolvulus arvensis</i> L.	4,410	0.165		
<i>Polygonum convolvulus</i> L.	819	0.031		
<i>Amaranthus retroflexus</i> L.	630	0.024		
<i>Stellaria media</i> L. Vill	1,008	0.037		
<i>Senecio jacobaca</i> L.	630	0.024		
<i>Vicia sativa</i> L.	630	0.024		
<i>Equisetum arvense</i> L.	1,008	0.037		
<i>Echium vulgare</i> L.	630	0.024		
<b>Total no. of plants/surface unit</b>	<b>26,712</b>			

**Table 2.1. Weeds species identified in apple and pear field trials (V2, spontaneous grass cover)**

Weed species	Family	Flowering period	No. of plants /m <sup>2</sup>	No. of. plants / 3 determination
<i>Trifolium repens</i> L.	<i>Fabaceae</i>	June-September	15.0	47
<i>Poa pratensis</i> L.	<i>Poaceae</i>	May-September	12.3	37
<i>Echinochloa cruss-gali</i> L.	<i>Poaceae</i>	July-October	10.6	32
<i>Achillea millefolium</i> L.	<i>Asteraceae</i>	June-September	3.3	10
<i>Lamium purpureum</i> L.	<i>Lamiaceae</i>	March	3.0	9
<i>Taraxacum officinale</i> L.	<i>Asteraceae</i>	March-April	3.3	10
<i>Thlaspi arvense</i> L.	<i>Brassicaceae</i>	May-September	2.3	7
<i>Convolvulus arvensis</i> L.	<i>Convolvulaceae</i>	Almost all the vegetation period	3.3	10
<i>Cirsium arvense</i> L.	<i>Asteraceae</i>	Summer	1.3	4
<i>Rumex crispus</i> L.	<i>Polygonaceae</i>	June-September	1.0	3
<i>Melilotus officinalis</i> L. Pall	<i>Fabaceae</i>	March-July	1.0	3
<i>Plantago major</i> L.	<i>Plantaginaceae</i>	June-September	1.0	3
<i>Potentilla reptans</i> L.	<i>Rosaceae</i>	May-August	1.0	3
<i>Hypochaeris radicata</i> L.	<i>Asteraceae</i>	June-August	1.0	3
<i>Prunella vulgaris</i> L.	<i>Lamiaceae</i>	June-August	1.0	3
<i>Solanum nigrum</i> L.	<i>Solanaceae</i>	June-September	1.0	3
<b>Total no. of plants/m<sup>2</sup></b>			<b>61.4</b>	<b>187</b>

**Table 2.2. Biodiversity indices in apple and pear field trials (V2, spontaneous grass cover)**

Weed species	Abundance/ Surface unit	Dominance	Simpson Index (D)	Shannon Index (H)
<i>Trifolium repens</i> L.	9,450	0.2443	<b>0.1443</b>	<b>2.2625</b>
<i>Poa pratensis</i> L.	7,749	0.2003		
<i>Echinochloa cruss-gali</i> L.	6,678	0.1726		
<i>Achillea millefolium</i> L.	2,079	0.0537		
<i>Lamium purpureum</i> L.	1,890	0.0488		
<i>Taraxacum officinale</i> L.	2,079	0.0537		
<i>Thlaspi arvense</i> L.	1,449	0.0374		
<i>Convolvulus arvensis</i> L.	2,079	0.0537		
<i>Cirsium arvense</i> L.	819	0.0211		
<i>Rumex crispus</i> L.	630	0.0163		
<i>Melilotus officinalis</i> L. Pall	630	0.0163		
<i>Plantago major</i> L.	630	0.0163		
<i>Potentilla reptans</i> L.	630	0.0163		
<i>Hypochaeris radicata</i> L.	630	0.0163		
<i>Prunella vulgaris</i> L.	630	0.0163		
<i>Solanum nigrum</i> L.	630	0.0163		

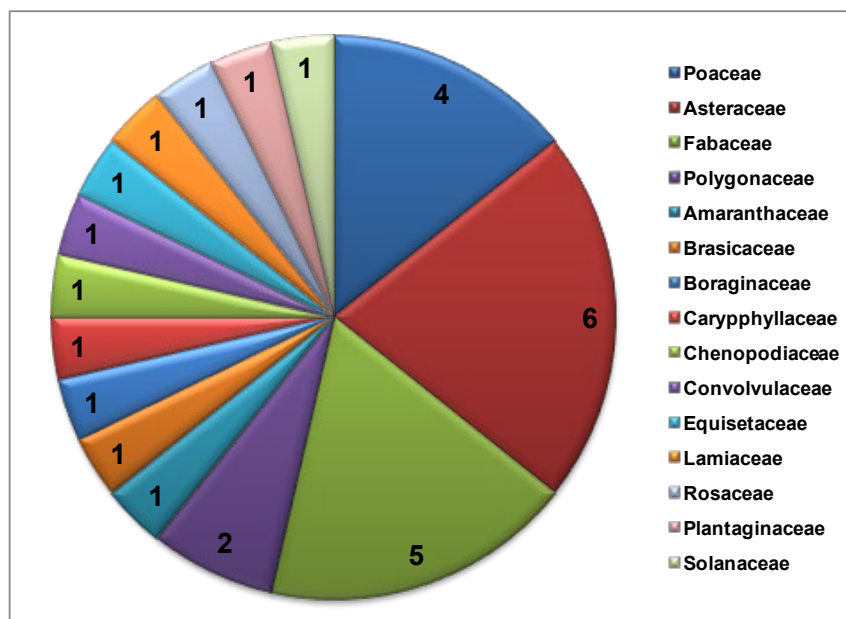
<b>Total no. of plants/surface unit</b>	<b>38,682</b>			
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**Table 3.1. Weeds species identified in apple and pear field trials (V3, artificial grass cover)**

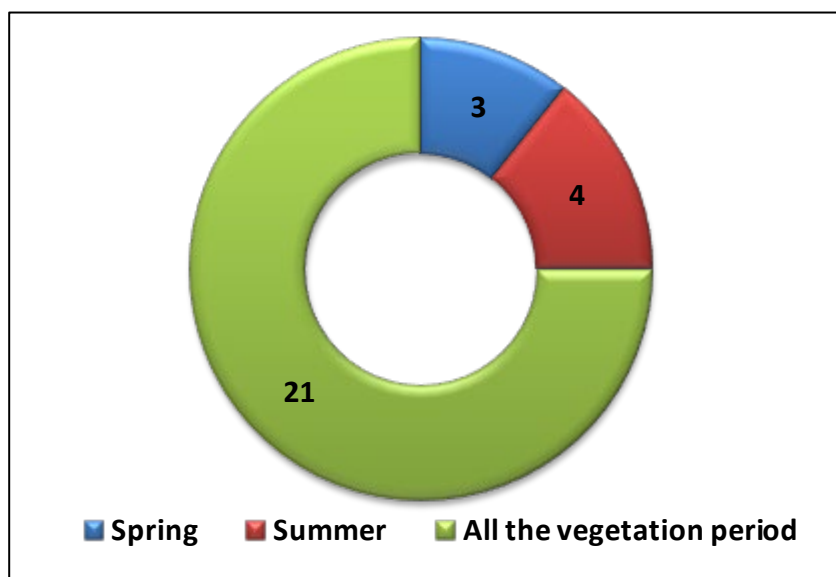
Variant	Weed species	Family	Flowering period	No. of plant/m <sup>2</sup>	No. of plant/3 determination
V3.1 <i>Lolium perenne</i>	<i>Lolium perenne</i> L.	Poaceae		38.0	114.0
	<i>Plantago major</i> L.	Plantaginaceae	June-September	2.0	6.0
	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Almost all the vegetation period	5.0	15.0
	<b>Total no. of plants/m<sup>2</sup></b>			<b>45.0</b>	
V3.2 <i>Festuca rubra</i>	<i>Festuca rubra</i> L.	Poaceae	May-June	34.0	102.0
	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Almost all the vegetation period	2.0	6.0
	<i>Echinochloa crus-gali</i> L.	Poaceae	July-October	15.0	45.0
	<b>Total no. of plants/m<sup>2</sup></b>			<b>51.0</b>	
V3.3 <i>Medicago sativa</i>	<i>Medicago sativa</i> L.	Fabaceae	May-October	33.0	99.0
	<i>Poa pratensis</i> L.	Poaceae	May-September	11.0	33.0
	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Almost all the vegetation period	3.0	9.0
	<i>Echinochloa crus-gali</i> L.	Poaceae	July-October	9.0	27.0
	<b>Total no. of plants/m<sup>2</sup></b>			<b>56.0</b>	
V3.4 - <i>Lotus corniculatus</i>	<i>Lotus corniculatus</i> L.	Fabaceae	June-October	41.0	123.0
	<i>Echinochloa crus-gali</i> L.	Poaceae	July-October	13.0	39.0
	<i>Taraxacum officinale</i> L.	Asteraceae	March-April	2.0	6.0
	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Almost all the vegetation period	2.0	6.0
	<b>Total no. of plants/m<sup>2</sup></b>			<b>58.0</b>	
V3.5 mixture	<i>Lolium perenne</i> L.	Poaceae		19.0	57.0
	<i>Lotus corniculatus</i> L.	Fabaceae	June-October	15.0	45.0
	<i>Echinochloa crus-gali</i> L.	Poaceae	July-October	10.0	30.0
	<i>Taraxacum officinale</i> L.	Asteraceae	March-April	3.0	9.0
	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Almost all the vegetation period	2.0	6.0
	<i>Festuca rubra</i> L.	Poaceae	May-June	14.0	42.0
	<i>Medicago sativa</i> L.	Fabaceae	May-October	13.0	39.0
	<b>Total no. of plants/m<sup>2</sup></b>			<b>76.0</b>	
<b>Total no. of plants/m<sup>2</sup></b>			<b>286.0</b>		

**Table 3.2. Biodiversity indices in apple and pear field trials (V3, artificial grass cover)**

Variant	Weed species	Abundance/ Surface unit	Dominance	Simpson Index (D)	Shannon Index (H)
V3.1 <i>Lolium perenne</i> L.	<i>Lolium perenne</i> L.	23,940	0.1329	0.0865	2.6583
	<i>Plantago major</i> L.	1,260	0.0070		
	<i>Convolvulus arvensis</i> L.	3,150	0.0175		
V3.2 <i>Festuca rubra</i> L.	<i>Festuca rubra</i> L.	21,420	0.1189		
	<i>Convolvulus arvensis</i> L.	1,260	0.0070		
	<i>Echinochloa crus-gali</i> L.	9,450	0.0524		
V3.3 <i>Medicago sativa</i> L.	<i>Medicago sativa</i> L.	20,790	0.1154		
	<i>Poa pratensis</i> L.	6,930	0.0385		
	<i>Convolvulus arvensis</i> L.	1,890	0.0105		
	<i>Echinochloa crus-gali</i> L.	5,670	0.0315		
V3.4 <i>Lotus corniculatus</i> L.	<i>Lotus corniculatus</i> L.	25,830	0.1434		
	<i>Echinochloa crus-gali</i> L.	8,190	0.0455		
	<i>Taraxacum officinale</i> L.	1,260	0.0070		
	<i>Convolvulus arvensis</i> L.	1,260	0.0070		
V3.5 mixture	<i>Lolium perenne</i> L.	11,970	0.0664		
	<i>Lotus corniculatus</i> L.	9,450	0.0524		
	<i>Echinochloa crus-gali</i> L.	6,300	0.0350		
	<i>Taraxacum officinale</i> L.	1,890	0.0105		
	<i>Convolvulus arvensis</i> L.	1,260	0.0070		
	<i>Festuca rubra</i> L.	8,820	0.0490		
	<i>Medicago sativa</i> L.	8,190	0.0455		
<b>Total no. of plants/surface unit</b>		180,180			



**Fig. 3. Systematic classification of weeds identified in apple and pear field trials**



**Fig. 4. Classification of weeds identified in apple and pear field trials according to the flowering period**

**Table 4. The diversity index *Margalef* and similarity index *Jacard***

No.	Variant	No. of species	Total no. of plants from all species	Diversity index <i>Margalef</i>	Similarity Index <i>Jacard</i>
1	V1 – clean soil	10	26,712	0.88	5.71
2	V2 – spontaneous grass cover	16	38,682	1.42	
3	V3 – artificial grass cover	9	180,180	0.66	