European Journal of Agriculture and Forestry Research
Vol.6, No.4, pp.43-56, August 2018
Published by European Centre for Research Training and Development UK (www.eajournals.org)

WEED SURVEYS IN RAINFED CANOLA (*BRASSICA NAPUS* L.) FIELDS IN CHAOUIA, MOROCCO

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ABSTRACT: *Weed surveys were conducted in 2014-15 and 2015-16 in 23 rainfed canola fields in Chaouia, semi-arid Morocco, to identify weed flora. A total of 139 weed species were identified. : 91 species in January 2015 and 2016 before in-crop weed control with herbicides and/or hand removal, and 126 species in March 2015 and 2016 after weed control. Weed densities before weed control ranged from 48 to 333 plants m^{-2} with an average of 152 plants m^{-2}, and densities after weed control ranged from 41 to 667 plants m^{-2} with an average of 115 plants m^{-2}. Weeds found after herbicide use and hand removal were a) weeds not controlled or partially controlled by herbicides, b) weeds that emerged after herbicide application, and c) weeds not manually removed after chemical weed control. Research should focus on an integrated weed management strategy based on the use of competitive cultivars, high crop density, preemergence and postemergence herbicides, and mechanical cultivation in canola planted with wide row spacing.*

KEYWORDS: Canola, weed density, weed frequency, weed relative abundance, Morocco.

INTRODUCTION

Canola has been reintroduced into Morocco since 2009 essentially for cooking oil production. The area planted with canola in 2015-16 was approximately 3000 hectares and it is expected to boost crop production by 2020. Yields vary between 1.0 and 3.6 Tons ha^{-1}, and seeds are about 43% oil, that is low in saturated fat, excellent food choice for a healthy diet (El Brahli, 2016). The oil from canola is used for cooking and baking at home, restaurants, and in food processing plants.

Weeds commonly occur in canola crops and their infestation is a major yield-reducing factor. In Australia, heavy infestations of wild radish (*Raphanus raphanistrum*) have reduced canola yields by up to 90% (Blackshaw *et al*., 2002). However, the magnitude of canola yield loss depended on crop cultivar (Aminpanah *et al*., 2013; Asaduzzaman *et al*., 2014), weed species (Daugovish *et al*., 2002; Maataoui *et al*., 2003c, 2004, 2005a, 2005b; Simard and Légère, 2004), weed density (Blackshaw *et al*., 2002; Maataoui *et al*., 2005b), duration of competition (Maataoui and Habib, 1995; Martin *et al*., 2001; Maataoui *et al*., 2003a; Harker *et al*., 2008), and environmental conditions (Maataoui *et al*., 2003c, 2004, 2005a; Harker *et al*., 2013). Weed competition also reduces grain quality and market value of the canola seed. In Australia, wild radish did not directly reduce canola quality, but if wild radish seed were not separated from canola seed, the amount of erucic acid and glucosinolates was increased above marketable levels (Blackshaw *et al*., 2002).

Integrated weed management (IWM) generally involves short- to medium-term adoption of combinations of technologies to reduce yield loss from the competitive effects of weeds. IWM decision strategies include competitive hybrids, high density planting, cultivation, and

ISSN: 2054-6319 (Print), 2054-6327(online)

herbicides (Bnioukil, 1989; Bah Thierno, 1990; Harker *et al.*, 2003; Maataoui *et al*., 2003b; Degenhardt *et al*., 2005).

Surveying weed distributions within a given geographic area can be useful for identifying species shifts with time, streamlining educational programs conducted by local extension agents, and directing futur weed science research efforts. Significant changes in control strategies will inevitably affect weed species composition in agricultural fields, and weed surveys can help to monitor these effects. Surveys on a smaller geographic scale may be more useful to a more localized clientele and may be used for identifying emerging weed problems (Thomas, 1985; Lemerle *et al*., 2001; Fried and Reboud, 2007).

The objective of this study was to identify and quantify weeds in rainfed canola fields in Chaouia, Morocco.

MATERIAL AND METHODS

Study location and agronomic practices

Weed surveys were conducted in Chaouia (semi-arid region of central Moroccco). Annual precipitation varied from 214 mm in 2014-15 to 212 mm in 2015-16, with more than 60% occurring from November through April (Table 1). The monthly minimal temperatures were 4-9 °C in winter (December to February) and the monthly maximal temperatures were 30-36 °C in summer (June to August).

The canola crop was planted in November at 3.5 kg ha^{-1} of seeds and fertilized at 100 kg ha^{-1} of diammonium phosphate (18-46-0). Fields have been planted using conventional or no-till system. At 15 to 20 cm crop height, grass herbicides such as fluazifop-p-butyl (187.5 g ha^{-1}), haloxyfop (52 g ha^{-1}), propaquizafop (50 g ha^{-1}), and quizalofop-p-tefuryl (40 g ha^{-1}). For broadleaf weed control, a mixture of clopyralid (48 g ha^{-1}) + picloram (16 g ha^{-1}) + aminopyralid (8 g ha^{-1}) was used early postemergence. Herbicides were sprayed with tractor-mounted sprayers, and volumes of spray were 200 to 300 L ha^{-1}. Top dressing nitrogen was used after herbicide application at the rate of 100 kg ha^{-1} of ammonium nitrate (33%). At the crop flowering or fruiting stage, weeds infesting canola fields were removed and collected for free by farmers or their neighbors to feed livestock (sheep, cattle, horses, mules, and donkeys). Canola was harvested by the combine in May-June.

Weed survey

In canola fields, first floristic surveys were conducted in January 2015 and 2016 after crop emergence but before weed control, and second surveys were conducted at the flowering stage in March 2015 and 2016 after weed control. A total of 23 fields were surveyed in both years. The sampled fields ranged from 1 to 10 ha. Fields were located in different rural towns of Settat, Berrechid, El Gara, and Benslimane. The soil is clayey (52% clay, 25% silt, and 23% sand), suitable for several crops, especially canola.

Weeds in canola fields were identified and counted in 10 quadrats (1 m × 25 cm) dropped at random along diagonal line transects in each field. Species identification was done using the "Flora of Morocco" by Fennane *et al*. (1999, 2007, 2014). Scientific names cited in table 2 are those recommended by Dobignard and Chatelain (2010-13).

ISSN: 2054-6319 (Print), 2054-6327(online)

For synthesis, relative abundance (RA) of each weed was calculated using weed frequency, relative frequency, field uniformity, relative field uniformity, field density, and relative field density (Thomas, 1985). Frequency of a species was the number of the fields where this species occurred expressed as a percentage of 23 surveyed fields. Field uniformity of a species was the number of quadrats where this species occurred expressed as a percentage of the 230 surveyed quadrats. Field density refers to the number of individuals of a species per square meter and was calculated by totaling plant number of a species in each field and dividing by 23 fields. Relative abundance for a species is the sum of relative frequency, relative field uniformity, and relative field density for that species.

RESULTS AND DISCUSSION

Weed diversity

This study showed a weed flora of 139 weed species in 23 canola fields: 91 species in the January surveys before weed control and 126 species in the March survey after herbicide application and/or hand removal (Table 2). Out of 139 weed species, broadleaf weeds were dominant with 122 species, or 88% of the total weeds. The annuals were dominant with 120 species, or 86% of the total.

The 10 most abundant weed species (i.e. species with the highest values of relative abundance) before weed control were rigid ryegrass (*Lolium rigidum*, RA = 25), common poppy (*Papaver rhoeas*, RA = 24), four-leaf allseed (*Polycarpon tetraphyllum*, RA = 13), field fumitory (*Fumaria agraria*, RA = 13), friar's cowl (*Arisarum vulgare*, RA = 13), spiny emex (*Emex spinosa*, RA = 11), crown daisy (*Glebionis coronaria*, RA = 11), wild roquet (*Diplotaxis tenuisiliqua*, RA = 10), field pimpernel (*Lysimachia arvensis*, RA = 9), and littleseed canarygrass (*Phalaris minor*, RA = 8).

The 91 weed species found in the January surveys revealed the important weed seedbank in cropped fields under rainfed conditions. They are usually associated with rainfed small grain cereals such as bread wheat (*Triticum aestivum*), durum wheat (*Triticum durum*), and barley (*Hordeum murinum*) planted in November or December (Taleb and Maillet, 1994).

The 10 most abundant weed species after herbicide use and hand removal of weeds were ripgut brome (*Anisantha rigida*, RA = 28, rigid ryegrass (*Lolium rigidum*, RA = 23), sterile oat (*Avena sterilis*, RA = 12), common poppy (*Papaver rhoeas*, RA = 10), four-leaf allseed (*polycarpon tetraphyllum*, RA = 10), field pimpernel (*Lysimachia arvensis*, RA = 9), lesser snapdragon (*Misopates orontium*, RA = 8), hairy rupturewort (*Herniaria cinerea*, RA = 8), crown daisy (*Glebionis coronaria*, RA = 8), and spiny emex (*Emex spinosa*, RA = 8).

Annual *Brassicaceae* such as wild roquet (*Diplotaxis tenuisiliqua*), wild mustard (*Sinapis arvensis*), and wild radish (*Raphanus raphanistrum*) were found in 62, 31, and 31% of the fields. These annual broadleaf weeds emerge in autumn (September-November) and become problematic in winter (December-February) and spring (March-May). The successful spread of *Brassicaceae* into canola can be attributed to a) the lack of control by the hercicides used (clopyralid, 48 g ha^{-1} + picloram, 16 g ha^{-1} + aminopyralid, 8 g ha^{-1}), and b) the fecundity of mature plants, which can produce numerous seeds in crops planted in rotation with canola.

ISSN: 2054-6319 (Print), 2054-6327(online)

Ripgut brome (*Anisantha rigida*), rigid ryegrass (*Lolium rigidum*), sterile oat (*Avena sterilis*), and lesser canarygrass (*Phalaris minor*) were the most troublesome winter annual grass weeds. These are the most common winter weeds in small grain cereals in Chaouia (Taleb and Maillet, 1994).

Field bindweed (*Convolvulus arvensis*) and Bermudagrass (*Cynodon dactylon*) were the perennial weed species considered problematic (Table 2). Both can be difficult to control due to long and spreading rhizomes. Field bindweed can be controlled with 2,4-D in wheat or barley, and Bermudagrass can be controlled with glyphosate before planting or after crop harvest.

Weed richness

In January 2015 and 2016, the number of weed species ranged between 9 and 37, with an average of 19 species per field. During surveys of March 2015 and 2016, the number of weed species per field ranged between 8 and 34, with an average of 22 species per field. These figures indicate that the weed richness varied from one field to another due to weed management practices (Blackshaw *et al*., 2005; Fried and Reboud, 2007).

Weed Density

Weed densities taken after crop emergence and before applying in-crop herbicides ranged from 48 to 333 plants m^{-2} per field with an average of 152 plants m^{-2}. Densities at the flowering stage after herbicide application and hand removal of weeds ranged from 41 to 667 plants m^{-2} with an average of 115 plants m^{-2}. Weeds observed in March surveys after canola weed control were a) weeds not controlled or partially controlled by herbicides, b) weeds that emerged after herbicide application, and/or c) plants not collected from canola fields by farmers or their neighbors and used to feed livestock.

In January surveys, densities of rigid ryegrass, common poppy, and fumitory were 25, 18, and 14 plants m^{-2}, respectively. After weed control, weed densities of these 3 weeds were reduced to 19, 3 and 1 plant m^{-2}, repectively. These results indicated that changes in weed communities and population densities in response to herbicides and hand removal have been observed.

Weed Control in farmers' fields

These surveys indicated that the weed management techniques used by canola growers did not usually provide excellent control. This was due to a) non use or inappropriate use of herbicides, b) unjustified delayed herbicide application, c) inadequate weed stage at the time of application, d) stressed weeds under rainfed conditions, e) prevalence of *Brassicaceae* and perennials that were not controlled by the only registered herbicides clopyralid (48 g ha^{-1}) + picloram (16 g ha^{-1}) + aminopyralid (8 g ha^{-1}), f) non use of mechanical cultivation between rows since row spacing was about 30 cm, and/or g) hand removal was concentrated only on large and palatable weeds. The cost of broadleaf herbicides was 50 \$US ha^{-1}, with an application cost of 5 \$US ha^{-1}. Thus, broadleaf herbicides were very expensive, but some weeds such as the *Brassicaceae* were not controlled.

In some fields, the herbicide mixture (clopyralid, 48 g ha^{-1} + Picloram, 16 g ha^{-1} + Aminopyralid, 8 g ha^{-1}) was effective on many broadlaeaf weeds, particularly at the seedling stage, except the *Brassicaceae.* This was the only option available to canola growers for broadleaf weed control. Therefore, herbicide companies should attempt to register more

ISSN: 2054-6319 (Print), 2054-6327(online)

postemergence herbicides with alternate modes of action to limit the development of resistance. If growers would include more pre-emergence herbicides in their weed management program, then fewer postemergence applications would be required to manage weeds in canola. Additionally, this could reduce the number of required herbicide applications, thus reducing labor and fuel costs.

Grass herbicides did not always provide excellent control of annual grasses. However, there is a heavy reliance on "fops". These herbicides are inexpensive in Morocco and effectively control grass weeds when applied in a timely fashion under appropriate climatic conditions. The cost of grass herbicides was 13 \$US ha^{-1}, with an application cost of 5 \$US ha^{-1}.

Integration of postemergence herbicides with hand pulling was not in most cases effective. Usually, hand removal is time-consuming, tedious, and costly because labor is becoming scarce and unavailable, and labor wages are higher (10 \$US day^{-1}). Thus, growers neglected to cultivate between rows due to narrow row spacing and/or neglected to hire labor to control adequately weeds prior to harvest, thereby providing a source of seeds for reinfestation. The use of premergence and postemergence herbicides in combination with mechanical cultivation when canola is planted with wide row spacing (50 to 70 cm) should be evaluated. Introduction of Clearfield canola with imazamox or triazine tolerance, widely used in Canada and Australia, would help to achieve appropriate weed control.

CONCLUSIONS

This study revealed the presence of 139 weed species in 23 rainfed canola fields. Average weed density before weed control was 152 plants m^{-2}, while average density after herbicide application and/or hand removal of weeds was 115 plants m^{-2}. Considering that improving weed management is a priority, these results indicate that a focus is needed on abundant and competitive weed species such as common poppy (*Papaver rhoeas*), spiny emex (*Emex spinosa*), crown daisy (*Glebionis coronaria*), wild roquet (*Diplotaxis tenuisiliqua*), wild mustard (*Sinapis arvensis*), wild radish (*Raphanus raphanistrum*), ripgut brome (*Anisantha rigida*), etc… To effectively manage weeds, growers need to adapt strategies that will improve their weed management programs. Using herbicides with various modes of action might help reduce the intensity of selection for resistance. Research should focus on an integrated weed management strategy based on the use of competitive cultivars, high crop density, delay date of seeding, use of short growth cycle cultivars, use of clearfield and herbicide tolerant cultivars, use of preemergence and/or postemergence herbicides, and mechanical cultivation in canola planted with wide row spacing.

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APENDIX

Table 1. Monthly precipitation and temperatures in Settat, Morocco, in 2014-15 and 2015-16.

Month	2014-15			2015-16		
	Rainfall mm	Minimal temperature °C	Maximal temperature °C	Rainfall mm	Minimal temperature °C	Maximal temperature °C
September	3.1	17.3	29.6	16.2	15.7	28.9
October	4.2	15.9	30.1	16.6	15.3	27.0
November	18.3	11.7	19.9	20.4	9.0	23.4
December	46.1	6.2	16.5	0	8.8	23.6
January	48.8	4.7	15.9	19.4	7.5	20.8
February	6.5	4.3	14.9	55.5	7.2	18.2
March	52.3	6.6	20.1	52.0	6.0	18.9
April	0	9.6	23.7	7.2	8.9	22.6
May	26.9	13.5	29.7	24.8	12.8	25.8
June	8.3	15.6	30.7	0	15.6	30.6
July	0	18.4	35.0	0	19.4	35.0
August	0	18.3	32.4	0	19.8	36.3
Total	214.5			212.1		

Table 2. Density, frequency, and relative abundance of weeds in 23 canola fields in Chaouia, Morocco, in 2014-15 and 2015-16.

Weed species	January survey				March survey			
	Weed density	Weed frequency in 230 quadrats	Weed frequency in 23 fields	Relative abundance	Weed density	Weed frequency in 230 quadrats	Weed frequency in 23 fields	Relative abundance
	Plants m^{-2}	%	%	%	Plants m^{-2}	%	%	%
Annual broadleaf weeds								
Papaver rhoeas L.	17,98	43,85	76,92	23,86	2,78	26,09	60,87	9,61
Polycarpon tetraphyllum (L.) L.	12,31	16,15	38,46	13,05	5,02	20,43	39,13	9,59
Fumaria agraria Lag.	13,54	13,85	30,77	13,04	0,75	7,83	30,43	3,37
Emex spinosa (L.) Campd.	4,68	22,31	76,92	11,18	1,59	20,43	43,48	6,82
Glebionis coronaria (L.) Spach	3,32	28,46	61,54	10,61	1,43	18,26	73,91	7,72
	3,22	25,38	61,54	9,97	2,78	14,35	39,13	6,63
	3,64	20,00	61,54	9,27	2,45	25,22	60,87	9,17
	0,74	12,31	46,15	5,15	1,34	21,74	73,91	8,23
	2,54	13,08	23,08	5,27	3,50	18,70	34,78	7,78
	7,00	9,23	23,08	7,49	0,90	13,91	39,13	4,93
	1,54	10,77	23,08	4,19	1,11	11,30	56,52	5,47
	0,68	10,00	38,46	4,28	0,77	11,74	52,17	5,05
	1,78	10,00	30,77	4,60	0,80	6,52	39,13	3,60

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Diplotaxis	0,41	7,69	53,85	4,49	0,17	4,35	39,13	2,69
tenuisiliqua	0,06	0,77	7,69	0,58	1,60	7,83	34,78	4,31
Delile	0,12	1,54	15,38	1,16	0,68	9,57	39,13	4,01
Lysimachia	0,11	2,31	15,38	1,30	1,30	7,83	26,09	3,65
arvensis	0,40	6,15	30,77	3,00	0,66	9,57	30,43	3,59
(L.)U.M.&A.	0,55	4,62	30,77	2,82	0,80	8,70	30,43	3,56
Misopates	0,51	8,46	30,77	3,49	1,06	7,83	26,09	3,44
orontium (L.)	0,18	3,08	30,77	2,29	0,37	7,39	39,13	3,37
Raf.	0,43	6,15	23,08	2,61	1,18	5,65	21,74	2,98
Herniaria cinerea	0,55	5,38	15,38	2,15	0,89	5,65	26,09	2,92
DC.	0,77	5,38	15,38	2,29	1,43	4,35	13,04	2,57
Polygonum	0,43	4,62	15,38	1,93	0,80	5,65	17,39	2,45
aviculare L.	0,12	1,54	7,69	0,76	0,64	6,09	17,39	2,38
Chenopodium	0,23	3,08	15,38	1,52	1,08	4,78	13,04	2,34
murale L.	1,68	8,46	15,38	3,45	0,47	6,52	13,04	2,11
Glaucium	1,23	4,62	23,08	2,86	0,59	5,65	13,04	2,06
corniculatum (L.)	0,74	3,85	23,08	2,39	0,31	3,91	21,74	1,93
J.H.R.	0,32	4,62	30,77	2,66	0,33	3,04	21,74	1,80
Plantago afra L.	0,07	1,54	15,38	1,13	0,12	2,61	26,09	1,75
Astragalus	0,08	1,54	15,38	1,14	0,17	3,48	21,74	1,74
boeticus L.	0,16	3,85	23,08	2,02	0,16	3,48	21,74	1,72
Bupleurum	0,04	3,08	7,69	0,99	0,30	3,91	17,39	1,72
lancifolium Horn.	0,69	4,62	7,69	1,70	0,87	4,35	4,35	1,69
Malva parviflora	0,46	4,62	15,38	1,95	0,54	4,35	8,70	1,60
L.	0,04	0,77	7,69	0,57	0,19	3,48	17,39	1,55
Silene nocturna	0,08	1,54	7,69	0,73	0,10	2,61	21,74	1,53
L.	0,15	1,54	7,69	0,78	0,43	4,35	8,70	1,51
Sinapis arvensis	0,04	0,77	7,69	0,57	0,10	2,17	21,74	1,46
L.	1,05	9,23	23,08	3,58	0,17	3,91	13,04	1,41
Papaver	1,10	7,69	46,15	4,54	0,23	2,17	17,39	1,36
hybridum L.	1,95	10,00	46,15	5,52	0,16	2,17	17,39	1,30
Beta macrocarpa	0,27	5,38	23,08	2,37	0,31	2,61	8,70	1,11
Guss.	0,23	1,54	15,38	1,24	0,17	1,74	13,04	1,05
Raphanus	0,76	3,08	30,77	2,67	0,07	2,17	13,04	1,03
raphanistrum L.	0,31	3,08	7,69	1,17	0,07	1,74	13,04	0,95
Chenopodium	0,71	5,38	7,69	1,85	0,07	1,74	8,70	0,75
vulvaria L.	0,12	2,31	7,69	0,90	0,05	1,30	8,70	0,67
Ridolfia segetum	0,06	1,54	15,38	1,13	0,13	0,87	8,70	0,66
(Guss.) Moris	0,03	0,77	7,69	0,56	0,03	0,87	8,70	0,58
Silene gallica L.	0,30	2,31	23,08	1,82	0,03	0,87	8,70	0,58
Galium	0,03	0,77	7,69	0,56	0,05	0,87	4,35	0,39
verrucosum	0,08	1,54	15,38	1,14	0,03	0,87	4,35	0,38
Huds.	0,04	0,77	7,69	0,57	0,03	0,87	4,35	0,38
Teucrium	0,03	0,77	7,69	0,56	0,06	0,43	4,35	0,32
resupinatum	0,15	3,08	7,69	1,07	0,05	0,43	4,35	0,32
Desf.	0,06	1,54	7,69	0,72	0,02	0,43	4,35	0,29
Euphorbia exigua	0,27	3,85	15,38	1,68	0,02	0,43	4,35	0,29
L.	0,03	0,77	7,69	0,56	0,02	0,43	4,35	0,29
Centaurea diluta	0,08	1,54	7,69	0,73	0,02	0,43	4,35	0,29
Aiton	0,08	1,54	15,38	1,14	0,02	0,43	4,35	0,29
Spergula arvensis	0,06	1,54	15,38	1,13	0,00	0,43	0,00	0,07
L.								

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Cichorium intybus L.
Scorpiurus muricatus L.
Vaccaria hispanica (Mill.) R.
Eryngium ilicifolium Lam.
Torilis nodosa (L.) Gaertn.
Silybum marianum (L.) Gaertn.
Capsella bursa-pastoris (L.) M.
Anacyclus radiatus Loisel.
Sherardia arvensis L.
Sonchus oleraceus L.
Rumex bucephalophorus L.
Leontodon saxatilis Lam.
Calendula stellata Cav.
Fumaria parviflora Lam.
Melilotus sulcatus Desf.
Scandix pecten veneris L.
Senecio vulgaris L.
Scolymus maculatus L.
Urtica urens L.
Ammi majus L.
Filago pyramidata L.
Lamium amplexicaule L.
Amaranthus blitoides S. Watson
Galium tricornutum Dandy
Adonis annua L.

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Euphorbia medicaginea Boiss.								
Hippocrepis multisiliquosa L.								
Rumex pulcher L.								
Malva nicaeensis All.								
Chenopodium opulifolium L.								
Linaria incarnata (Vent.) Spr.								
Onopordum macracanthum S.								
Reseda alba L.								
Vicia lutea L.								
Vicia sativa L.								
Lithospermum	0,12	2,31	15,38	1,31				
arvense L.	0,11	1,54	15,38	1,16				
Lathyrus ochrus	0,15	1,54	7,69	0,78				
(L.) DC.	0,15	1,54	7,69	0,78				
Helminthotheca	0,12	1,54	7,69	0,76				
echioides (L.) H.	0,04	0,77	7,69	0,57				
Silene muscipula	0,04	0,77	7,69	0,57				
L.	0,04	0,77	7,69	0,57				
Lathyrus	0,04	0,77	7,69	0,57				
articulatus L.	0,03	0,77	7,69	0,56				
Delphinium halteratum Sm.								
Medicago truncatula Gaertn.								
Picnomon acarna (L.) Cass.								
Stellaria media (L.) Vill.								
Carduus pycnocephalus L.								
Diplotaxis					0,87	6,09	13,04	2,38
catholica (L.)					0,66	5,65	13,04	2,13
DC.					0,50	3,91	21,74	2,10
Spergularia					0,19	3,04	21,74	1,68
purpurea (Pers.)					0,09	2,61	17,39	1,32
G. D.					0,35	3,48	8,70	1,29
Cladanthus					0,15	2,17	13,04	1,10
mixtus (L.)					0,11	2,17	13,04	1,07
Chevall.					0,12	2,17	8,70	0,87
Medicago					0,54	0,00	8,70	0,87
polymorpha L.					0,05	1,30	13,04	0,87
Calendula					0,02	3,48	4,35	0,80
arvensis L.					0,10	1,74	8,70	0,78
Campanula					0,16	2,17	4,35	0,70
lusitanica Loefl.					0,03	2,17	4,35	0,60

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Echium	0,03	0,87	8,70	0,58
plantagineum L.	0,23	0,87	4,35	0,55
Linaria	0,05	1,30	4,35	0,47
gharbensis Batt.	0,09	0,87	4,35	0,42
& Pit.	0,10	0,43	4,35	0,36
Daucus muricatus	0,07	0,43	4,35	0,33
(L.) L.	0,02	0,43	4,35	0,29
Heliotropium	0,02	0,43	4,35	0,29
europaeum L.	0,02	0,43	4,35	0,29
Scolymus	0,02	0,43	4,35	0,29
hispanicus L.	0,02	0,43	4,35	0,29
Geropogon	0,02	0,43	4,35	0,29
hybridus L.	0,02	0,43	4,35	0,29
Lythrum junceum	0,02	0,43	4,35	0,29
Banks & Sol.	0,02	0,43	4,35	0,29
Erodium	0,02	0,43	4,35	0,29
moschatum (L.)	0,02	0,43	4,35	0,29
L'Hér.	0,02	0,43	4,35	0,29
Cerastium	0,02	0,43	4,35	0,29
glomeratum				
Thuill.				
Carlina racemosa				
L.				
Erodium				
malacoides (L.)				
L'Hér.				
Matthiola				
parviflora (S.) R.				
Br.				
Fumaria				
densiflora DC.				
Phelipanche				
ramosa (L)				
Pomel				
Loeflingia				
hispanica L.				
Anchusa italica				
Retz.				
Biscutella				
auriculata L.				
Centaurea				
eriophora L.				
Chenopodium				
album L.				
Convolvulus				
tricolor L.				
Erigeron				
bonariensis L.				
Eruca vesicaria				
(L.) Cav.				
Hirschfeldia				
incana (L.) Lag.-				
Fos.				

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Malva multiflora (Cav.) S.,B.& G.								
Reseda lutea L.								
Silene apetala Willd.								
Silene rubella L.								
Solanum herculeum								
Annual grass weeds								
Anisantha rigidum (Roth) Hyl.		8,46 31,54 10,77	23,08 53,85 38,46	4,06 24,91 6,66				
Lolium rigidium Gaud.		18,46 5,38	38,46 7,69	8,16 2,63	24,57	24,78	47,83	27,68
Avena sterilis L.		6,15	7,69	2,30	18,92	27,39	52,17	23,42
Phalaris minor Retz.		0,77	7,69	0,57	6,96 1,86	17,83 8,70	56,52 21,74	11,64 4,08
Phalaris brachystachys Link					0,73 0,71 0,07	9,57 3,04 1,30	21,74 17,39 4,35	3,24 1,93 0,48
Wheat *(Triticum aest & T. dur.)*								
Barley *(Hordeum vulgare* L.*)*								
Catapodium rigidum (L.) C.E.H.					0,92	8,70	26,09	3,46
Poa annua L.					2,10	3,48	8,70	2,80
Phalaris paradoxa L.					0,17 0,03	5,65 0,43	26,09 4,35	2,31 0,30
Hordeum murinum L.								
Annual *Juncaceae*								
Juncus bufonius L.	7,31	3,85	7,69	5,91	5,11	3,91	4,35	5,29
Perennial weeds								
Arisarum vulgare Targ.-Tozz.	10,58 0,85	22,31 7,69	46,15 46,15	13,44 4,37				
Convolvulus arvensis L.	2,26 0,20	1,54 1,54	15,38 15,38	2,57 1,22	1,08	2,17	17,39	2,10
Ornithogalum narbonense L.	0,38 0,09	0,77 1,54	7,69 7,69	0,80 0,74	1,10 0,07	15,65 2,17	56,52 8,70	6,19 0,83
Silene vulgaris (Moench) Garcke					0,97 0,02	3,04 0,43	17,39 4,35	2,16 0,29
Launaea nudicaulis (L.) Hook.f.					0,09	0,87	8,70	0,62
Convolvulus althaeoides L.								
Mandragora afficinarum L.	0,03 0,03	0,77 0,77	7,69 7,69	0,56 0,56				

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Marrubium vulgare L.	0,03	0,00	7,69	0,42				
Rhaponticum acaule (L.) DC.								
Oxalis pes caprae L.					0,28	3,04	13,04	1,36
Cachrys libanotis L.					0,03	0,87	8,70	0,58
Corrigiola telephiifolia Pourr.					0,05	0,87	4,35	0,39
Carlina gummifera (L.) Less.					0,03	0,43	4,35	0,30
Ecballium elaterium (L.) A. R.					0,02	0,43	4,35	0,29
Rumex crispus L.					0,02	0,43	4,35	0,29
Salvia argentea L.					0,02	0,43	4,35	0,29
Cynodon dactylon (L.) Pers.					0,21	2,17	8,70	0,95
Biarum bovei (Schott) Talavera					0,02	0,43	4,35	0,29
Muscari comosum (L.) Mill.					0,02	0,43	4,35	0,29
TOTAL	152,20	546,15	1915,38	300,00	115,33	595,22	2165,22	300,00

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