

## DETERMINATION OF THE FREQUENCY AND DENSITY OF WEED SPECIES IN APPLE ORCHARDS IN KAHRAMANMARAS REGION OF TURKEY

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### Abstract

A study was carried out in Kahramanmaras region of Turkey during 2012-13 having ten subregions namely, Afsin, Andırın, Caglayancerit, Ekinozu, Elbistan, Göksun, Center, Nurhak, Pazarcık and Türkoglu to determine the range, density and frequency of weeds in apple orchards. In the orchards 133 weed species from 31 families were determined. The average density of weeds was 112.49 plants m<sup>-2</sup>. The maximum density of weed species was found in Göksun (127.30 plants m<sup>-2</sup>) followed by Elbistan (126.13 plants m<sup>-2</sup>), Ekinozu (125.95 plants m<sup>-2</sup>), Afsin (120.39 plants m<sup>-2</sup>), Center (117.94 plants m<sup>-2</sup>) and Caglayancerit (114.90 plants m<sup>-2</sup>), and the minimum density was determined in Pazarcık (69.51 plants m<sup>-2</sup>). From the identified 133 weed species one species belonged to Pteridophyta, 21 species to Monocotyledoneae and 111 species to Dicotyledoneae. The average densities of the weed species over 10 subregions for *Agropyron repens* (L.) P. Beauv., *Chenopodium album* L., *Bromus arvensis* L. and *Amaranthus retroflexus* L. were found to be 13.76, 12.17, 12.10 and 10.76 plants m<sup>-2</sup>, respectively. With regard to frequency of occurrence, *C. album* L. was detected more than 56% in six subregions excluding Andırın, Pazarcık, Türkoglu and Center; *A. retroflexus* L. more than 54% in 7 subregions excluding Center, Pazarcık and Türkoglu and *A. repens* (L.) P. Beauv. more than 50% in 10 subregions. Frequency of occurrence of *Cynodon dactylon* (L.) Pers. was observed 50.1, 50.9, 76.9% in Afsin, Caglayancerit and Andırın, respectively and it was below 50% in other 7 subregions. In terms of coverage, *Alopecurus myosuroides* Huds., *A. retroflexus*, *A. repens*, *B. arvensis*, *C. album*, *Convolvulus arvensis* L., *C. dactylon* and *Lactuca serriola* L. were determined to be within the range of 20.2 to 48.2% in the study areas while the other species were below 20%.

Keywords: Apple orchards, weed, density, frequency and general coverage.

### Introduction

Turkey has huge fruit production potential due to its suitable ecological conditions and it ranks third after China and the USA with its 69,492,000 tons annual apple production (Anon., 2012). In apple farming of Turkey, Isparta ranks first with its 634,795 tons and then Karaman and Nigde with their production 388,400 and 317,271 tons, respectively. Kahramanmaras ranks 10<sup>th</sup> in total land area of 56,060 ha and 12<sup>th</sup> in total production of 97,673 tons (Anon., 2013).

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Many factors affect the productivity and quality of apple production one of the most important is weed. Generally apple orchards are fertilized heavily to get higher fruit yield and the weeds grown in the orchards rob up the fertilizer at a faster rate than the apple plants resulting in lower yields (Verma and Chauhan, 2013). The weeds also harbor insects, diseases and rodents and thus they lower the quality and quantity of apples and may increase the cost of production by causing difficulties during fruit harvest. It is reported that both narrow leaved and broad leaved weeds grow in the apple orchards of Turkey and other apple growing countries of the world and caused problems of orchard management (Zeki *et al.*, 1994; Tepe, 1997; Yazlik and Tepe, 2001; Karaca and Guncan, 2003; Akbolat *et al.*, 2007; Ustuner and Akyol, 2007; Junk *et al.* 1997; Dastgheib and Frampton, 2000; Harington *et al.* 2000).

Since apple trees are poor competitors, their effective control becomes necessary. For this the weeds growing in any particular region must be properly identified. It is essential to know densities and frequencies of weed species grown in that region for their successful control. Besides, different weed species respond to different control methods. The challenge without identifying weed species will be unsuccessful and these will cause wastage of time, money and environmental pollution of herbicides. The most effective chemical control with weeds is the period when the weeds are 3-5 leaves. So determination of frequency occurrence, density, coverage of weeds and recognizing the life stages of those identified weeds will help selecting suitable control method. The survey study was therefore, conducted to identify weed species, and to determine their density, frequency of occurrence and coverage in Kahramanmaraş region of Turkey.

### **Materials and Method**

In the study, surveys made applied in the apple orchards in Kahramanmaraş region (Center, Afsin, Andırın, Caglayanerit, Ekinozu, Elbistan, Göksun, Nurhak, Pazarcık and Türkoglu) in 2012-2013. Considering the distribution and density of the apple orchards in the region, 10 subregion were selected and the samples were obtained from these subregion. In the survey, it was considered at least 3 km among the gardens and the samples were obtained from the 15 m inside of the edge of the garden. Within the 1000 square meters, 4 frames (1 square fareme) were used and weeds were obtained and counted (Odum, 1971). The number of the weed in the 1 square meter were calculated by dividing of the total number of the each species in 1 square meter to the survey area.

Weed density was calculated via  $Density = B/n$  formula (Guncan, 2001).

Here B = Total weeds number in the sample, n = Number of sample

In the evaluation, broad leaved weeds were considered as a whole plant while narrow leaved weed were considered as their stems and they were recorded on the survey cards. Species, numbers and coverages of weeds were recorded and

frequency of occurrence, number of plant and general coverages of obtained data were calculated by using the following formulas:

Frequency of occurrence (F.O.): The per cent of the occurrence of the weeds (%) in an area.

$$\text{Frequency of occurrence (\%)} = n/m \times 100$$

n: the number of the orchards containing species

M: total number of the orchards measured

Species Coverage (T.K.A.): It is expressed as average value that any species of weed covered surface.

$$\text{G.K.A (\%)} = \text{T.K.A./m}$$

G.K.A.: General coverage, m: Total number of surveys

As suggested by Ustuner and Guncan (2002), density scale was used as follows:

A. High dense (average more than 10 in per square meter)

B. Dense (average between 1-10 in per square)

C. Low dense (average between 0.1-1 in per square meter)

D. Rarely observed (average between 0.01-0.1 in per square meter)

The surveyed areas were divided in 10 subregions (Table 1).

**Table 1. Surveyed regions, the area of apple plantation and the number of frame in the study (Anon., 2013)**

Subregions	Apple plantation area (da)	The number of the frame
Afsin	4889	195
Andırın	182	60
Çağlayancerit	3878	155
Ekinözü	5395	215
Elbistan	6149	245
Göksun	29881	500
Center	3667	146
Nurhak	1271	53
Pazarcık	83	33
Türkoglu	211	64
Total	55606	1666

Because fruit trees are perennial, both summer and winter weeds grow in the apple orchards. Therefore, a total of 1666 samples were obtained in two different seasons. The first survey was made on April and May 2012-2013 while the second survey was made on August and September.

### Results and discussion

In the surveys of Kahramanmaraş region's apple orchards a total of 133 species of weeds belonging to 31 families including 1 pterydophyta, 21 monocotyledoneae and 111 dicotyledoneae and 112.49 (plants/m<sup>2</sup>) were detected (Table 2).

**Table 2. Number of families and weed species found in Kahramanmaraş region**

Phylum/Subclass	Number of families	Number of weed species
Pterydophyta	1	1
Monocotyledoneae	3	21
Dicotyledoneae	27	111

The average density of weeds in unit area was 13.76 plants m<sup>2</sup> for *A. repens*, 12.17 for *C. album*, 12.10 for *B. arvensis*, 10.76 for *A. retroflexus* and it was high in density. 9.25 for *C. dactylon*, 9.06 for *A. myosuroides*, 6.80 for *C. arvensis*, 4.54 for *D. glomerata*, 4.41 for *B. tectorum*, 3.94 for *L. serriola*, 2.50 for *S. viridis*, 2.28 for *D. sanguinalis*, 2.11 for *L. temulentum*, 1.99 for *S. halepense*, 1.33 for *C. draba* ssp *draba*, 1.25 for *A. cylindrica*, 1.07 for *C. arvense*, 1.04 for *C. galaticus* and 1.03 for *M. chamomilla* was densely detected.

**Table 3. Weed density, frequency of occurrence and general coverage of weeds in Kahramanmaraş region**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Agropyron repens</i> (L.) P.Beauv.	13.76	>50	20.2-48.2
<i>Chenopodium album</i> L.	12.17	>56	20.2-48.2
<i>Bromus arvensis</i> L.	12.10	>50	20.2-48.2
<i>Amaranthus retroflexus</i> L.	10.76	>54	20.2-48.2
<i>Cynodon dactylon</i> (L.) Pers.	9.25	>50	20.2-48.2
<i>Alopecurus myosuroides</i> Huds.	9.06	>50	20.2-48.2
<i>Convolvulus arvensis</i> L.	6.80	<50	20.2-48.2
<i>Dactylis glomerata</i> L.	4.54	<50	<20
<i>Bromus tectorum</i> L.	4.41	<50	<20
<i>Lactuca serriola</i> L.	3.94	<50	20.2-48.2
<i>Setaria viridis</i> (L.) P.Beauv.	2.50	<50	<20
<i>Digitaria sanguinalis</i> (L.) Scop.	2.28	<50	<20
<i>Lolium temulentum</i> L.	2.11	<50	<20
<i>Sorghum halepense</i> (L.) Pers.	1.99	<50	<20
<i>Cardaria draba</i> ssp <i>draba</i> (L.) Desv.	1.33	<50	<20
<i>Aegilops cylindrica</i> Host.	1.25	<50	<20
<i>Cirsium arvense</i> (L.) Scop.	1.07	<50	<20
<i>Convolvulus galaticus</i> Rost. ExChoisy.	1.04	<50	<20
<i>Matricaria chamomilla</i> L.	1.03	<50	<20

Frequency of occurrence of weeds in the region indicated that *C. album* was more than 56% in 6 subregions except for Andırın, Pazarcık, Türkoglu and Center. *A. repens* was more than 50% in 10 subregions. *A. retroflexus* was more than 54% in 7 subregions except from Center, Türkoglu and Pazarcık. *C. dactylon* was less than 50.1% in Afsin, 50.9% in Caglayancerit, 76.9% in Andırın and 50% in other 7 subregions while *B. arvensis* was less than 50% in Center subregion, more than 52% in the other 9 subregions. *A. myosuroides* was detected more than 50% in Andırın, Center, Caglayancerit and Gökşun and less than 50% in the other subregions. *C. arvensis* was only detected 55.6% in Center and less than 50% in the other subregions (Table 3). The coverages for *A. myosuroides*, *A. retroflexus*, *A. repens*, *B. arvensis*, *C. album*, *C. arvensis*, *C. dactylon* and *L. serriola* varied from 20.2 to 48.2%, while it was less than 20% for other species.

#### **Afsin subregion**

In this subregion, *C. album*, *A. repens*, *A. retroflexus*, *C. dactylon*, *B. arvensis*, *A. myosuroides* and *D. sanguinalis* were determined high densely. *C. arvensis*, *C. arvense*, *L. serriola*, *C. galaticus*, *M. chamomilla*, *A. cylindrica*, *B. tectorum*, *E. crus-galli*, *L. temulentum* and *P. rhoeas* were determined densely (Table 4).

**Table 4. Weed density, frequency of occurrence and general coverage of weeds in Afsin subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Chenopodium album</i> L.	16.2	60.8	48.2
<i>Agropyron repens</i> (L.) P.Beauv.	15.8	50.4	27.9
<i>Amaranthus retroflexus</i> L.	13.7	57.6	32.6
<i>Cynodon dactylon</i> (L.) Pers.	12.6	50.1	20.3
<i>Bromus arvensis</i> L.	11.4	52.5	28.1
<i>Alopecurus myosuroides</i> Huds.	10.9	48.6	19.5
<i>Digitaria sanguinalis</i> (L) Scop.	10.5	39.2	11.8
<i>Convolvulus arvensis</i> L.	7.4	42.3	14.7
<i>Cirsium arvense</i> (L.) Scop.	2.6	0.9	9.1
<i>Lactuca serriola</i> L.	2.3	0.8	6.5
<i>Convolvulus galaticus</i> Rost.Ex Choisy	2.2	0.13	1.9
<i>Matricaria chamomilla</i> L.	2.1	0.45	1.1
<i>Aegilops cylindrica</i> Host	2.1	0.11	1.8
<i>Bromus tectorum</i> L.	1.7	0.15	2.0
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	1.4	0.02	2.3
<i>Lolium temulentum</i> L.	1.2	0.23	1.4
<i>Papaver rhoeas</i> L.	1.2	0.6	2.2
Others	5.04	-	-
Total	120.34	-	-

The maximum frequency of occurrence for weed species was 60.8% for *C. album*, 52.5% for *B. arvensis*, 42.3% for *C. arvensis*, 57.6% for *A. retroflexus*, 50.4% for *A. repens* and 50.1 % for *C. dactylon*. General coverage of weeds were 48.2% for *C. album*, 32.6% for *A. retroflexus*, 28.1% for *B. arvensis*, 27.9% for *A. repens* and 20.3% for *C. dactylon*.

#### **Andırın subregion**

In Andırın's apple orchards, *A. repens*, *C. dactylon*, *D. glomerata*, *B. arvensis* and *A. myosuroides* were determined high densely. *C. arvensis*, *A. cylindrica*, *E. crus-galli*, *B. tectorum* and *S. viridis* were determined densely (Table 5).

The maximum frequency of occurrence of weed species were 81.4 % for *A. repens*, 76.9% *C. dactylon*, 69.3% for *D. glomerata*, 63.2% for *B. arvensis* and 40.1% *A. myosuroides*. General coverage of weeds were 42.3% for *A. repens*, 35.6% for *C. dactylon*, 28.4% for *D. glomerata* and 24.8% *B. arvensis*.

**Table 5. Weed density, frequency of occurrence and general coverage of weeds in Andırın subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Agropyron repens</i> (L.) P.Beauv.	19.8	81.4	42.3
<i>Cynodon dactylon</i> (L.) Pers.	15.46	76.9	35.6
<i>Dactylis glomerata</i> L.	13.3	69.3	28.4
<i>Bromus arvensis</i> L.	12.5	63.2	24.8
<i>Alopecurus myosuroides</i> Huds.	10.4	40.1	19.2
<i>Convolvulus arvensis</i> L.	2.63	29.5	6.9
<i>Aegilops cylindrica</i> Host.	1.7	10.4	3.6
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	1.68	7.3	1.2
<i>Bromus tectorum</i> L.	1.4	5.6	1.1
<i>Setaria viridis</i> (L.) Pal. Beauv.	1.29	3.3	0.6
Others	5.76	-	-
Total	85.92	-	-

#### **Caglayancerit subregion**

The weed species, *B. tectorum*, *B. arvensis*, *C. album*, *A. myosuroides*, *A. repens*, *A. retroflexus* and *C. dactylon* were determined high densely. *C. arvensis*, *D. glomerata*, *Cuscuta campestris*, *L. temulentum* and *S. viridis* were determined densely (Table 6).

The maximum frequency of occurrence of weed species were 76.7% for *B. tectorum*, 73.3% for *B. arvensis*, 70.1% for *C. album*, 54.2% for *A. retroflexus*, 52.7% for *A. myosuroides*, 50.9% for *C. dactylon* and 50.3% for *A. repens*. General coverage of weeds were 47.3% for *B. tectorum*, 41.2% for *C. album*, 40.8% for *B. arvensis*, 35.2% for *A. retroflexus*, 28.9% for *C. dactylon* and 26.3% for *A. repens*.

**Table 6. Weed density, frequency of occurrence and general coverage of weeds in Caglayancerit subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Bromus tectorum</i> L.	18.8	76.7	47.3
<i>Bromus arvensis</i> L.	14.61	73.3	40.8
<i>Chenopodium album</i> L.	12.90	70.1	41.2
<i>Alopecurus myosuroides</i> Huds	11.23	52.7	22.5
<i>Agropyron repens</i> (L.) P.Beauv.	10.46	50.3	26.3
<i>Amaranthus retroflexus</i> L.	10.23	54.2	35.2
<i>Cynodon dactylon</i> (L.) Pers	10.12	50.9	28.9
<i>Convolvulus arvensis</i> L.	6.28	41.8	25.6
<i>Dactylis glomerata</i> L.	2.47	11.9	3.8
<i>Cuscuta campestris</i> Yuncker	2.4	9.45	0.24
<i>Lolium temulentum</i> L.	1.41	5.6	2.3
<i>Setaria viridis</i> (L.) Pal. Beauv.	1.35	3.8	1.2
Others	12.64	-	-
Total	114.90	-	-

***Ekinözü subregion***

In this subregion's apple orchards, *C. album*, *A. retroflexus*, *B. arvensis*, *A.repens*, *C. dactylon* and *A. myosuroides* were determined high densely. *C. arvensis*, *S. viridis*, *L. serriola*, *C. draba ssp draba*, *C. galaticus*, *A. cylindrica*, *E. crus-galli*, *B. tectorum*, *C. arvense* and *Amaranthus blitoides* were determined densely (Table 7).

**Table 7. Weed density, frequency of occurrence and general coverage of weeds in Ekinozu subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Chenopodium album</i> L.	21.8	65.4	46.8
<i>Amaranthus retroflexus</i> L.	18.7	60.7	41.3
<i>Bromus arvensis</i> L.	15.4	58.2	30.4
<i>Agropyron repens</i> (L.) P.Beauv.	13.8	50.1	22.6
<i>Cynodon dactylon</i> (L.) Pers	12.9	46.7	23.5
<i>Alopecurus myosuroides</i> Huds	10.1	43.5	28.4
<i>Convolvulus arvensis</i> L:	8.3	42.9	29.2
<i>Setaria viridis</i> (L.) Pal. Beauv.	5.3	16.3	12.4
<i>Lactuca serriola</i> L.	4.9	15.2	10.3
<i>Cardaria draba ssp draba</i> (L.) Desv.	1.9	10.4	4.8
<i>Convolvulus galaticus</i> Rost.Ex Choisy.	1.6	0.24	3.9
<i>Aegilops cylindrica</i> Host.	1.5	0.15	3.0
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	1.4	0.23	2.2
<i>Bromus tectorum</i> L.	1.3	0.16	0.8
<i>Cirsium arvense</i> (L.) Scop.	1.1	0.4	2.0
<i>Amaranthus blitoides</i> S.Wats.	1.0	0.11	1.2
Others	4.95	-	-
Total	125.95	-	-

The maximum frequency of occurrence of weed species were 65.4% for *C. album*, 60.7% for *A. retroflexus*, 58.2% for *B. arvensis*, 50.1% for *A. repens* and 46.7% for *C. dactylon*. General coverage of weeds were 46.8% for *C. album*, 41.3% for *A. retroflexus*, 30.4% for *B. arvensis*, 29.2% for *C. arvensis* and 28.4 % for *A. myosuroides*.

#### ***Elbistan subregion***

In Elbistan, *C. album*, *B. arvensis*, *A. retroflexus*, *A. repens*, *L. serriola*, *C. dactylon* and *A. myosuroides* were determined high densely whereas *C. arvensis*, *L. temulentum*, *C. draba* ssp *draba*, *A. cylindrica*, *C. arvensis* and *P. lanceolata* were determined densely (Table 8).

The maximum frequency of occurrence of weed species were 73.6% for *C. album*, 65.8 % for *B. arvensis*, 62.4% for *A. retroflexus*, 51.7% for *A. repens* and 44.2% for *L. serriola*. General coverage of weeds were 39.6% for *C. album*, 30.2% for *B. arvensis*, 29.8% for *A. retroflexus*, 26.1% for *C. arvensis* and 25.4% for *A. repens*.

**Table 8. Weed density, frequency of occurrence and general coverage of weeds in Elbistan subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Chenopodium album</i> L.	19.40	73.6	39.6
<i>Bromus arvensis</i> L.	14.62	65.8	30.2
<i>Amaranthus retroflexus</i> L.	14.43	62.4	29.8
<i>Agropyron repens</i> (L.) P.Beauv.	13.25	51.7	25.4
<i>Lactuca serriola</i> L.	10.62	44.2	21.3
<i>Cynodon dactylon</i> (L.) Pers	10.30	38.5	20.2
<i>Alopecurus myosuroides</i> Huds	10.11	36.3	19.6
<i>Convolvulus arvensis</i> L.	9.8	35.2	26.1
<i>Convolvulus galaticus</i> Rost.Ex Choisy	3.4	0.2	2.4
<i>Lolium temulentum</i> L.	3.3	18.9	8.2
<i>Cardaria draba</i> ssp <i>draba</i> (L.) Desv.	3.2	15.3	7.9
<i>Aegilops cylindrica</i> Host.	2.8	4.3	4.5
<i>Cirsium arvensis</i> (L.) Scop.	2.1	10.5	6.3
<i>Plantago lanceolata</i> L.	1.3	0.96	2.1
Others	7.50	-	-
Total	126.13	-	-

#### ***Göksun subregion***

The weed species, *A. repens*, *A. retroflexus*, *C. album*, *B. arvensis*, *A. myosuroides*, *L. serriola*, *C. dactylon*, *L. temulentum*, *D. glomerata* were detected high densely whereas *C. arvensis*, *D. carota*, *A. cylindrica*, *C. draba* ssp *draba*, *S. viridis*, *D. sanguinalis*, *B. tectorum*, *P. lanceolata*, *C. arvensis*, *C. galaticus* and *P. media* were determined densely (Table 9).



The most frequency of occurrence of weed species were *C. album* 71.4%, *A. retroflexus* %70.9, *B. arvensis* L. 69.3 %, *A. repens* 68.6% and *A. myosuroides* %54.8. General coverage of weeds were *A. repens* 43.2%, *A. retroflexus* 38.1%, *C. album* 33.4%, *B. arvensis* L. 32.5%, *C. arvensis* L. 30.0% and *A. myosuroides* 21.6% rate.

**Table 9. Weed density, frequency of occurrence and general coverage of weeds in Göksun subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Agropyron repens</i> (L.) P.Beauv.	21.5	68.6	43.2
<i>Amaranthus retroflexus</i> L.	18.9	70.9	38.1
<i>Chenopodium album</i> L.	17.8	71.4	33.4
<i>Bromus arvensis</i> L.	16.9	69.3	32.5
<i>Alopecurus myosuroides</i> Huds.	11.2	54.8	21.6
<i>Lactuca serriola</i> L.	11.0	49.9	20.8
<i>Cynodon dactylon</i> (L.) Pers.	10.8	38.5	19.9
<i>Lolium temulentum</i> L.	10.7	32.1	18.4
<i>Dactylis glomerata</i> L.	10.4	28.7	17.3
<i>Convolvulus arvensis</i> L.	8.6	47.2	30.0
<i>Daucus carota</i> L.	4.6	13.10	8.2
<i>Aegilops cylindrica</i> Host.	4.1	10.8	7.3
<i>Cardaria draba</i> ssp <i>draba</i> (L.) Desv.	3.92	9.2	6.5
<i>Setaria viridis</i> (L.) P.Beauv.	3.8	7.5	6.2
<i>Digitaria sanguinalis</i> (L.) Scop.	3.1	8.6	6.1
<i>Bromus tectorum</i> L.	2.6	3.4	5.9
<i>Plantago lanceolata</i> L.	2.30	3.3	4.1
<i>Sorghum halepense</i> (L.) Pers.	2.30	1.4	0.3
<i>Cirsium arvense</i> (L.) Scop.	1.9	2.8	3.4
<i>Convolvulus galaticus</i> Rost.Ex Choisy	1.7	2.6	3.8
<i>Plantago media</i> L.	1.1	2.4	2.0
Others	8.08	-	-
Total	177.30	-	-

#### **Center subregion**

In Center subregion's apple orchards, *A. repens* (L.) P.Beauv., *A. myosuroides* and *C. arvensis* were determined high densely whereas *B. tectorum* L., *C. album*, *A. retroflexus*, *C. dactylon*, *D. sanguinalis*, *D. glomerata*, *S. halepense*, *C. campestris*, *A. sterilis*, *P. trivialis*, *C. solstitialis* subsp. *solstitialis*, *S. viridis*, *C. draba* ssp *draba*, *A. repens* (L.) DC., *B. arvensis*, *M. chamomilla*, *C. rotundus* and *P. australis* species were determined densely (Table 10).

The maximum frequency of occurrence of weed species were 58.1 % for *A. repens* (L.) P.Beauv, %57.2 for *A. myosuroides*, 55.6% for *C. arvensis* (L.) Pers., 53.7 % for *B. tectorum* L. and 42.5% for *C. album*. But general coverage of weeds were 30.3% for *C. album*, 30.2% for *C. arvensis* (L.) Pers., 28.3% for *A. retroflexus*, 24.7% for *B. tectorum* and *A. myosuroides* 22.6% rate.

**Table 10. Weed density, frequency of occurrence and general coverage of weeds in Center subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Agropyron repens</i> (L.) P.Beauv.	11.4	58.1	20.4
<i>Alopecurus myosuroides</i> Huds.	10.9	57.2	22.6
<i>Convolvulus arvensis</i> L.	10.8	55.6	30.2
<i>Bromus tectorum</i> L.	9.74	53.7	24.7
<i>Chenopodium album</i> L.	8.2	42.5	30.3
<i>Amaranthus retroflexus</i> L.	7.6	25.3	28.3
<i>Cynodon dactylon</i> (L.) Pers.	7.3	28.9	16.4
<i>Digitaria sanguinalis</i> (L) Scop.	5.6	8.4	2.1
<i>Dactylis glomerata</i> L.	5.4	28.7	12.8
<i>Sorghum halepense</i> (L.) Pers.	4.9	34.3	8.9
<i>Avena sterilis</i> L.	2.1	12.4	3.5
<i>Poa trivialis</i> L.	2.0	6.2	0.89
<i>Cuscuta campestris</i> Yuncker	1.82	9.3	0.3
<i>Centaurea solstitialis</i> subsp. <i>solstitialis</i>	1.72	1.3	0.92
<i>Setaria viridis</i> (L.) P. Beauv.	1.68	1.4	1.03
<i>Cardaria draba</i> ssp <i>draba</i> (L.) Desv.	1.59	18.4	2.8
<i>Acroptilon repens</i> (L.) DC.	1.53	2.1	0.5
<i>Bromus arvensis</i> L.	1.4	22.8	2.1
<i>Matricaria chamomilla</i> L.	1.25	20.1	1.6
<i>Cyperus rotundus</i> L.	1.2	17.9	1.6
<i>Phragmites australis</i> (cav.) Trin. Ex steudel	1.06	3.2	2.8
Others	18.75	-	-
Total	117.94	-	-

#### **Nurhak subregion**

In this area, *B. arvensis*, *A. repens* (L.) P.Beauv., *D. glomerata*, *A. retroflexus*, *C. album* and *A. myosuroides* were determined high densely. *L. serriola*, *S. viridis*, *C. dactylon*, *C. arvensis*, *C. solstitialis* subsp. *solstitialis*, *E. crus-galli*, *L. temulentum* and *M. longifolia* were determined densely (Table 11).

The maximum frequency of occurrence of weed species were 60.6% for *B. arvensis*, 59.4% for *A. retroflexus*, 56.2% for *C. album*, 54.3% for *A. repens* and 52.1% for *D. glomerata*. General coverage of weeds were 32.6% for *B. arvensis*, 34.8% for *A. retroflexus*, 29.3% for *C. album*, 26.5% for *D. glomerata* and 23.4% for *A. repens*.

**Table 11. Weed density, frequency of occurrence and general coverage of weeds in Nurhak subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Bromus arvensis</i> L.	12.8	60.6	32.6
<i>Agropyron repens</i> (L.) P.Beauv.	11.2	54.3	23.4
<i>Dactylis glomerata</i> L.	11.0	52.1	26.5
<i>Amaranthus retroflexus</i> L.	10.7	59.4	34.8
<i>Chenopodium album</i> L.	10.5	56.2	29.3
<i>Alopecurus myosuroides</i> Huds.	10.3	43.8	20.5
<i>Lactuca serriola</i> L.	5.2	27.3	12.7
<i>Setaria viridis</i> (L.) P.Beauv.	5.0	10.2	9.6
<i>Cynodon dactylon</i> (L.) Pers.	4.7	13.5	8.3
<i>Convolvulus arvensis</i> L.	3.8	20.7	7.2
<i>Centaurea solstitialis</i> subsp. <i>solstitialis</i>	2.64	2.5	1.1
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	1.5	2.1	1.6
<i>Lolium temulentum</i> L.	1.28	4.6	4.5
<i>Mentha longifolia</i> (L.) Hudson.	1.12	1.3	2.1
Others	6.01	-	-
Total	97.75	-	-

**Pazarcık subregion**

The weed species, *B. arvensis*, *A. repens* (L.) P.Beauv. were determined high densely. *B. tectorum*, *C. dactylon*, *C. album*, *A. retroflexus*, *C. arvensis*, *A. myosuroides*, *S. halepense*, *D. glomerata*, *C. solstitialis* subsp. *solstitialis*, *D. sanguinalis*, *S. viridis*, *L. temulentum*, *L. amplexicaule* and *A. columnaris* species were determined densely (Table 12).

**Table 12. Weed density, frequency of occurrence and general coverage of weeds in Pazarcık subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Bromus arvensis</i> L.	10.5	54.9	30.3
<i>Agropyron repens</i> (L.) P.Beauv.	10.1	53.6	25.1
<i>Bromus tectorum</i> L.	7.2	38.3	19.8
<i>Cynodon dactylon</i> (L.) Pers.	5.3	32.8	17.2
<i>Chenopodium album</i> L.	4.9	30.4	16.4
<i>Amaranthus retroflexus</i> L.	4.3	25.7	19.3
<i>Convolvulus arvensis</i> L.	3.2	20.3	16.0
<i>Alopecurus myosuroides</i> Huds.	2.4	8.2	5.6
<i>Sorghum halepense</i> (L.) Pers.	2.1	9.2	4.7
<i>Dactylis glomerata</i> L.	1.6	9.6	3.2
<i>Centaurea solstitialis</i> subsp. <i>solstitialis</i>	1.4	4.1	2.4
<i>Digitaria sanguinalis</i> (L.) Scop.	1.3	3.9	2.9
<i>Setaria viridis</i> (L.) P.Beauv.	1.2	6.5	1.8
<i>Lolium temulentum</i> L.	1.19	2.1	1.6
<i>Lamium amplexicaule</i> L.	1.11	3.2	1.9
<i>Aegilops columnaris</i> Zhuk.	1.1	1.3	0.3
Others	10.61	-	-
Total	69.51	-	-

The most frequency of occurrence of weed species was 54.9% for *B. arvensis*, 53.6% for *A. repens*, 38.3% for *B. tectorum*, 32.8% for *C. dactylon* and 30.4% for *C. album*. General coverage of weeds were 30.3% for *B. arvensis*, 25.1% for *A. repens*, 19.8% for *B. tectorum*, 19.3% for *A. retroflexus* and 17.2% for *C. dactylon*.

#### **Türkoglu subregion**

In this region, *B. arvensis*, *S. halepense* ve *A. repens* (L.) P.Beauv. were determined high densely. *C. album*, *A. retroflexus*, *C. arvensis*, *S. viridis*, *L. serriola*, *A. myosuroides*, *C. dactylon*, *M. chamomilla*, *D. sanguinalis*, *S. arvensis*, *C. rotundus*, *S. asper* and *D. glomerata* were determined densely (Table 13).

The frequency of occurrence of weed species were %54.2 for *B. arvensis*, 52.4% for *S. halepense*, 51.8% for *A. repens*, 43,9% for *C. album* and 37.3% for *A. retroflexus*. General coverage of weeds were 30.9% for *B. arvensis*, 29.4% for *S. halepense*, 28.2% for *A. retroflexus*, 25.1% for *C. album* and 24.6% for *A. repens*.

**Table 13. Weed density, frequency of occurrence and general coverage of weeds in Türkoglu subregion**

Weed species	Density (plants/m <sup>2</sup> )	Frequency(%)	Coverage(%)
<i>Bromus arvensis</i> L.	10.9	54.2	30.9
<i>Sorghum halepense</i> (L.) Pers.	10.6	52.4	29.4
<i>Agropyron repens</i> (L.) P.Beauv.	10.3	51.8	24.6
<i>Chenopodium album</i> L.	9.2	43.9	25.1
<i>Amaranthus retroflexus</i> L.	8.1	37.3	28.2
<i>Convolvulus arvensis</i> L.	7.2	22.6	19.5
<i>Setaria viridis</i> (L.) P.Beauv.	3.4	14.1	12.2
<i>Lactuca serriola</i> L.	3.2	13.6	10.4
<i>Alopecurus myosuroides</i> Huds.	3.1	12.1	10.6
<i>Cynodon dactylon</i> (L.) Pers.	3.0	11.5	8.9
<i>Matricaria chamomilla</i> L.	2.5	10.2	6.4
<i>Digitaria sanguinalis</i> (L.) Scop.	2.3	7.8	6.5
<i>Sinapis arvensis</i> (L.)	2.1	9.1	5.3
<i>Cyperus rotundus</i> L.	1.9	8.7	5.7
<i>Sonchus asper</i> (L.) Hill.	1.4	7.4	5.2
<i>Dactylis glomerata</i> L.	1.2	5.9	3.6
Others	8.74	-	-
Total	89.14	-	-

Species and densities of the weeds found in the apple orchards of Kahramanmaraş showed differences according to the subregions. Some species were distributed in all regions while some species were distributed regionally. A.

*repens* (L.) P. Beauv. was determined at high density in the all subregions. *C. album* was observed as high dense in the subregions of Afsin, Caglayancerit, Ekinozu, Elbistan, Göksun and Nurhak while it was detected dense in the subregions of Center, Pazarcık and Türkoglu and it was found low dense in the Andırın. *B. arvensis* was high dense found in the subregions of Afsin, Caglayancerit, Ekinozu, Elbistan, Göksun, Nurhak, Pazarcık and Türkoglu while it was found dense in Andırın and Center subregion. Similarly, *A. retroflexus* was observed with high dense in the subregions of Afsin, Caglayancerit, Ekinozu, Elbistan, Göksun, Center, Nurhak and Türkoglu while it was observed dense in the Pazarcık and low dense in the Andırın. *C. dactylon* was detected as high dense in the subregions of Afsin, Andırın, Caglayancerit, Ekinozu, Elbistan and Göksun while it was determined as dense in the subregions of Center, Nurhak, Pazarcık and Türkoglu. *A. myosuroides* was detected as high dense in the subregions of Afsin, Caglayancerit, Ekinozu, Elbistan, Göksun, Center and Nurhak while it was found dense in the subregions of Andırın, Pazarcık and Türkoglu.

*C. arvensis* was found high dense in Center and Türkoglu, dense in Afsin, Andırın, Caglayancerit, Ekinozu, Elbistan, Göksun, Nurhak and Pazarcık. *D. glomerata* was found high dense in Andırın and Göksun, dense in Caglayancerit, Center, Pazarcık and Türkoglu, and it doesn't exist in Afsin, Ekinozu and Elbistan. *B. tectorum* was found high dense in Caglayancerit and Center, dense in Afsin, Andırın, Ekinözü, Göksun and Pazarcık, and low dense in Elbistan, Nurhak, and Türkoglu. *L. serriola* was found high dense in Elbistan and Göksun, dense in Afsin, Ekinozu, Nurhak, Türkoglu and low dense in Andırın, Caglayancerit, Center and Pazarcık. *S. viridis* was found dense in Andırın, Caglayancerit, Ekinözü, Göksun, Center, Nurhak, Pazarcık and low dense in Afsin and Elbistan. *D. sanguinalis* was found high dense in Afsin, dense in Göksun, Center, Pazarcık and Türkoglu and it doesn't exist in Andırın, Caglayancerit, Ekinözü, Elbistan and Nurhak. *L. temulentum* was high dense in Göksun, dense in Afsin, Caglayancerit, Elbistan, Nurhak and Pazarcık and low dense in Andırın, Ekinozu, Center and Türkoglu. *S. halepense* was high dense in Türkoglu, dense in Göksun, Center and Pazarcık, and it doesn't exist in Afsin, Andırın, Caglayancerit, Ekinozu, Elbistan and Nurhak. *C. draba* sp *draba* was found dense in Ekinozu, Elbistan, Göksun and Center, low dense in Afsin, Caglayancerit, Nurhak, Pazarcık and Türkoglu and rarely observed in Andırın. *A. cylindrica* was found dense in Afsin, Andırın, Ekinozu, Elbistan and Göksun, low dense in Caglayancerit, and it doesn't exist in Center, Nurhak, Pazarcık and Türkoglu. *C. arvense* was dense in Afsin, Ekinozu, Elbistan and Göksun, low dense in Caglayancerit, Center, Nurhak, Pazarcık and Türkoglu and low dense in Andırın. *C. galaticus* was found dense in Afsin, Ekinozu, Elbistan and Göksun, low dense in Andırın, Caglayancerit and Center and it doesn't exist in Nurhak and Pazarcık. *M. chamomilla* was found dense in Afsin, Center and Türkoglu,

low dense in Caglayancerit, Ekinozu, Elbistan, Göksun, Nurhak, Pazarcık and Andırın.

Kahramanmaraş region is located in Mediterranean region and Continental climate zones. Therefore, while Center, Pazarcık and Türkoglu subregions are located in the Mediterranean climate, Andırın and Caglayancerit are located in the transition climate. However, Göksun, Afsin, Elbistan, Nurhak and Ekinozu have a continental climate. The region have different soil structure types. The pH of the soil in the region varied from 7.06 to 8.33 and generally it was 7.60. Calcareous contents of the region were generally less than 5% (Yılmaz *et al.*, 2000).

The weed density in the Göksun subregion was found much more than that of the other subregion because it had 6 times larger apple orchards area than other subregions. Because Pazarcık subregion was the smallest apple orchards area, its weed density was found low. Determined density, frequency of occurrence and coverage of the some species of weeds varied according to subregions. In this study, densities of the perennial plants with rhizome and stolon were especially found high.

Densities of *Cyperus* spp. and *P. oleracea* in the Mediterranean region were reported as the most common weeds especially in the summer season (Kadıoğlu and Ulu, 1993). Frequency of occurrence of *Stellaria media*, *M. chamomille*, *Oxalis* spp., *Poa annua* and *L. serriola* were more than 50% on March and April in the same study. In Aydın region, 47 weed species belonging to 20 families were reported by Ögüt and Boz (2007) and frequency of occurrence were 79.80% for *S. media*, 63.60% for *M. chamomilla*, 55.50% for *Oxalis corniculata*, 52.80% for *Poa annua* and 50.0% for *L. serriola* in the dormant season. On the summer season, frequency of occurrence of *P. oleracea*, *C. rotundus* and *Amaranthus* spp. were 87.80, 85.80 and 63.30%, respectively. Frequency of occurrence of *T. terrestris*, *C. dactylon*, *C. arvensis*, *D. sanguinalis*, *L. serriola*, *C. album*, *E. crus-galli* and *S. halepense* varied from 20 to 45% while the other weeds were in between 2 and 10% frequency of occurrence. The coverage of the weeds were 56.25% for *P. oleracea*, 52.70% for *C. rotundus*, 16.62% for *C. dactylon*, 16.54% for *Trifolium* spp., 13.39% for *D. sanguinalis*, and 12.74% for *Amaranthus* spp. (Ögüt and Boz, 2007). A total of 47 weed species belonging to 19 families were identified on the apple orchards in Nigde region (Ustuner and Ustuner, 2011). In the survey studies in Isparta's apple orchards, densities of *A. retroflexus*, *P. oleracea* (8.92 plants m<sup>-2</sup>) and *Setaria verticillata* were detected as 10.56%, 8.92% and 4.79%, respectively. The coverage areas were 5.14% for *A. retroflexus*, 3.69% for *Tribulus terrestris* and 3.00% for *P. oleracea*. The most common weed species in the apple orchards were 83.33% for *C. album*, *C. arvensis* and *P. oleracea*, 77.78% for *A. retroflexus* and 77.22% for *L. serriola* (Kitis, 2011).

Densities and frequency of occurrence of weeds in Turkey were reported by Kadioğlu and Ulu (1993), Zeki *et al.*, (1994), Tepe (1997), Yazlık and Tepe (2001), Karaca and Guncan (2003), Ustuner and Akyol (2007), Ögüt and Boz (2007) and Kitis (2011). The results of this studies were similar with our results. Majority of the weeds were *A. repens* (L.) P.Beauv., *A. myosuroides*, *Amaranthus* spp., *B. tectorum*, *C. album*, *C. dactylon*, *S. viridis*, *D. glomerata*, *C. arvensis*, *M. chamomilla*, *L. serriola*, *S. halepense* and *D. sanguinalis*. However, the species of *Trifolium* spp., *Lolium perenne*, *Lotus corniculatus* L., *Taraxacum* spp., *P. annua*, *P. lanceolata*, *Stelleria media*, *Oxalis corniculata*, *P. oleracea*, *C. bursa-pastoris*, *C. rotundus*, *E. crus-galli* and *T. terrestris* showed differences according to the region. The reason of these differences is different climate due to conditions, irrigation systems, soil type and altitudes of the regions.

The results of the present study were also consistent with the results of the studies carried out different region in the world (Dastgheib and Frampton, 2000; Harrington *et al.*, 2002; Hamma and Ibrahim, 2013; Verma and Chauhan, 2013). *A. retroflexus*, *A. repens* *C. album* and *C. arvensis* in the present study were similar with the species in the previous studies.

Some of the factors such as the altitude, soil structure, climate, irrigation system and plant communities of the region played a vital role in these similarities.

Consequently, densities, frequency of occurrence and coverage of the weeds may be different according to the subregion. These numerical values may also vary in the same region. The factors such as altitude, climate, soil structure, irrigation systems, tree corolla width (shadowing) and plantation area's size of the region may play a role in emerging of this variation.

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