International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Seasonal, biometric and dynamic monitoring of the Shihia plant *Cotula cinerea* Del (1831) and its accompanying plants in the Saharan region Oued-Souf (south-east of Algeria)

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Abstract: ***This work is for the purpose of making a biometric and dynamic study for the plant Cotula cinerea Del and its accompaniers in the region of Oued- Souf through the annual monitoring during the year 2009-2010. After studying and monitoring it was found that the distribution of plants is controlled by external factors (the amount of rainfall, seasonal temperature and the soil). and the development phase of the plant. life depends on many factors thus a phase can be just two weeks , so that the number of individuals has a direct correlation with the coverage rate and the diameter of the plant and the number of branches these height is in fruiting period, these standards may be assigned by external factors. Also that the rate of pollination is low because of the absence of ray flowers among these plants which causes the absence of pollinating insects. For the territorial monitoring there were 34 species of accompanying plants belong to 15 families most part of it divided into 4 botanicals family: Asteraceae, Chenopodiaceae, Poaceae and Borraginaceae, and we observed the dominance of the annual species Thérophytes that represents 64 % and this completes these life in short periods.***

Keywords: *Cotula cinerea* Del., biometric and dynamic study, accompanying plants, Oued-Souf

1. Introduction

Cotula cinerea Del [Syn. *Brocchia cinerea* (Del) Vis.] is one of 03 species of genre Cotula (Asteraceae) in Algeria **[17] [10]**, it is a wild plant that grows in Arab Saharian regions, among these regions Oued Souf **[23]**; **[20]** which locally known as (Shiha, Shihia, Shih el ibel) **[23]**. It is an annual herbaceous plant **[2]**, it can reach 30 cm high and the aerial part is covered with Intensive white stubble **[22]**. The leaves are thick divided to a top part with two or three segments, in the stem of the top branch there are yellow inflorescences **[22] [23]**.

This plant contains many active compounds such as *flavonoids* **[10]**, essential oils and turpentines which gives a powerful and specific odor to the plants **[18]**. The leaves extracts of *Cotula cinerea* are very efficacies against fungus [5], it can be used to cure bellyache and stomachache **[18]** and fever and headache, Migraine headaches and cough and joints inflammation. **[13]**and for a further study on this plant and to become familiar with its properties we did the following:

- Seasonal follow up for biometric measurements to *Cotula cinerea* Del, through many measures to plants (rate of total coverage/coverage rate of plants/ number of individual/ plants diameter/ plants height/ branches number) for different stages of its life.
- Seasonal follow up for the accompanying species to *Cotula cinerea* Del in the study areas in order to deduce the main plant type of the accompanying plants for the studied plant.
- The study of the main stages in the life of the plant *Cotula cinerea* Del and approximation of its duration also follows the rate of fertilization and seed production of this plant.

2. Choice of Study Areas

The annual monitoring was made in a period between June 2009 to June 2010 in my Hassani Abdelkarim and Dhokkar areas (Table 2.1, Figure.2.1) that are linked administratively to the city of Hassani Abdelkarim region of Oued Souf in the farther east of the Grand Erg Oriental **[16]** through five study zones were selected from these two regions because of its richness of these plants **[23]**.

Table 2.1: Astronomical positions of the study zones

Geographical position	*Study area*	*Height above the sea level (m)*	*Latitude*	*Longitude*
Hassani Abdelkarim	1	58	N 33° 28.806'	E 006° 53.603'
	2	52	N 33° 29.063'	E 006° 53.475'
	4	51	N 33° 28.979'	E 006° 53.566'
Dhokkar	3	50	N 33° 29.487'	E 006° 53.281'
	5	48	N 33° 29.557'	E 006° 53.627'

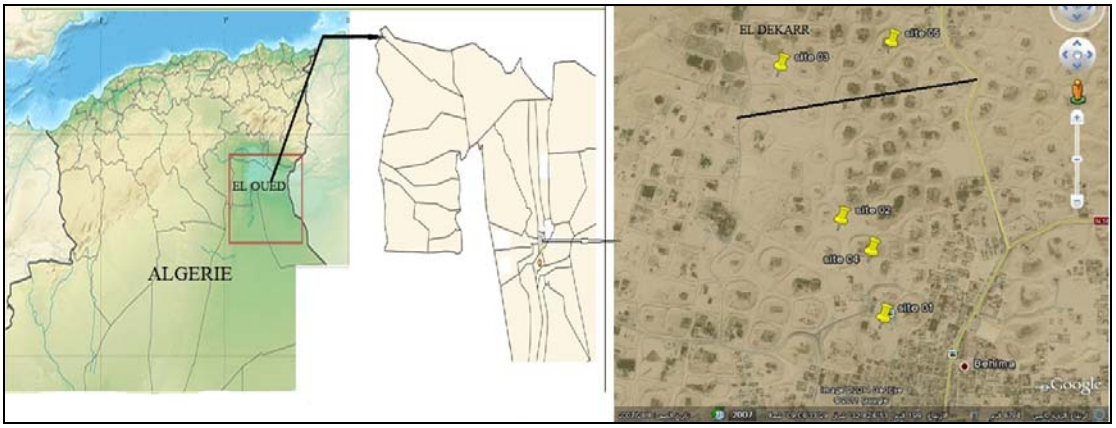

Figure2.1: Study areas of Shihia plant (*Cotula cinerea* Del.)

For the surveys on land, they were scheduled for five seasons as shown in Table 2.2.

Table 2.2: Schedule of surveys to the five study areas

	Survey 1 summer 2009	Survey 2 fall 2009	Survey3 Winter 2010	Survey 4 Spring 2010	Survey 5 Summer 2010
Station 01	11/6/2009	28/10/09	5/2/2010	23/03/10	24/06/10
Station 02	12/6/2009	28/10/09	5/2/2010	23/03/10	24/06/10
Station 03	16/06/09	28/10/09	12/2/2010	24/03/10	24/06/10
Station 04	16/06/09	28/10/09	5/2/2010	25/03/10	25/06/10
Station 05	20/06/09	28/10/09	12/2/2010	25/03/10	25/06/10

3. Materials and Methods

3.1. Biometrical Methods of the Studied Plants

During the seasons of the study: Each area is divided into four (04) squares taken randomly with the conservation of the same repetition for each survey **[11]** to the study of *Cotula cinerea* Del and its accompanying plants **[1]**.

For the studied plant-type: the study variables were regrouped in the table 3.3.

Table 3.3: Biometrical method used to study the ecology of *Cotula cinerea* of study of (formal) measures for the type of plants studied in each iteration **[6]**.

Iteration rate of total coverage (percentage)	%
Type of studied plant	
Shihia (*Cotula cinerea* Del)	
Coverage rate in percentage	%
Individual number	n
Plants status	Vegetative / Flowering / fruiting
Plants diameter	(cm)
Plants height	(cm)
Branches number/plant	n

3.2. Number of flowers and seeds produced

We estimated the average success of pollination of plants in the study areas **[14]** collecting 10 capitulates from random positions of each study area in flowering and fruiting periods to calculate the number of flowers and seeds by capitulate.

Figure 3.1: *Cotula cinerea Del*. in flowering period (by Chouikh, 2010)

3.3. For the accompanying plants

It is through the counting and classifying the accompanying plants in each of the study seasons **[12]**.Also the estimation of biological diversity through counting the number of taxa by station and their density **[8]**; **[9]**.

4. Results and Discussion

Through the annual monitoring of the total coverage rate (Figure 4.1) it is noticed that maximum coverage was noted in summer 2009 because the amount of precipitation of spring /summer 2009 was highly (160 mm in sum of both seasons) **[19]**, followed by autumn 2009 and spring 2010 as the total coverage rate was 32.75%, because the availability of many types that are vivacious and adapted to drought. In winter, the coverage rate was minimal (27.25%) due to the lack of the types that grow during this season; also the soil factor affects the development and diversity of vegetation. [**[3**We also noticed that the standard deviation is rather large because there is a disruption of the coverage rate in the study area.

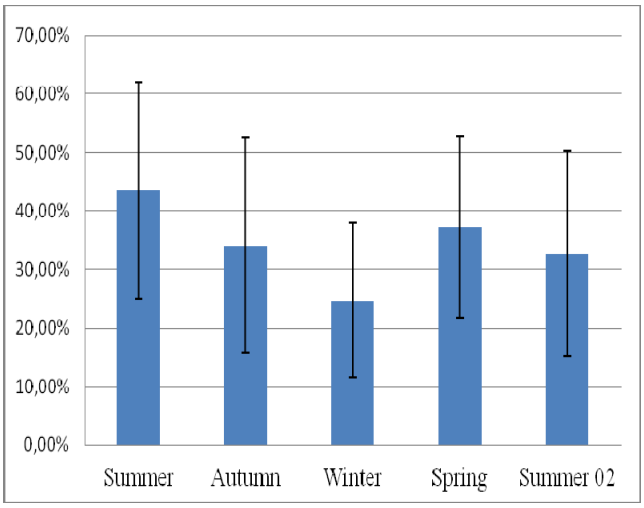

Figure 4.1: Annual average rate of total coverage

4.1. Average coverage rate of the studied plants:

The results in figure 4.2 reveal that the highest rate of *Cotula cinerea* Del was found in summer 2009, it was due to the large amount of rainfall before this survey: winter and spring of 2009 (160 mm in the sum of two seasons). After that the coverage rate was reduced sharply during autumn and winter and then there was an increase during spring 2010 and this is the perfect season to enlarge this *Shihia* plant, as for summer 2010 the coverage rate was void because of the low amount of precipitation and the increase in temperature 31.8°C **[19]**.

Also we noticed that the standard deviation is greater than the average in the autumn and winter and spring due to the large temperature difference between the study areas and the iterations (repetitions) of the study areas as some repetition was zero and other reached 9% in fall and 17% in winter and 18% in spring all this explained by the great disturbance of the diversity of plants **[23]**.

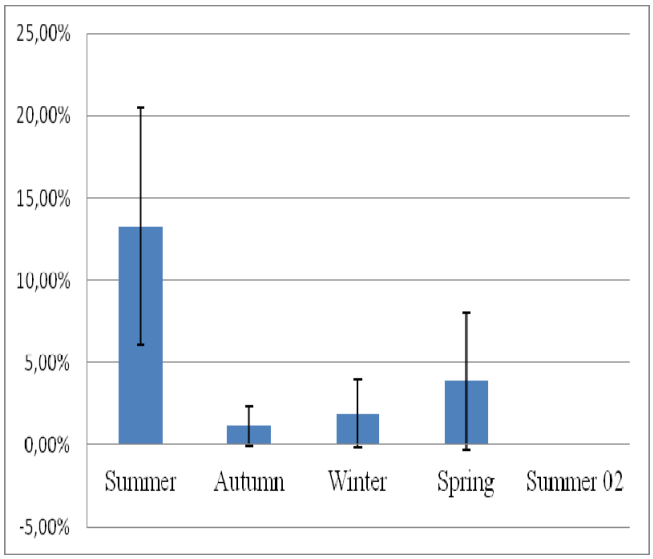

Figure 4.2: The annual monitoring of the average coverage rate of Shihia (*Cotula cinerea* Del.).

According to these results, we can said that the *Cotula cinerea* diversity is controlled by a many factors, the most important is the amount of precipitation **[4]**; **[7]**; **[15]**, the temperature and the soil nature as it is widely distributed in light and sandy soils **[2]**.

The annual monitoring reveal that the development cycle of *Cotula cinerea* Del composed by three stages this plant and after the annual monitoring we have concluded that the periods and stages of life of the plant are as follow:

- Vegetative phase: from mid-October to mid-January.
- Flowering phase: from mid-January until the end of February.
- Fruiting phase: from the beginning of March to early April.

All of the growth phases of this plant are related to its ability to adapt with drought **[21]** which is related to climatic factors (precipitation and temperature) there is an increase or decrease between these periods, sometimes the phase can reach only two weeks in order to avoid drought.

4.2. The average number of individuals

According to the results obtained (Figure 4.3) we noticed that the majority of the number of plants (35.25/10m^2) was found in spring and (16.80/10m^2) in autumn and (23.45/10m^2) in winter, because the amount of precipitation in fall were low and there were plants that could not complete their life cycles and the coverage rate is related to the number and size of plants in each study area indicating that the increase in the number and size of individual plants affects the coverage rate. The number of individuals in summer 2009 was almost equal to the number of plants in winter, but the coverage rate is high in summer and low in winter.

The standard deviation was above the average in autumn, winter and spring. This variability is due to the disturbed distribution of plants in the study areas. The individuals' number is quite stable in the study areas investigate period 2009, this stability was due to the abundance of precipitation amount in winter and spring of 2009. à cause in the summer of 2009, the number of individuals which is quite stable in the study areas because the abundance of precipitation amount in winter and spring of 2009.

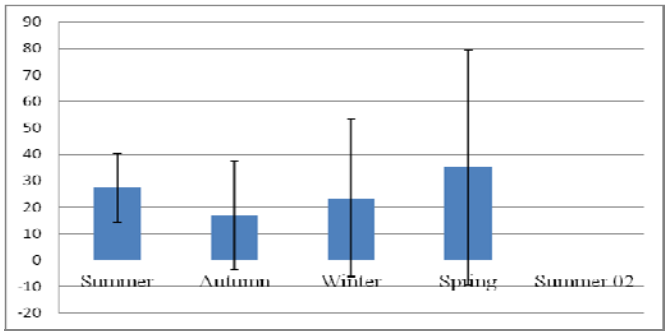

Figure 4.3: Annual monitoring of the average number of individuals of *Cotula cinerea* Del.

4.3. Average diameter of the plant:

We noticed that the diameter of *Cotula cinerea* (figure 4.4) was larger in summer and winter 2009 (the fruiting phase).

The diameter was less in spring than in winter, it was due to the growth of a new generation of plants in late winter and after we took the measures; the plants in spring were in the flowering phase and for autumn the diameter was small because the plants were in the vegetation phase, also we concluded that the diameter is related to the age and the size of the plant, plants in early stages of growth (vegetative stage) have reduced diameter compared to advanced stages (in flowering and fruiting) where they have almost the same values because the plants cease growing at the beginning of seed formation.

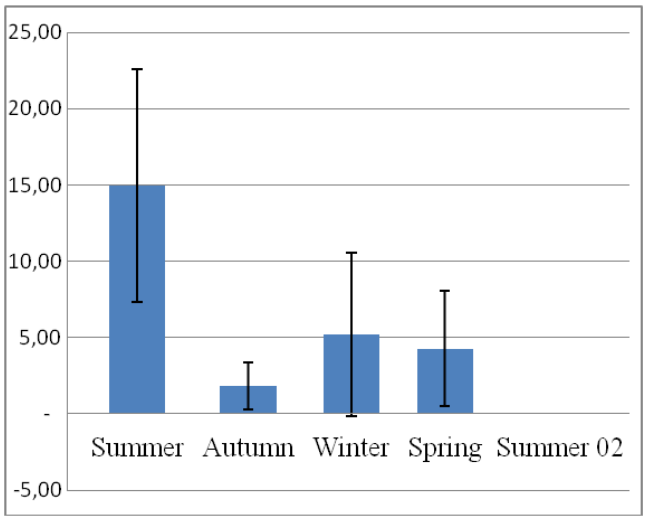

Figure 4.4: Seasonal variations for the average diameter of *Cotula cinerea* Del

4.4. The average plant height:

The plants height is maximum in flowering and fruiting phase (seasons: winter, spring and summer 2009) compared to the vegetative phase (autumn) as the height of the plants is directly related to its diameter, diameter growth is related to height growth (figure 4.5).

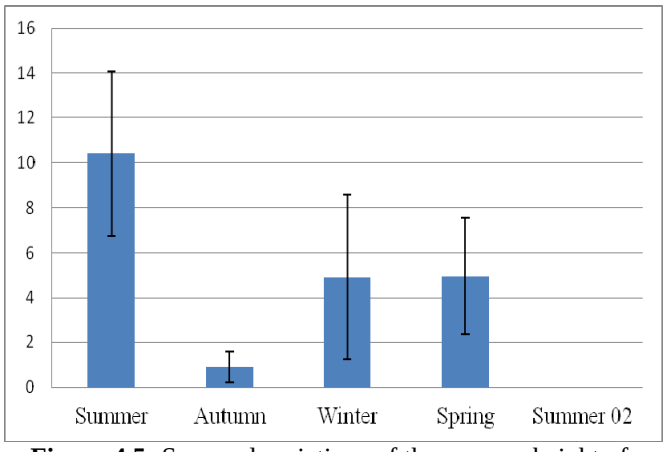

Figure 4.5: Seasonal variations of the average height of *Cotula cinerea* Del

4.5. The average number of branches of *Cotula cinerea* Del

The number of branches is close in all life stages of the plant. It is lower in spring than in autumn and summer, because the plants were in the flowering phase of the new generation that appears at the end of winter (figure 4.6). We concluded that the branches number has no relation to the diameter and the age of the plant.

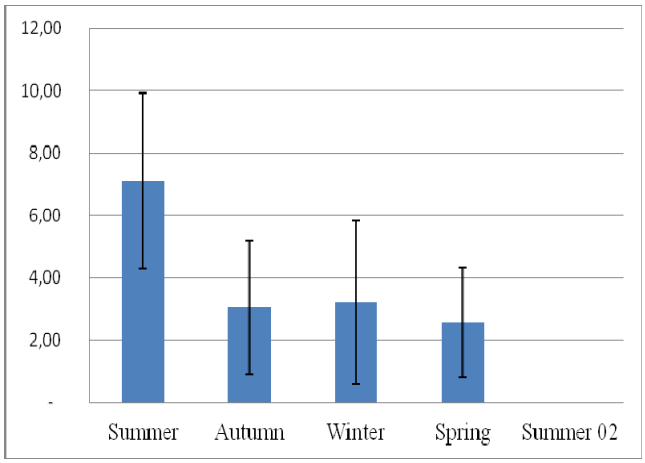

Figure 4.6: Annual variations of the average number of branches of *Cotula cinerea* Del

4.6. The average number of flowers and seeds and pollination rate:

According to the observation of the results in figure 4.7, we noticed that the pollination rate is between 25% and 40% in the study areas with some low rate due to: the capitulate producer that lack ray florets attract insects in order to pollinate and the lack of pollinating insect's factors in the study area due to the lack of precipitation; it is also likely that the fertilization fails after pollination because of the tough climate.

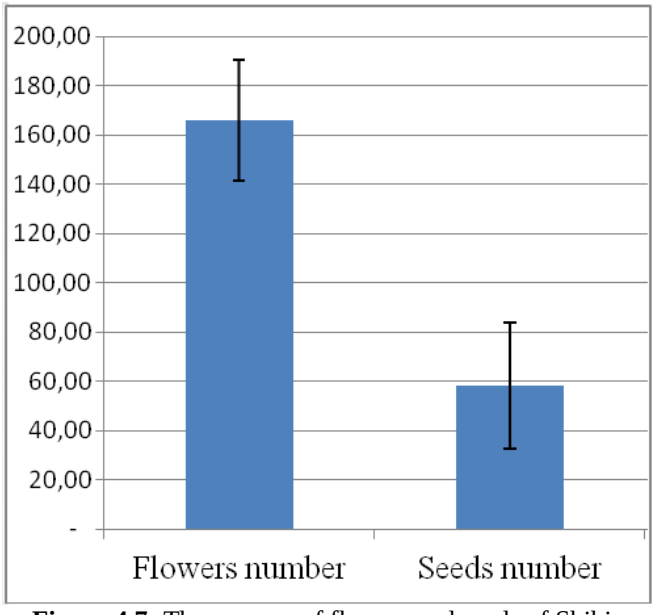

Figure 4.7: The average of flowers and seeds of Shihia *Cotula cinerea* Del plant in the study areas

4.7. The accompanying plants of the *Cotula cinerea* Del in the study areas

An important data of the plant diversity was obtained After the annual monitoring we obtained important data on the plant diversity in the study area (figure 4.8) and

accompanying plants of *Cotula cinerea* Del (table 4.1, figure 4.9).

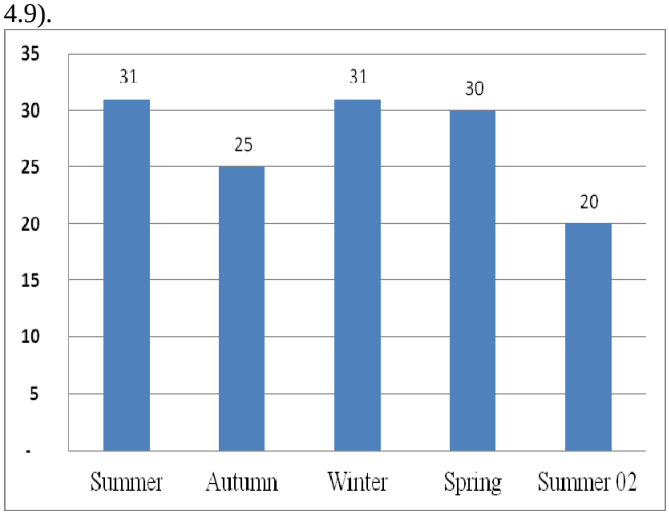

Figure 4.8: Floristic wealth of the seasons

According to the results in figure 4.8, we can say that the annual distribution of the accompanying plants varies from one season to another. The maximum was found in summer winter and spring, almost 30 taxa developed in these periods, because both of the taxa are seasonal plants. of the growth of many seasonal plants in both seasons due to the availability of amount of precipitation and suitable temperature to the growth of this types of plants. In autumn and summer the number is low, it due to the lack of seasonal and hardy plants adapted to drought. and the number of types is low in autumn and summer due to the lack of seasonal types and survival of perennial types adapted to drought.

Table 4.1: Accompanying plants of *Cotula cinerea* Del in the study areas. *(Th: Thérophytes; Ph: Phanérophytes;He: Hémicryptophytes; Ch.: Chamaephytes; Ge: Géophytes).*

Plant type	*Family*	*Biological type*
Aristida plumosa	Poaceae	Ph
Arnebia decumbens	Boraginaceae	Th
Asphodelus refractus	Liliaceae	Ge
Astragalus cruciatus	Fabaceae	Th
Atractylis flava	Asteraceae	Th
Bassia muricata	Chenopodiaceae	Th
Chenopodium murale	Chenopodiaceae	Th
Cleome arabia	Capparidaceae	Th
Cornulaca monacantha	Chenopodiaceae	Ph
Cutandia dichotoma	Poaceae	Th
Danthonia froskahlii	Poaceae	Ph
Echiochilon fruticosum	Boraginaceae	He
Erodium glaucophyllum	Geraniaceae	Ge
Erodium laciniatum	Geraniaceae	Ge
Euphorbia guyoniana	Euphorbiaceae	He
Helianthemum lipii	Cistaceae	Ch
Ifloga spicata	Asteraceae	Th
Koelpenia liniaris	Asteraceae	Th
Launaea glomerata	Asteraceae	Th
Launaea resedifolia	Asteraceae	Th
Lotus halophylus	Fabaceae	Th
Malcolmia aegyptiaca	Brassicaceae	Th
Mathiola livida	Brassicaceae	Th
Moltkia ciliata	Boraginaceae	He
Neurada procumbens	Rosaceae	Th
Nolletia chrysocomoïdes	Asteraceae	Th
Onopordon macrocanthum	Asteraceae	Th
Plantago albicans	Plantaginaceae	Th
Plantago psyllium	Plantaginaceae	Th
Polycarpaea repens	Caryophyllaceae	Th
Salsola foetida	Chenopodiaceae	Ph
Schismus barbatus	Poaceae	Th
Silene villosa	Caryophyllaceae	Th
Zygophyllum album	Zygophyllaceae	He

All specie of accompanying plants (34), which were counted in the study seasons, belongs to 15 plant families (figure 4.9)

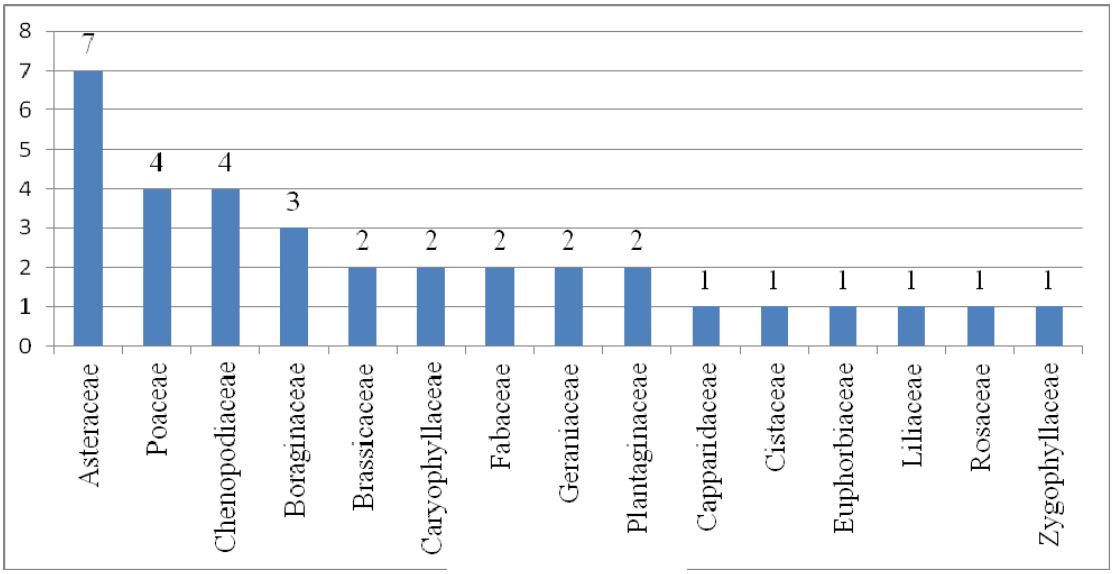

Figure 4.9: Distribution of the accompanying plants of *Cotula cinerea* Del counted through the seasons of study for the plant species

The family of Asteraceae is the first in the classification of the type's number with 07 species plants types because this type is most widely distributed in the area with power seed dispersal and the variation of its biological form. The second position occupied by two botanical families (Chenopodiaceae and Poaceae) with 04 species for each family type and after that the Borraginaceae family with 03 types. These same groups represent 50% of total accompanying plants number, because the majority numbers are annual species. They can accomplish their life cycles in short period humid that accomplished their life cycles in short periods to avoid long periods of drought in which these study areas are characterized.

According to the results of the biological species of the accompanying plants (figure 4.10), we noticed that Therophytes types are omnipresent (64%). because of the climate's nature which is characterized by long periods of drought also the intervention of human beings that live near the study areas.

The seconde place occuped by Phanerophytes and Hemicryptophytes because these types are adapted to the dry climate with special mechanisms. The Geophytes presented by bulb plants *Asphodelus refractus* and tubers one such as *Erodium* so we found 03 types of Geophytes which have special parts for the bulb in *Asphodelus refractus* plants and tubers in *Erodium* plants that help to withstand the conditions of severe drought and high temperature by the burial of its part in the ground until the arrival of the good conditions to grow, also there is a type belonging to Chamaephytes because of the very high temperatures accompanying the lack of precipitation **[12]**.

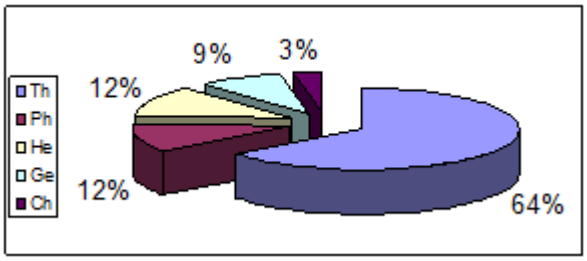

Figure 4.10: Percentage of the biological types of *Cotula cinerea* Del floristic cortege.

The Therophytes are in the top of biological types in all seasons (Figure 4.11) in the biological forms of the accompanying plants then the Phanerophytes then Hemicryptophytes and Geophytes.

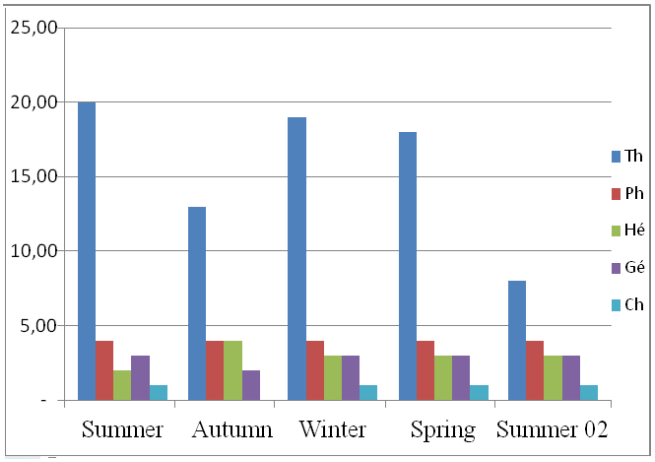

Figure 4.11: percentage of the biological types of *Cotula cinerea* floristic cortege seasonally.

5. Conclusion and Future Works

The present study revealed that:

After the annual monitoring of the Shihia *Cotula cinerea* Del and the accompanying plants in the year 2009-2010 we concluded that:

- The total coverage rate in the study areas has a direct link with the amount of precipitation, also the biological diversity that appears in autumn and spring due to the growth of seasonal plants undried Xerophytes unlike the winter which is characterized by very frost resistant plant types, and in summer where perennials plants are resistant to drought.
- *Cotula cinerea* is distributed widely in spring because of the abundance of rainfall amount and the appropriate temperature and the soil's nature in which they are distributed extensively in the light sandy soils and low in other soils.
- According to the annual monitoring of the studied plant we were able to identify the stages of life of the plant as follows:
- Vegetative Phase: mid-October to mid-January.
- Flowering Phase: mid-January to the end February.
- Fruiting Phase: from the beginning of March to the beginning of April.
- All these growth phases are well related to drought resistance **[21]** the climate can cause to reduce or to extend each phase so that a phase can last only two weeks.
- Within the availability of appropriate conditions, the new generation can grow parallel to the previous generation but it can reach its life cycle in a short period than the previous generation.
- The number of the studying plants was important in spring (3.525 m^2) due to the existence of two generations in this season followed by winter (2.345 m^2) and autumn (3.525 m^2), it is zero in summer (0 m^2) due to lack of the conditions (high temperatures and low precipitation).
- The diameter of the plant is high in fruiting phase (in spring) and fewer in the flowering phase (in winter).
- The height of the plant is important in flowering phase (in spring) in the fruiting phase as it tends to increase its diameter depends on the height.

- The number of the plants branches is almost the same in all stages of life also the number of branches has a direct link to the plant's diameter.
- It is considered that the rate of pollination of *Cotula cinerea* Del is low, it is between 25 and 40% and it depends on the type of petal producer and the lack of ray florets that attract insects for the purpose of pollination on one hand and the failure of fertilization after pollination because of the harsh climate on the other.
- The seasonal distribution of the accompanying Shihia *Cotula cinerea* Del plants varies from season to another and the maximal plant diversity is in spring and winter (30 plant types), and it is according to the growth of many seasonal types as well as the permanent existence perennial types and diversity (Floristic Wealth) will be minimal in summer and autumn due to the disappearance of seasonal types and the survival of perennial seasonal types.
- According to the monitoring we obtained 34 of plants types belonging to 15 plant families, the composed family Asteraceae is the most encountered with 07 types because it is one of the most common plant species in the area with a great power to form and disperse the seeds on one hand and the diversity of its biological form on the other.
- As we observed the domination of Therophytes represent 64% because the climate is characterized with long periods of drought forcing seasonal plants to complete its life cycle in short periods, then the biological types phanerophytes and hemicryptophytes since they are perennial types which fit dry climate of the area, also the types Geophytes that is distinguished by 03 plant types containing tubers and bulbs and at the end Chamaephytes with one type.
- And for the annual distribution of the accompanying biological types Therophytes are in the top of all seasons followed by Phanerophytes , Hemicryptophytes and Geophytes.
- **Future work focus on Conservation milieus natural at this plant and development of traditional medicinal use and evaluation in Vivo and in Vitro.**

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