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Thermal variation effects on the germination of *Tetraclinis articulata* embryos in different ecotypes in western Algeria.

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ABSTRACT

Tetraclinis articulata or Thuya of Maghreb is one of the endemic species living in the south-occidental Mediterranean Sea; this area is also called Maghreb (Algeria, Marrocco and Tunisia), Thuya has the originality of growing in semi arid and sub-humid bioclimatic layers. This work aims to appreciate the aptitude of germination of the Thuya's embryo in three different ages and in four different ecologic stations in western Algeria. Tetraclinis articulate embryos germinate in natural as well as artificial conditions in temperatures which are differently in order to choose the best ecological species having the potential specificity of adaptation to extreme climatic conditions then to recommend its plantation Thuya aiming to emphasize the marginalized zones in our country.Each temperatures which are qualified as treatment.

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INTRODUCTION

Deforestation is one of the main causes of erosion and deterioration of arable land in Algeria,. The latter is caused by frequent fires and overexploitation of timber. The management of this problem has faced the choice of fast growing plant species, was to be used in projects for fixing and protection of land.

It is so important and essential that the productive forest area is increasing and biological erosion and desertification are growing. In this context cedar (*Tetraclinis articulata*) is a species could yield interesting effects which make regarded, and rightly, as a mixture of outstanding ability to regenerate from seed. Its suckers power can hold back erosion, stabilize, set up the soil and produce a substantial pile of timber. (El Hamrouni, 1978; Benabbad, 1982). The cedar Maghreb exists only in North Africa, where it occupies large areas in in the west of Algeria. It is most common in Oran, both on the coast sector in the domestic sector. It is also widespread on the limestone of the Tell Atlas in western Algeria. It ranks second after the Aleppo pine and evergreen oak (Letreuch Belarouci 1991). Several researchers such as (Bachoua & Voreux 1986; Berchiche 1986; Chantrec 1993; Ackermann, 1995; Baba Aissa, 2000; Dakak, (1999, 2002); Maatoug, 2003; Aounty & Oufara, 2006, Dif et *al*, 2014; Rahmani et *al*, 2014 and others have devoted their work on the use of wood, and the therapeutic use of plant ecology Tetraclinis articulata, while the study of thermal effects on the germination of Maghreb cedar embryos is often treated with a very small sample.

A. Monographic of Tetraclinis articulata :

The cedar Maghreb (*Tetraclinis articulata* Vahl) is part of the phylum spermaphytes under phylum gymnosperms, Order conifer family Cupressaceae. (Quezel 1981). The botanical characteristics were described by (Boudy, 1950) as followings:

The Maghreb is a cedar coniferous evergreen and light (see Figure 1); in his youth, the port is pyramidal, the leaves are reduced to scales and opposed by two nested. The fruit is a cubic shape cone opening with four valves under the effect of heat thereby releasing the winged seeds. The longevity of cedar can exceed 400 years. Its production is generally provided by release of stem or seeding (Maatoug 2003) .despite it has a slow growth but it has wood is good for construction. The cedar Maghreb is an endemic essence of the south western Mediterranean (Benabid, 1976; Quezel 1981) its density decreases from west to east. (Benabdeli, 1992);

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However Bachoua & Voreux 1986 estimate the cedar area in North Africa about one million hectares. All authors who have studied this species Benabid, 1976; Alcaraz, 1982; Somon, 1982; Benabdeli, (1976, 1996) and the other agree it is undemanding in soil factors, it is indifferent to the chemical nature of the substratum but it seems however showing a preference for calcareous soils and soils fersialitiques more or less deep furniture. (Boudy, 1950). It has an ability to adapt to different types of bioclimates particularly hot semi-arid, temperate and sub-humid fees or expenses. (Benabid, 1976).A high humidity excludes it from the east. Generally cedar is an undemanding species climatic conditions, it tolerates drought, heat resistant and not cold moist (Letreuch Belarouci 1991).

Indeed the cedar Maghreb can descend to sea level but this is not a normal station for him. Adapted to extreme conditions cedar grows on an annual rainfall range of 300mm and an average yearly temperature of 15.2 ° C; the ordinary temperatures of the warmest month (M) is 32.5 ° C. (Kadik 1987; Benabdeli, 1992).

A. Plant material and its origin:

The biological material at different ages, for this study comes from trees growing under natural conditions of four separate stations; embryos at the conservation of forests, were preserved at room temperature and away from moisture until their economic consumption. These embryos 10 years, 15 years and 20 years.

In the four stations selected for this study, *Tetraclinis articulata* is well represented; these stations are differentiated from one another by distinct ecological requirements, such as the nature of soil, altitude and bioclimate. Figure 2 and 3 show the location of these stations. Furthermore, the ecological characteristics of each type of station are listed beneath:

-*Station No. 01: The Tenira station :*

Location: 16 Km from the wilaya of Sidi Bel Abbes

Bioclimatic Floor: semiarid than cool winter; the altitude is 705 m on a gradient of 5%; the mean yearly temperature is 15.7 ° C; the annual rainfall is 393 mm; seasonal diet is HPAE (0NM 2000).

The soil type is calcareous sandstone on a rock (Benouda 1994).

-*Station No. 02: The Benisaf station :*

Location: located on the coastline on the Mediterranean Sea and 30 kilometer from the Wilaya of Temouchent.

Bioclimatic Floor: warm temperate semi arid winter; height is 68 m; the mean yearly temperature is 16.9 ° C; annual precipitation is 330 mm; soil type is decalcified limestone rock on a Jurassic sandstone (Boudouaya, 2002).

-*Station No. 03: The station Tiaret :*

Location: The highlands of western Algerian.

Bioclimatic Floor: semi arid, hot, dry summer and frigid in winter; the height is 1200 m; the mean yearly temperature is 25 ° C to 30 ° C; annual precipitation is 250 mm A350; the soil is brown limestone type engine (Maatoug, 2003).

-*Station No. 04: The Zegla station (town Telagh) :*

Location: situated on the southern slopes of the mountains of Dhaya, located 80 km from the wilaya of Sidi Bel Abbes.

Bioclimatic Floor: less winter very cold semi-arid; altitude varies from 1000-1400 m; the mean yearly temperature is 13 ° C; an average yearly rainfall between 250 and 350 mm, with a PHAE type seasonal pattern. (ONM, 2000). The soil is limestone type and brown sandstone, limestone bedrock with shallow depth and two walkways. (Benabdeli 1996)

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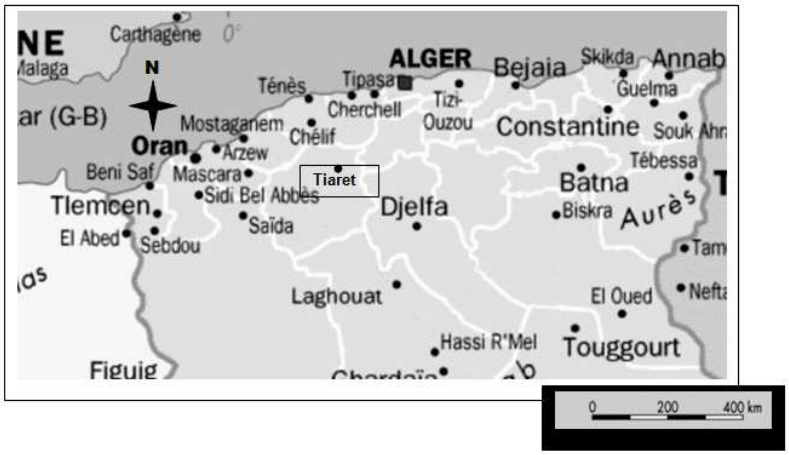
Fig. 1: *Tetraclinis articulata*



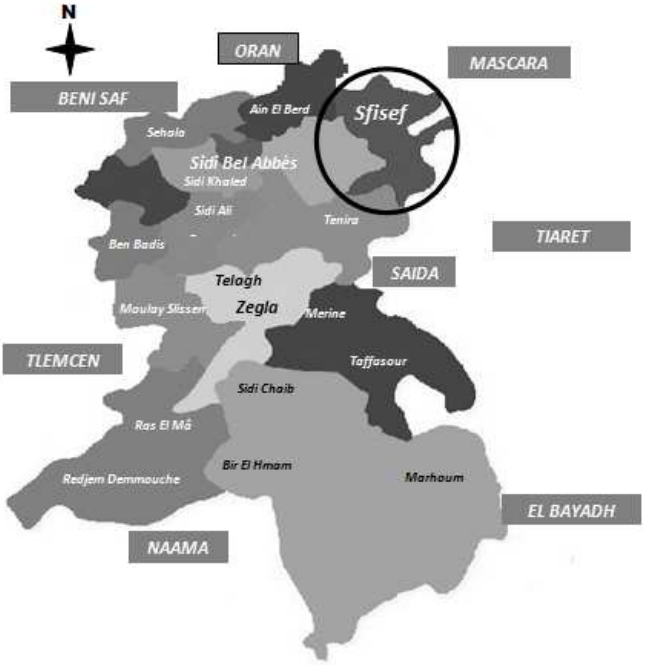


Fig. 2 &3 : geographical position of the four studied stations

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B. Methodology

1. Presentation of the experimental area:

Experiments in natural and controlled conditions, took position in the nursery of the common Sfisef part of the plain of the wilaya of Sidi Bel Abbes (Western Algeria) which it is connected by National Highway No 07 (see Figure 3). Nursery Sfisef was created in 1956, it is located in the north west exposure to a 1% incline and an elevation of 450 m. The legal nature of the land is state-owned. It thrives in semi-arid bioclimatic stage cold winter, an average annual rainfall of 350 mm and an average annual temperature of14, 5 ° C (Hamdad, 2002).

2. Experimental setup:

Embryos that show no apparent abnormalities were prepared by soaking in warm water for 24 hours to allow softening of the skin and stimulating germination, are disinfected by sodium hypochlorite diluted to 1% and then placed in glass Petri dishes lined with filter paper and soaked in distilled water. (The growth process is not addressed in this article saw its volume).

Germination tests cover a number DE200 embryos over two repetitions for each 100embryons age of each station is different ecotypes 2400 embryos were subjected to four different treatments that are:

- Treatment No. 01: temperature controlled greenhouse (artificial conditions).
- Treatment No. 02: temperature of the nursery ground (natural conditions).
- Treatment No. 03: Low temperature to order de4 ° C (Controlled).
- Treatment No. 04: oven temperature at 30 ° C (controlled temperature)

The greenhouse temperature is appreciated by a Maxi mini thermometer. (Table No. II). The ground temperatures are determined using climate data recorded by the station. (Table No. III).

The germination test was completed on February 2008 and the embryos were subsequently sprayed with the same amount of water every 48 hours with the exception of those under treatment No. 04 (that of the oven) that are watered every 24 hours.

The experiment lasted 20 weeks, during which observations and measurements were established. The observation and assessment parameters of the experiment based on the following: the germination criterion is that adopted by most physiologists (Come, 1970; Mazliak 1982; Corbineau *et al*, 1987; Heller, 1987). This is the slot of the skin and the appearance of the radical. The counting of germinated seeds is done every day.

Germination tests are shown by the germination capacity represents the utmost percentage of germinated embryos (Heller *et al*., 1990).

The way of expression of the results is generally in the form of germination curve describing the studied phenomenon, indicating the change in accumulated germination percentages with time, germination tests also take account of the germination rate, which gives an exact and perfect idea on ability to germination of our seed lot; latency is chosen as greatness to express this speed (Mazliak 1982).

In the experiment, the various factors that may influence the germination of embryos are kept as constant as possible, the only factor that varies is the temperature.

RESULTS AND DISCUSSION

Results:

The effect of each treatment on the ability to germinate different ecotypes *Tetraclinis articulata* is illustrated as figures No. (4 5 ... 15) and a summary result is shown in the form of a histogram (Figure 16):

- For treatment No. 01 (temperature-controlled greenhouse) the highest germination rate is recorded for the seeds of Station No. 02 (Benisaf station) with a percentage of 90% for the three ages and time 4weeks latency for seeds of 10 years and 5 weeks for the other two. By cons embryos Station No. 01 (Tenira station) had a germination rate of 83% of embryos 10 years, 80% for those 15 years and 78% for 20 years with a time of latency of 3.4 and 4 weeks of age. The third place of the seeds (Tiaret) came in third with a maximum germination percentage of 60% for the three ages, and a latency of 3, 4and 4 weeks respectively with the three ages. The seeds of station No. 04 (Zegla station) yielded a germination rate of 56, 55 and 53% respectively, with age and 6 weeks latency for embryos 10 and 5 weeks for two other ages.

-For Treatment No. 02 (natural conditions of the terrain) seeds of station No. 01 seem well suited to this type of treatment with a germination rate of 77% recorded for the embryos aged 10 and 15, and 76% for those 20 years, the germination rate was 4 weeks embryos 10 and 15 years and 5 weeks for those 20 years. Embryos Station No. 04 gave a maximum percentage of 72% for embryos 10 and 15 years and 70% for those 20 years. The germination rate is 3, 4and 4 weeks of age. Third position are derived embryos of Station No. 02 with a maximum germination rate of 66, 62 and 60% respectively, with age and a latency of 8, 7, and 6 weeks respectively with age. During this treatment the seeds of the third station could achieve that 53,52 and 50% respectively with age. The latency time is 6 weeks for embryos of 10and 15 years and those 5 weeks to 20 years.

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-For Treatment No. 03 (low temperature 4 ° C) the embryos of all stations recorded no value except those of 4 Zegla station which registered a 30% rate with a latency rate four weeks all ages confused. Low temperatures are thus a determining element for the sprouting of our embryos.

-For Treatment No. 04 (the oven temperature: 30 ° C) with the exception of embryos Station No. 03 that seem best fitted to the conditions of treatment No. 04, with a maximum germination rate of 72 % for embryos 10 and 15 and a rate of 70 for those 20 years with a latency of 3, 4 and 4 according to the age, embryos station # 1 are recorded only 42, 40 and 41% respectively with age and in 6, 7 and 6 weeks respectively with age.

Embryos Station No. 02 gave a maximum percentage of 42%, 40% and 35% respectively with age. The recorded germination rate was 4 weeks for seed 5 weeks to 10 years and those of 15and 20 years. For Station No. 04 recorded germination capacity was 40%, 39% and 37% respectively, with age, with a germination rate of 6 weeks age all confused.

Table n 1:

The date of harvest embryos	Age at time of use
07/ 1996	10 years (120 month)
07/ 1991	15years (180 month)
07/ 1986	20 years(240 month)

Table n ° 2:

	Jan	Feb.	March	April	Mai	June	Jul	August	Sep	Oct	Nov.	Dec
Serre (°C).	12,5	15,2	18,5	22,4	24,12	30,0	32,0	-	-	-	-	-

Table n ° 3: (ONM, 2000)

	Sep	Oct	Nov	Dec	Jan	Feb	March	April	May	June	Jul	August
Minimal temperature	14,6	10,4	06,5	03,4	02,3	02,9	04,3	05,9	09,6	13,5	16,4	17,2
Maximum temperature	28,9	24,4	19,6	16,1	14,7	16,6	18,0	19,7	24,8	29,3	33,6	34,3

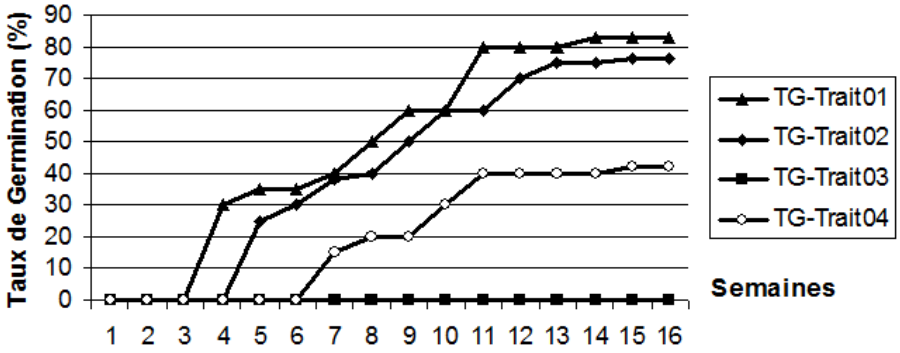

Fig. 4: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °01 (10 years old)

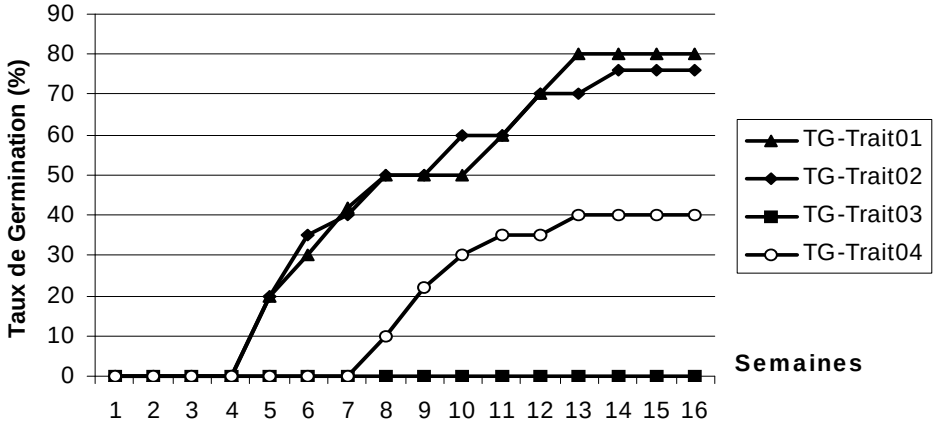

Fig. 5: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °01 (15 years old)

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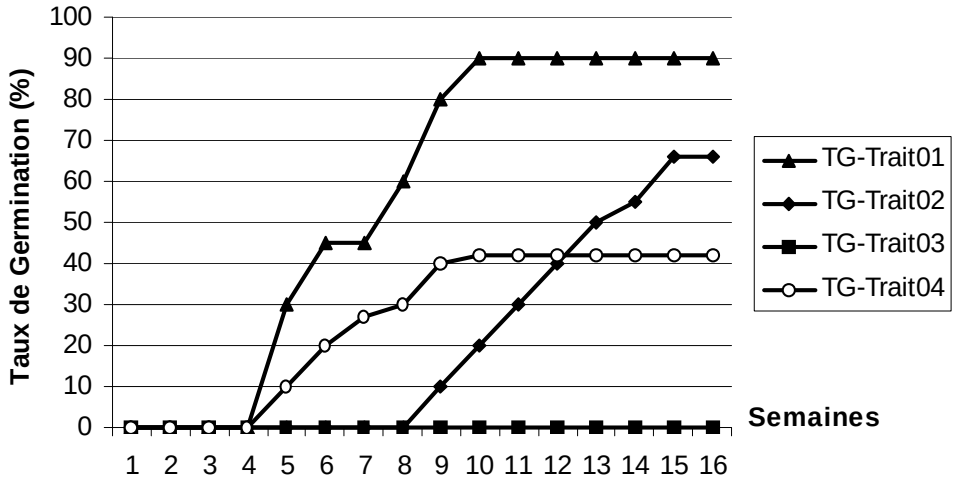

Fig. 6: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °01 (20 years old)

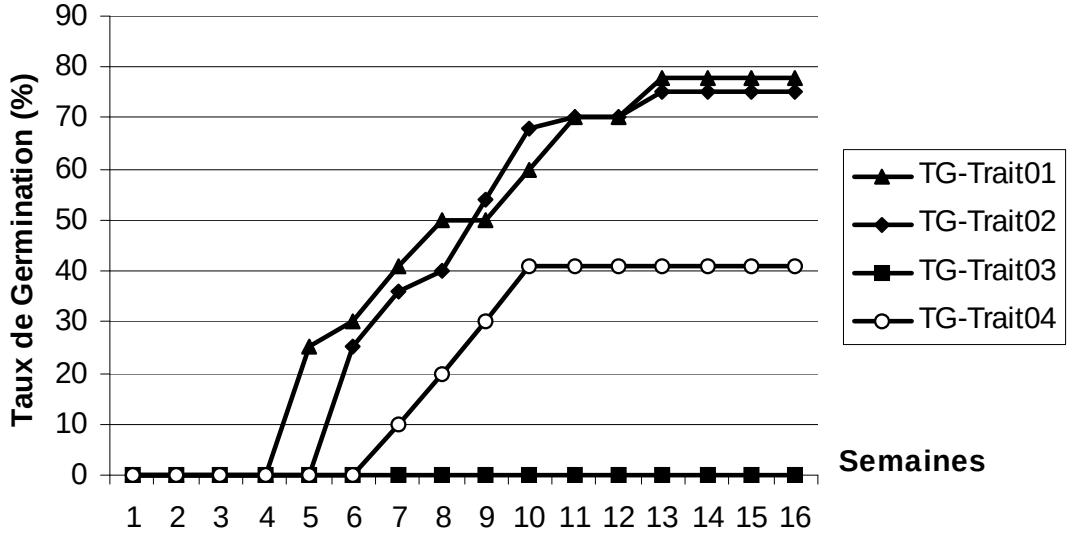

Fig. 7: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °02 (10 years old)

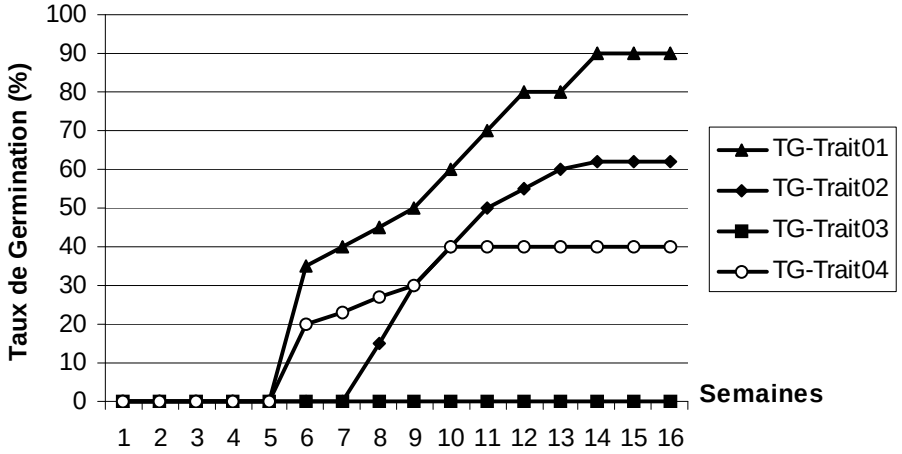

Fig. 8: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °02 (15 years old)

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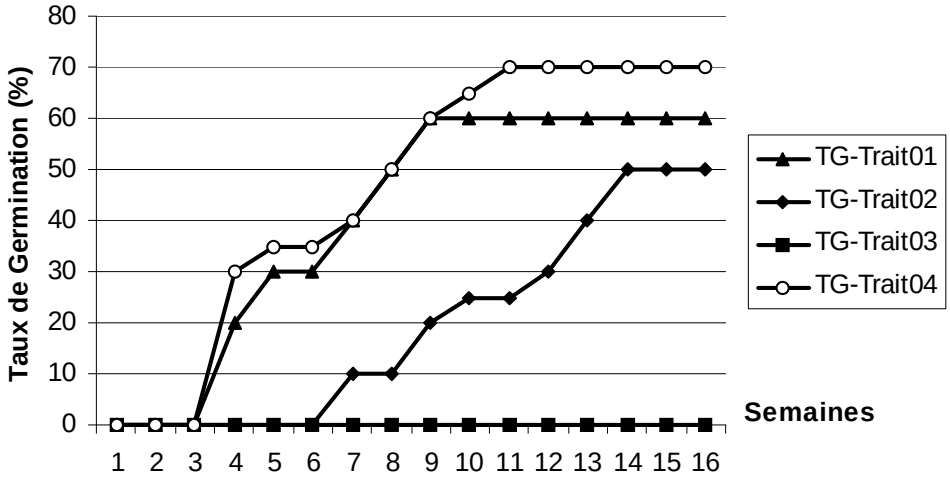

Fig. 9: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °02 (20 years old)

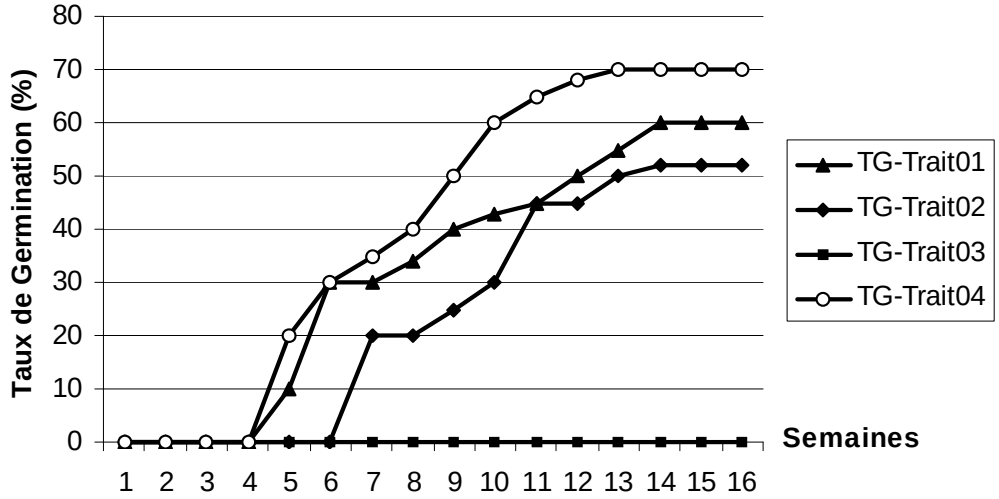

Fig. 10: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °03 (10 years old)

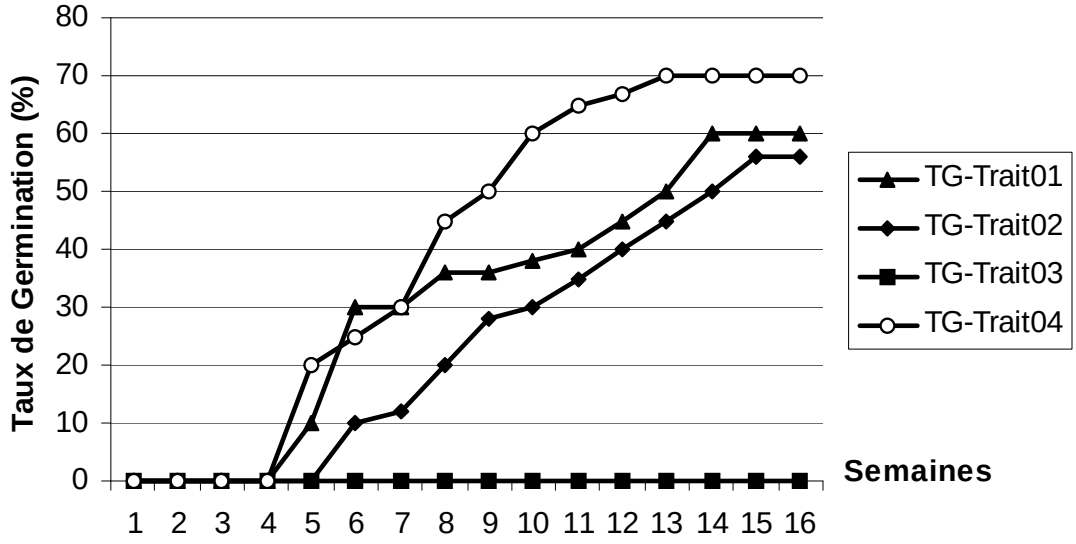

Fig. 11: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °03 (15 years old)

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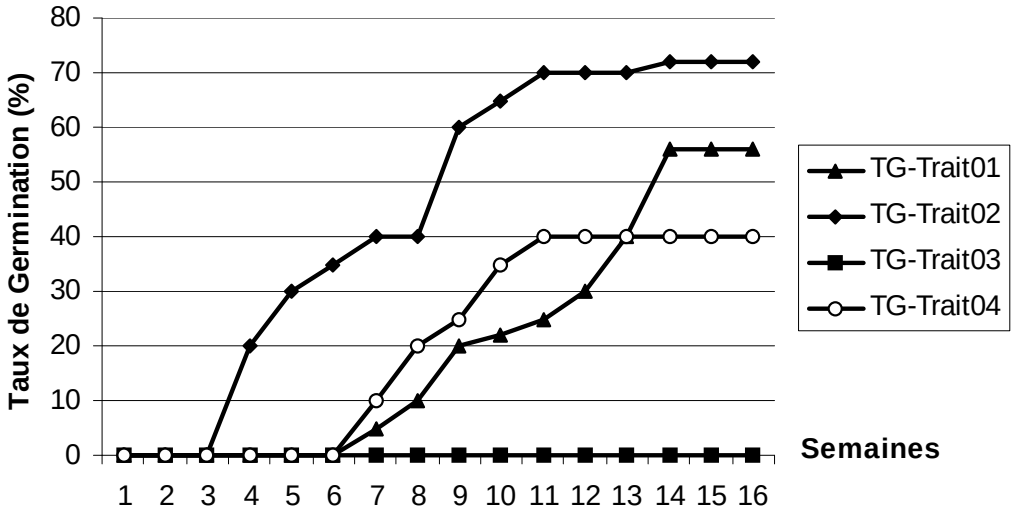

Fig. 12: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °03 (20 years old)

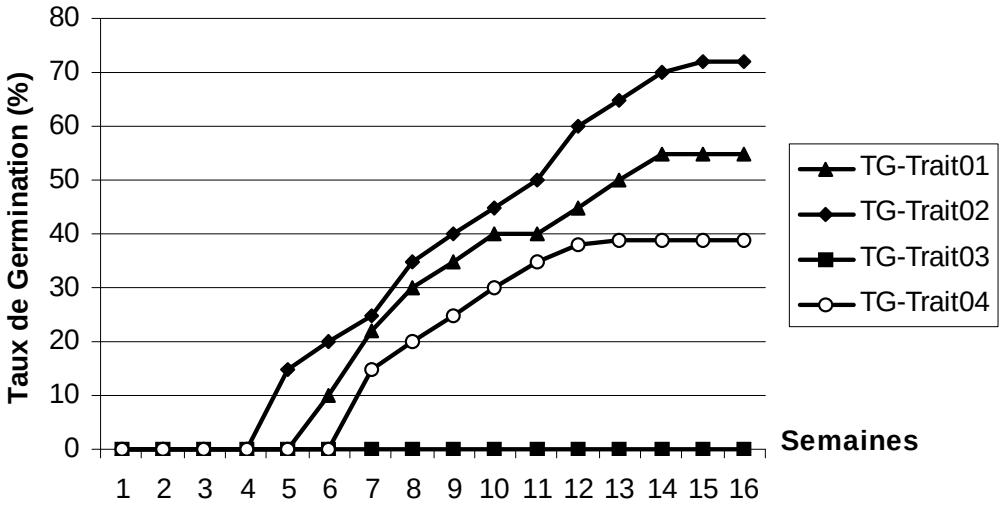

Fig. 13: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °04 (10 years old)

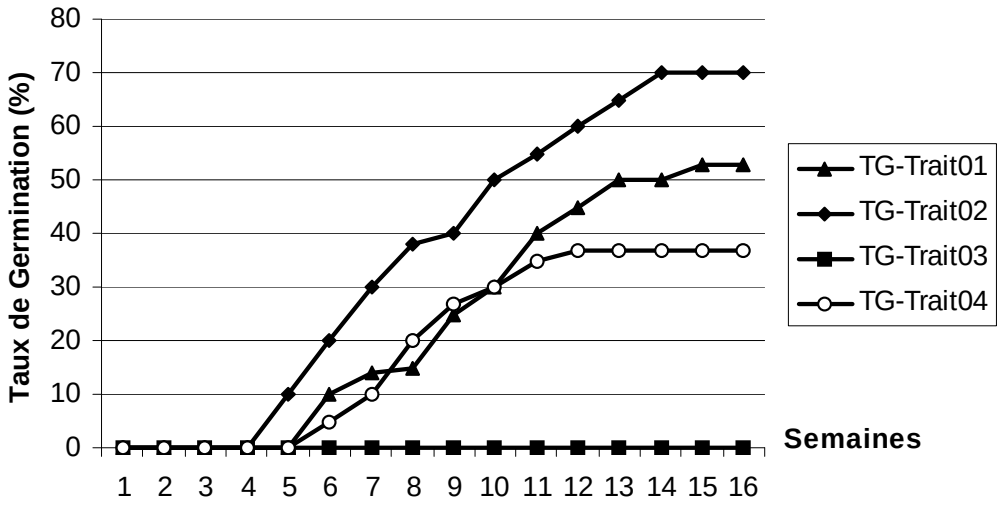

Fig. 14: Effects of four treatments on the germination of *Tetraclinis articulata* embryos of station n °04 (15 years old)

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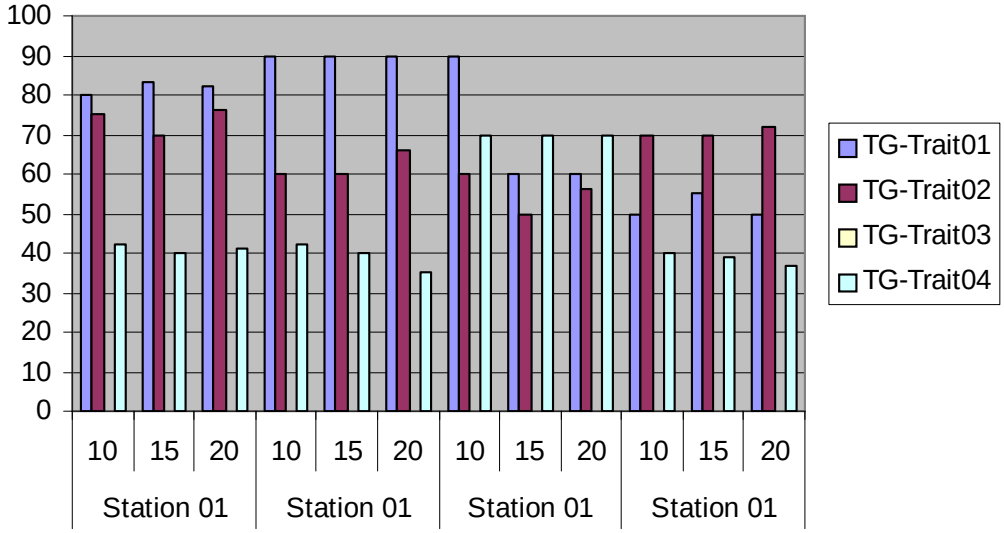

Fig. 15: Total results of the effects of the four treatments on *Tetraclinis articulta* in the four stations by categories of age (10, 15 and 20 years)

Discussion:

In this work, we defined the degree of adaptation of the different archetypes under controlled and natural conditions and at different temperatures, which results in the percentage and the germination speed.

- Thus, the treatments utilized to the embryos of four stations are in favor germination with some level of conflict with the exception of the low temperature that inhibits germination at the zegla seed germinating exception but one month rate remarkable. Embryos station 1of Tenira "upper semi arid fresh winter annual average temperature at 15.7 ° C" found a favorable habitat in the treatment of controlled greenhouse "Average temperature of four months of study: 17.2 ° C "and in the natural field conditions of the nursery" Average temperature is de14,5 ° C ", and the embryos from station 2 of Benisaf (hot winter temperate semiarid, average temperature equals 16.9 ° C) find them also an ambient temperature in the treatment of the greenhouse and the treatment of the land of the nursery. The embryos of the station 4 Zegla (very cold winter to lower semi arid average temperature equal to 13 ° C) are well adapted to the natural conditions of the nursery and fairly well to the conditions of the greenhouse. Germination of embryos at an elevated temperature of about 30 ° C is possible for the three stations mentioned above. It is considered favorable temperature for embryos Station 3 Tiaret (warm dry semi-arid in summer, average temperature above 25 ° C to 30 ° C). By cons as their germination is even possible in the land of the nursery and in the greenhouse conditions.

These results support those found by the researchers who turned along the ability of seed germination of different ecological races with different heat treatments such as Mehdadi, 1991; Eloujdi, 1993; Nouala, 1994 Bendimerad, 2007... and authors such as Mazliak 1982; Heller *et al*l, 1990... which show the influence of temperature and geographical origin on the germination capacity of different archetypes in natural or artificial conditions chosen by the experimenter. However, the optimum temperature of our embryos is between 15 and 30 ° C while noting that this optimum germination fluctuates according to the geographical origin of embryos (Mazliak 1982).

Conclusion :

The results confirm that the temperature plays a key role and potential in the physiology of germination of different ecotypes Tetraclinis articulata. Between a temperature of 15 ° to 30 ° C, the germs have a germination between 50 and 90%; These promising results help explain the ease regeneration of this species that has furnished validation of its good adaptation in arid bioclimatic storeys, semi-arid and sub-humid even in temperate and warm alternative, in the coastal regions where the temperature remains clement all year regeneration is remarkable cedar Maghreb. It is a species that can be practiced with advantage in the soil fixing work and enrichment of our woodland heritage. However, it seems that the cold inhibits germination without forgetting that the geographical origin has its say in this country.

Furthermore, although age seems to induce an issue on the germination capacity of the embryos from the same area, the germination rate can only fall slightly with age at a rate of 1 to 3% every five years.

Finally, we hope that these results will be taken into consideration and we hope that further studies will be done in this field in order to select the best race *Tetraclinis articulata* and recommend the enhancement of

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degraded and steppe areas currently experiencing alarming destruction of vegetation due to anthropozoogène pressure affecting the ecological balance. Rational management to save the steppe vegetation cover and propose its improvement by the choice of species known for their hardiness and easy adaptation to climatic variations, provided that policy makers in our countries attach significant importance to this species especially that it is disappearing voice.

Work is underway to track the process of growth and development *Tetraclinis articulata* and others to determine the effect of site factors on the composition of its organic bio embryos and essential oils of the leaves.

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