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Functional Response Post-Fire of *Chamaerops Humilis* L. (Arecaceae)

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Abstract: Fire can be regarded as a disturber of ecosystems. It entails a modification of plant structures in place. In the Mediterranean region, the current vegetation is conditioned and adapted to this fire system. The analysis of post-fire response of *Chamaerops humilis* L., (Arecaceae) species widespread in the Western part of Algeria and in the most of the matorral of Tlemcen shows that the determinism of stipes height (H) explains the variations of average lengths of regenerated leaves (M) (R^2 = 64%). Furthermore, researchers notice that there is a highly difference significant (p = 0<0.05) at the power recovery in the phenological post-fire which depends on the height of the stipe; it is 100% for class 1; 93% for class 2; 58.33% for class 3 and only 5.55% for the class 4. This response of *Chamaerops humilis* L., is a damaging caused by fire, it shows the resistance of this species in this disturbing phenomenon as evidenced by the strong recovery of their workforce (81.25%).

Key words: *Chamaerops humilis* L., response, post-fire, stipe, leaves, lengths

INTRODUCTION

Most Mediterranean forest shave an unbalanced ecological system but generally they are well adapted in mater of space, time, various disturbances and the changes of dynamic structures and also the architecture of the stand where they can generate (Barbero and Quezel, 1980). Although in all biological systems, the processes of germination growth and developments are naturally dynamic. However, some disturbance factors especially fires induce changes in physiognomic of the ecosystem either in the regressive or progressive directions. The fire is related to the Mediterranean landscape, it has plays an important impact in the dynamics of plant since a long time in vegetable communities in the Mediterranean basin (Trabaud, 1980, 1992; Trabaud and Lepart, 1980). The phenomenon of regeneration also known as estate regeneration occurs in areas that are affected by moderate disturbances (fires of medium intensity) that allow the persistence *in situ* of a bank of seed and below-ground and above the rapid regeneration by a rejected strains (Hasnaoui, 2008). This succession is indeed conditioned by the critical phases of the cycle life of plants that are linked to demographic and reproductive processes specific to the species its dispersal capabilities at the rate seed of predation and its potential for regeneration through sexual reproduction or vegetative (Quezel and Medail, 2003). In Algeria, many more recent works dealing with the importance of fires are abundant (Benabdelli, 1996; Madoui, 2002; Missoumi *et al*., 2002; Benderradji *et al*., 2004). Moreover, the Western part of Algeria has not escaped the fire, most work on post-disturbance dynamics of plant communities, especially after fire (Benabdelli, 1996; Hasnaoui, 2008; Bekkouche *et al*., 2008) emphasize the rapid regeneration of vegetation both in terms of the structure of the richness and floristic composition. In this context, several researchers (Trabaud, 1987; Herranz *et al*., 1996) spoke of self-succession to describe this rapid post-fire dynamics in agreement with Egler (1954) conception relating to the initial floristic composition of the plant community. The scientific understanding of the influence of fire on regeneration of *Chamaerops humilis* L. (*Ch*) is logically prior to the conservation of this natural resource which forms an integral part. Such knowledge will know the response to the fire of the species in question and identify the parameters adaptive to environmental disturbances. Therefore, the investigation aims to assess quantitatively the impact of fire on regeneration post-fire *Ch*, a species widespread in the Western part of Algeria.

MATERIALS AND METHODS

Biology of the species: *Chamaerops humilis* L., or the palm doum is a monocot belonging to the family Arecaceae, tribe of Coryphoideae, endemic to the

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Western Mediterranean basin (Negre, 1951; Cuenod, 1954; Maire, 1957; Quezel and Santa, 1962). It is a perennial stipe usually small, often stemless but sometimes reaching several meters if the plant is protected. The leaves are split range well beyond the medium spiny petioles, with ligule very short, bifid segments (Maire, 1957). According to Hasnaoui (2008) and Uhl and Dransfield (1987), the fruit is globular to oblong, ellipsoid, brown epicarp with fine grooves clear. The flowering of this taxon occurs in spring (between March-April) and yields of palm fruit at the end of August and the beginning of September (Hasnaoui, 2008). *Ch* is a widespread species in the Western Mediterranean region (Maire, 1957). It is also ecologically a biological indicator of major stage thermo- Mediterranean vegetation (Ozenda, 1981).

Study area: The study was conducted on the Northern slopes of the mountains of Tlemcen in the area of Ain-El-Houtz (belongs administratively to Tlemcen wilaya) located in a 34°75' N of latitude and 1°19' W of longitude and an altitudinal range between 550 and 650 m. The climate is Mediterranean. The average annual rainfall for the period 1984-2009 is 345.2 mm on average (Fig. 1).

The maximum average monthly temperature is 31.2°C for the warmest months and average monthly minimum temperatures 2.9°C with January as the coolest month. Finally, the climagramme pluviothermic of Emberger up station study in the semi-arid floor to cool Winter. The area is characterized by a calcareous substrate. The vegetation is mainly represented by a mosaic of species or *Olea europea*, *Chamaerops humilis*, *Calycotome intermedia*, *Asparagus stipularis*, *Asparagus acutifolius*, *Thymus ciliatus*, *Urginea maritima*, *Thapsia garganica*, *Bromus rubens*, *Hordeum murimum*, *Paronychia argentea*.

Methodological approach: Morphometric measures post-fire were performed on individuals drawn by Simple Random Sampling (SRS) of a population of *Ch* having burned. The site in which researchers performed the measurements presents a NE direction and is located in an open-dominated matorral of *Ch* which has an index of abundance-dominance scale 3 of the Braun Blanquet on limestone. This is the preferred area of *Ch* although, it can grow on all sorts of soil (Merlo *et al*., 1993). In August, 2010 (time), the heights of the stems of the population of *Ch* were measured just after the passage of a fire. A total of 128 feet were recorded at different stages. To better define the phonological dynamics of post-fire plant, researchers performed a geo-localization of each foot on fire and researchers took the heights of burnt stipes remaining with a tape measure. Overall, after 3 months of follow up, 512 measurements were made at regular intervals (one measure each month). Measurements were made on the height of stipes at time (just after the fire) and the extent of each newly emerged leaf at time t1-t3. Others observations were performed after 12 months to confirmed the results.

Statistical approach: To highlight the relationship between the height of the stipes (H) and length of newly emerged leaves of *Ch* at different times (Mt1-Mt3), a correlation between H and the average the lengths of the regenerated leaves M has been established. The heights of stipes identified after passage of fire were divided into 4 different classes of 5 cm amplitude in order to establish

Fig. 1: Localization of the study area

histograms to identify classes outstanding. The stipes with a height greater than or equal to 15.5 cm was grouped in class 4. At end, to better report and explain the difference in post-fire recovery phenology of these 4 classes, Analysis Of Variance (ANOVA) was performed.

RESULTS

Analysis of correlations: The calculation of correlations between perform H and M allowed us to obtain a value of r = -0.8 with p = 0, showing a negative linear correlation between and very highly significant H and M ($p < 0.001$). When there is an increase in H and M tends to decrease and vice versa. A regression analysis was made to estimate changes in M according to H using the equation of the regression line.

Analysis of regressions: The regression results indicate the direction, magnitude and statistical significance of the relationship between a predictor H and response M (Fig. 2). The regression analysis between M and H gives the equation of the regression line is: H = 18.0-1.15 M (with H and M in centimeters). The p value of analysis of variance (0.000) indicates that the relationship between M and H is statistically significant at a level of 0.05 which also confirms the value of the estimated coefficient of pH which is 0.000. R^2 shows that M represents 64% of the variance H indicating that the model is fitted to the data.

Contrasting responses of leaves: About 3 months after the passage of fire, accounted for 81.25% of feet of *Ch* had a positively response (positive functional response). Figure 3 represents the number of feet burned and regenerated will record approximately zero regeneration in class 4. However, the percentage of regenerated feet increases going back to classes respectively 3, 2 and 1; it is 100% for class 1, 93% for class 2, 58.33% for class 3 and 5.55% only for class 4. The Analysis of Variance (ANOVA) showed a highly significant difference

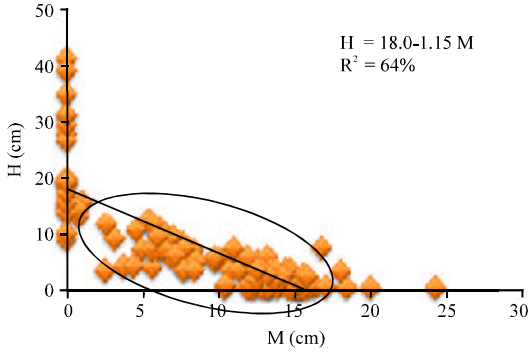

Fig. 2: Regression line H as a function of M

($p = 0 < 0.05$) at power recovery phonological post-fire. The 1st class has a positive biological stimulus, however the 4th class does not.

In addition, measurements of aboveground biomass (Mt1-Mt3) post-fire occurred every month for 3 months (Table 1) to note that the regression lines established for the first 3 classes show a homogeneous growth with $R^2 \geq 0.99$. Calculating the growth rate reached 2 cm month^{-1} on average for class 1; 1.67 cm month^{-1} for class

Table 1: Evolution post fire of the length of the leaves of *Chamaerops humilis* L.

Classes	Mt1 (cm)	Mt2 (cm)	Mt3 (cm)
Class 1 (0.5-5.5)	7.539	13.1850	18.6720
Class 2 (5.5-10.5)	3.182	7.5790	12.6650
Class 3 (10.5-15.5)	0.536	2.2000	4.3450
Class 4≥15.5	0.000	0.0000	0.1720

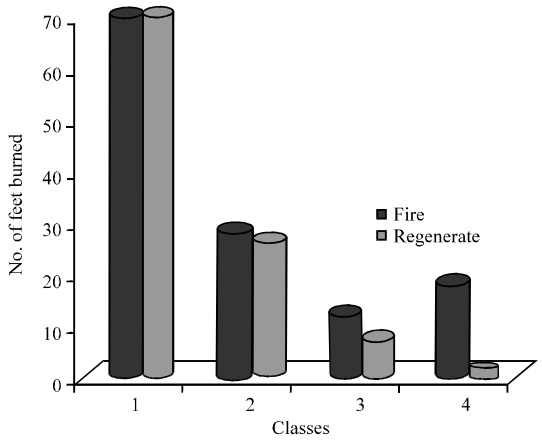

Fig. 3: Dispersal of number of feet burned and regenerated by class

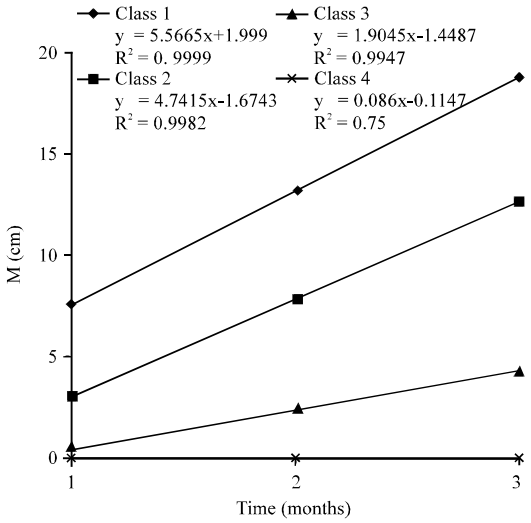

Fig. 4: The kinetics of elongation above the ground of biomass of *Chamaerops humilis* L., after fire

2 and 1.44 cm month^{-1} for class 3. That produced by the class 4 is 0.11 cm month^{-1}. The observations after 12 months of the feet of the class 4 showed a limited response. There was no recovery for the majority of phenological feet. Finally, the relationship is significant (Fig. 4) and it is the form:

$$E = aT + b$$

Where:

E = Elongation
T = Time
b = Slope; growth velocity (cm month^{-1})

DISCUSSION

Obviously in this territory of Western Algeria, the only determinism height of stipe H is not sufficient to explain the variability of average lengths of leaves regenerated M after fire of *Ch* a much of the variation of M (64%) is explained by the effect of the height of the stipe but the rest is not. It also appears that current climatic conditions are not a good catalyst for this regeneration (Quezel, 2000). Nevertheless, the observations and measurements were made in August during this period the rainfall is almost non-existent. We must remember that the abundance of natural regeneration is also influenced by climatic conditions (rainfall) and the sufficient production of seeds, the latter being irregular in time. It is the combination of these factors with the tillage which will modulate the abundance of regeneration. Also, this finding confirms what has been advanced by Boudy (1950) on the power of post-fire regeneration of *Tetraclinis articulata*. However, this response of *Ch* injuries caused by fire shows the resistance of this species in this disturbing phenomenon, as evidenced by the strong recovery phenology of their workforce (81.25%). The renewal of the aerial part of the *Ch* is based on the ability to release strains.

CONCLUSION

The researches done by Blondel and Midgley (2001) showed a clear dominance of vegetative regeneration and persistence of species releasing strains in post-fire communities. In parallel, it will be interesting as obvious to make the ability to release up between correlation and the stipe of *Ch* if permitted will be saving in the maintenance of chamaeropaie therefore contributes to a better understanding of the dynamics post-fire of this vegetable formation and it helps to optimize the rehabilitation process of this taxon with multiple uses.

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