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I J N R E

Effect of residual muds on the germination of the Oak cork (*Quercus suber* L.)

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Résumé:

La difficulté de germination du Chêne liège (*Quercus suber)* a fait l'objet de plusieurs études, bien que plusieurs traitements (par le froid ou la stratification et par des produits chimiques) soient utilisés. Dans cette travail, nous suggérons d'utiliser différentes doses de boues d'épuration comme amendement au sol et de voir leur influence sur la progression de la germination des graines de cette sorte. Les glands sains du Chêne liège ont été mis en germination dans une chambre de culture (température moyenne 20 ± 2°C, intensité lumineuse 6000 lux et durée d'illumination de 16 heures en blocs aléatoires complets à trois répétitions. Les substrats sont établis (constitués) par un mélange de boue et de terre forestière avec diverses proportions à savoir : 0, 10, 20, 40 et 80 % de boues Après 48 jours nous avons mesuré le pouvoir germinatif, le temps moyen et la vitesse de germination Les résultats obtenus montrent que l'apport des boues a un effet significatif sur les paramètres morphologiques modérés.C'est au taux de 20 % que les effets des boues sont surtout les plus marqués sur le pourcentage de germination et de TMG.Ceci laisse penser que l'effet de l'apport des boues sur la germination peut être positif surtout pendant les premiers stades de développement de *Quercus suber*.

Mots clés: Oak cork, residual muds, germination, traitement.

Abstract:

The difficulty of germination of the Oak cork (*Quercus suber*) made the object of several studies, although several treatments (by the cold or the stratification and by chemicals) are used. In this optics, we suggest using various doses of sewage sludge as amendment on the ground and seeing their influence on the progress of the germination of the seeds of this sort. The healthy acorns of the Oak cork were put germinating in a room of culture (temperature averages 20 ± 2°C, luminous intensity 6000 lux and lasted of illumination of 16 hours in complete unpredictable blocks with three repetitions. The substrata are established (constituted) by a mixture of mud and by forest ground with various proportions namely: 0, 10, 20, 40 and 80 % of muds. After 48 days we measured the germinal power, the average time and the speed of germination. The obtained results show that the contribution of muds has a significant effect on the moderate morphological parameters. It is at the rate 20 % that the effects of muds are especially most marked on the percentage of germination and TMG. This lets us think that the effect of the contribution of muds on the germination can be positive especially during the first stages of development of *Quercus suber*.

Keywords: Oak cork, residual muds, germination, treatment.

1. Introduction

The physico-chemical composition of residual sludge, (fertilizers, heavy metals, salts (Ademe, 2001) [1] can cause disturbances in plants by inducing them in different types of stress (saline, water and osmotic).

Their accumulation has been demonstrated in many species and in different stress, osmotic, water and thermal situations [2]., 1998); soluble sugars; abscisic acid (ABA) which is considered to be a stress hormone which would lead the plant to take protective measures against attacks, especially at the approach of low temperatures [3]. Photosynthetic activity can also be affected by environmental constraints.

The difficulty of germinating cork oak has been the subject of several studies[4,5,6,7,8], although several treatments (by cold or stratification and by chemicals) have been used. To obtain rapid and homogeneous germination, the most widely used method is to remove the seminal envelopes made up of a pericarp and an integument respectively [4,9,10].

The storage conditions must respect a very important factor, which is the water content.

Minimum water content is recommended, because any decrease in this result in a severe loss of germination capacity. [6,7], this parameter will be detailed later.

The recovery of residual sludge by spreading seems the most effective means, from an ecological and economic point of view, namely that this practice has a double objective:

Take advantage of the natural biological capacities of soils to "digest" the sludge and reintroduce the elements into the natural cycles,

Enhance the fertilizing properties of residual sludge for crops.

With this in mind, we propose to use different doses of sewage sludge as a soil amendment and to see their influence on the course of the germination of cork oak acorns (*Quercus suber* L.).

2. Materials et Methods

2.1. Soil

This is forest soil taken from the surface horizon "A", just below the humus layers at about 10 to 15 cm from the soil surface at the level of the Djebel Ouahche reserve.

2.2. Residual sludge

The sludge used in our experiment from the Ibnziad wastewater treatment plant was produced in September 2006, was produced in September 2006, unpleasant odor, presence of remarkable fauna (larvae, nematodes, mites, etc.). The sludge was taken at random from drying beds (both on the ends of the beds and in the center).

2.3. Plant material

For our work, we used: The acorns of the cork oak. They are harvested from the ground at the end of November 2006 at Ibn Badiss -wilaya of Constantine. They have a brown color, length varying between

2.5 and 4cm and a diameter between 1 and 1.5cm. These acorns were delivered to us by the nursery by Djebel Ouahch -Constantine-

2.4. Mixtures and choice of substrates

The mixtures used consist of soil and residual sludge. By this test, we are trying to make a physicochemical characterization of the sludge, and to see what will be the behavior of the cork oak plants in these treatments, in order to substitute the supposed ideal mixture (50% blond peat + 50% composted pine bark) [11] and economically expensive., We chose locally available and affordable materials.

Table 1 illustrates the composition and the name of the different treatments tested.

Table 1. Composition and the name of the different treatments tested.

	The mixture	
Substrates	**Soil**	**Sludge**
T1	90%	10%
T2	80%	20%
T3	60%	40%
T4	20%	80%
Blanc	100%	0%

2.5. Conditions of the experiment

The acorns are germinated in plastic pots on 12/02/2006, each pot was repeated three times. The germination test is carried out under semi-controlled conditions in the laboratory (average temperature of 20 ± 2 ° C, light intensity of 6000 lux and lighting duration of 16 hours), it is a question of counting the germinated seeds (emergence of the hypocotyl) every 3 days.

The trial will not end, only after three successive counts and no new germination is recorded.

2.6. Experimental apparatus

We opted for a full random block trial with 3 repetitions, each block is made up of 6 pots each containing 3 acorns and each corresponding to a treatment (Fig.1) which gives:

5 × 3 = 15 acorns per block and 15 × 3 = 45 acorns for the whole device.

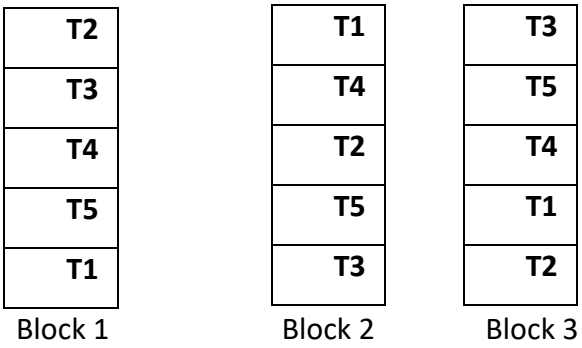

Figure 1. Map of the germination experimental set-up

2.7. Pre-treatment of seeds

The acorns are soaked for a few minutes in lukewarm water, in order to eliminate those in poor condition or parasitized. Those who float have been cast aside, acorns judged to be healthy are allowed to germinate.

2.8. Determination of water content

The water content of fresh acorns, has been determined, out of 10 acorns weighed one by one.

Their dry weight (PS) is evaluated after 17 hours at 103 ºC. The water content, expressed in% relative to the fresh weight (PF) of the acorns, was calculated by the following formula:

$$H\% = 100\ (PF - PS)\ /PF \qquad [13]$$

The appreciation of certain parameters allows us to better characterize whether the seeds are well constituted or not. These parameters are:

2.9. Germination control

Determined by two parameters: mean germination time (GMT) and germination rate (TG).

The average germination time is calculated by the following formula given by Maziliak, 1982 [12]:

$$TMG = (N1T1+N2T2+\ldots\ldots\ldots\ldots NnTn)/N$$

N1: number of seeds germinating at time T1

N: Total number of seeds that germinated at the end of the test time

The germination rate is calculated by the formula cited by Maziliak, 1982[12].

TG%= Number of germinated seeds / Total number of seeds.

3. Résultats et Discussions

The water content

The water content is obtained according to the method (IRST, 1985) [13].

To maintain the germination power of acorns, it is necessary to maintain a relatively high water content varying between 42 and 45%.

The acorn water content results are reported in Table 2

Table 2. Average water content of cork oak acorns (N = 10)

Number of acorns	**Fresh weight (g)**	**Dry weight (g)**	**Humidity level (%)**
1	10,5	6,2	40,95
2	7,1	4,3	39,43
3	7,11	3,58	49,6
4	8,4	5,1	39,28
5	7,6	4,05	46,71
6	7,38	4,06	44,97
7	7,3	4,4	39,72
8	7,28	4,02	44,21
9	7,3	4,4	39,72
10	8,5	4,9	42,35
Medium	7,84±0,33	4,50±0,23	42,69±1,13

According to Table 02, the average moisture content of acorns after harvest is 42.69% ± 1.13.

According to Steinmetz (1970) [14], the critical dehydration threshold for acorns from European oaks is between 25 and 35%.

For cork oak, the critical dehydration threshold compatible with maintaining germination power is 40% [7].

The water content of the acorns, used for our experiment, is around 42%, this value allows us to conclude that the water content of the acorns meets the standards cited above and that our seeds are not lethal.

The germination rate

After 48 days, we obtained the results shown in figure 2.

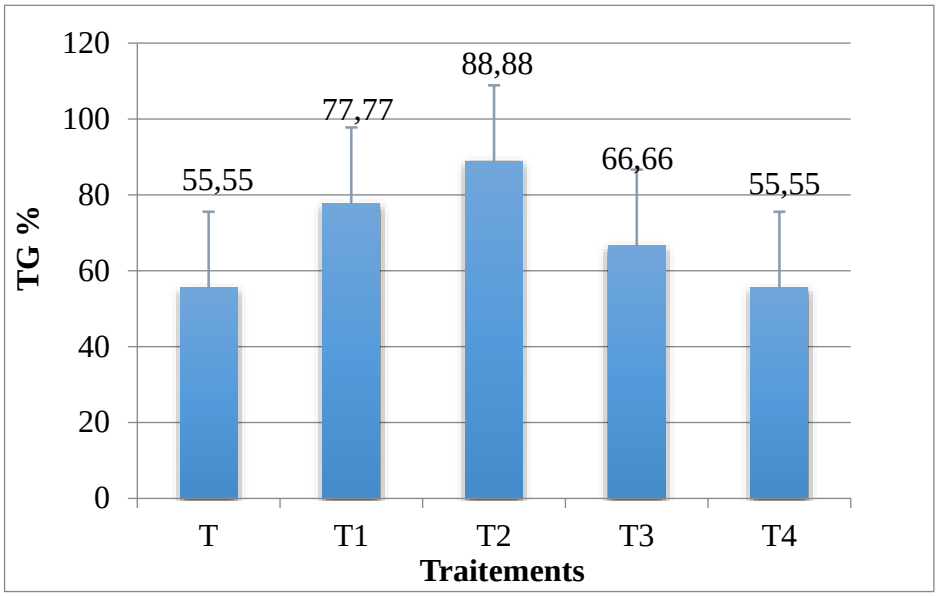

Figure 2. Germination rate in the different treatments

From Figure 02, the highest germination rate is recorded for T2 treatment, the lowest rate is recorded for treatment T and T4 (55.55%).

However, the acorns in substrates 01 and 03 achieved an almost identical germination capacity of approximately 70%.

What should also be noted is that the acorns which are germinated in the soil (control) only reached a germination capacity of 55.55%, which confirms the hypothesis of difficult germination in the soil.

Mean time to germination (GMT)

The speed of germination of fresh cork oak acorns is very slow, thus translating the existence of a dormancy which seems to depend on the producing tree [15].

The mean germination time (GMT) gives an idea of the speed of germination, the results obtained are recorded in table 3.

Table 3. Average germination time in the different treatments

Treatments	T	T1	T2	T3	T4
(GMT) (day)	44,43	43.69	40.90	40,88	43.66

Table 03 shows that the lowest mean germination time is recorded for the T3 treatment which contains 40% sludge.

The T1 and T4 treatments represent the same values of the mean germination time (43 days), these two treatments represent the two extremes in terms of dose, that is, the largest and the smallest dose of sludge.

The highest mean germination time is recorded for the control which contains only forest soil, with a GMT equal to 44 days, which confirms the hypothesis of very slow germination in the species *Quercus suber.*

Comparison of the influence of different treatments on the rate and average time of germination

The results of germination in the various experimental devices are reported in Table 4

Table 4. Comparison of the influence of different treatments on TG % and GMT

Treatments	TG (%)	GMT (day)
T	55,55	44,43
T1	77,77	43.69
T2	88,88	40.90
T3	66,66	40,88
T4	55,55	43.66

The evolution of germination is graphically represented by curves in Figure 3

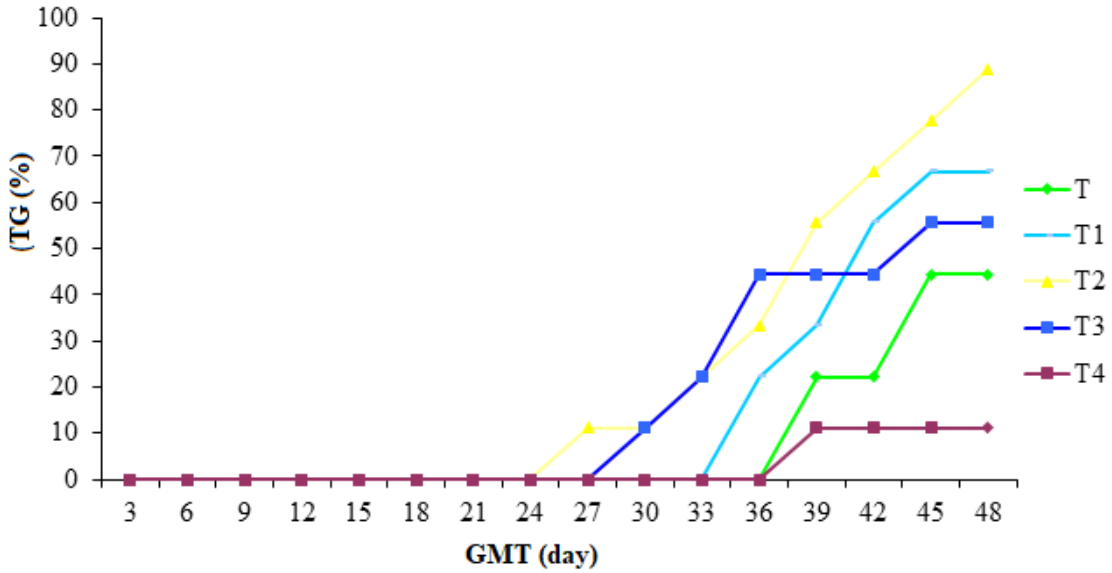

Figure 3. Curves expressing the rate and the mean germination time subjected to the different treatments (T, T1, T2, T3, and T4).

After an experimental period of 6 weeks, we find, from Table 04 and Figure 03, , that the highest TG% is recorded for the T2 treatment with a percentage of 88.88% with the GMT corresponding to 44.90% days.

TG and TMG differ from one treatment to another, this is confirmed by the two-way controlled analysis of variance test which reveals a very highly significant treatment and time effect (Table.5).

Table 5. Analysis of variance for germination

Source	DL	SC	CM	F	P	Meaning
Treatments	4	1317,6	329,4	6,53	0,	T.H.S***
Days	15	45497,	3033,1	60,1	000	T.H.S***
	60	1	50,5	2	0,	
Total	79	49841,9				

The control shows the longest average time, i.e. the slowest germination compared to the other treatments (Fig. 3).

According to Come (1974) [16] the speed or capacity of germination gives only an inaccurate idea of the ability of certain seeds to germinate.

Indeed, according to the experimental conditions, the germination capacity can be unchanged, while the speed of germination is very different, i.e. acorns germinate very quickly but in small numbers, which is confirmed by our results.

These results obtained in the present study, which remains dependent on the conditions under which the germination tests are carried out and the state of maturity of the acorns tested, allow us to observe that the various treatments adopted induced an increase in the speed of germination compared to acorns cultivated in the soil (control).

4. Conclusion

Throughout the experiment, the difficulty of germination was confirmed, that is, acorns take a long time for the hypocotyl to appear, however some parameters, such as germination rate and average germination time, such as germination rate and average germination time, can give us indications that allow us to choose the appropriate substrate (s) from which we can not improve the germination itself but rather play on the speed with which this germination takes place.

Based on the results obtained, the following conclusions can be drawn:

-The T2 treatment gives the best germination power compared to the control which corresponds to the soil.

-The four mud treatments give us the best results in terms of germination rate or GMT relative to the soil.

Through these two conclusions we can say that the T2 treatment which corresponds to 20% of sludge gives the best germination speed with the highest rate. Although this rate is high compared to that obtained in the soil, it remains weak all the same; and since the germination rate obtained by the T3 treatment is high, we can therefore increase the density of cork oak acorn seedlings to obtain a better yield with a very high speed.

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