Journal of Fundamental and Applied Sciences

ISSN 1112-9867

Available online at http://www.jfas.info

Research Article

RAMEAL CHIPPED WOOD AS A TOOL FOR SOIL TEMPERATURE REGULATION

Ibrahim. Kerrouche*, Ghania. Ouahrani

Laboratory of ecology Dep.Eco. FSNV. University of Brothers Mentouri Constantine1, Constantine, Algeria

Received: 27 December 2021 / Accepted: 07 Avril 2022 / Published: 08 Avril 2022

ABSTRACT

The objective of our work is to study the influence of Rameal Chipped Wood (FCW) and cattle manure in the presence and absence of earthworms *Octodrilus complanatus* on the regulation of soil temperature of a sandy loam soil. The study station is located in a semi-arid zone (Constantine, Algeria). The results obtained show that the contribution of FCW cattle manure in the presence and absence of earthworms *Octodrilus complanatus* has a beneficial effect on soil temperature.

Keywords: Constantine; Cattle manure; *Octodrilus complanatus*; Soil temperature.

Author Correspondence, e-mail: kerroucheibrahim@gmail.com

doi: http://dx.doi.org/10.4314/jfas.1193

1. INTRODUCTION

The soil is a dynamic complex, characterized by an internal atmosphere, a particular water saving, specific flora and fauna, mineral elements. But the soil is also a dynamic environment because its properties are acquired gradually under the combined action of environmental factors [1]. According to [2]; soil is a porous mineral environment, from which gas and liquid can circulate in it. We can therefore divide it into three physical compartments: a gas

Journal of Fundamental and Applied Sciences is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License. Libraries Resource Directory. We are listed under Research Associations category.

compartment, a liquid compartment and a solid compartment. To these three compartments plus the living organic compartment creating matter organic.

Soil temperature is an important factor in all soil studies. Soil temperature effects: physical properties of the soil: Pedogenesis, temperature variations: Freezing / thawing alternations favor the disintegration of the rock and consequently contribute to soil formation. A low temperature (freezing) influences the dynamics of water and air (liquid and gas transfer). The chemical properties of the soil: Chemical reactions take place as a function of temperature. The biological properties of the soil: temperature controls germination, microbial activity and that of living soil organisms.

The presence of organic matter in agricultural soils is an important factor in assessing it's condition. Rameal Chipped Wood (RCW) and Manure are energy inputs that can improve the soil. Rameal Chipped Wood (RCW) refers to the set of branches that have a diameter of less than 7 cm [3]. These branches are characterized by a low content of phenolic compounds and a relatively high nutrient content [4,5]. In addition, RCW is an important source of carbon for degraded agricultural soils [6]. In general, organic amendments, rich in carbon, promote soil life [7].

Manure is an organic matter resulting from the excrements (excrements and urine) of animals mixed with the litter, after composting, it is used as a fertilizer in agriculture, manure contributes to the maintenance of soil fertility [8].

Earthworm fauna is known for its importance for the "formation of topsoil". The mechanical role of earthworms is considerable; it is akin to plowing, remarkable for its qualities far superior to those of conventional tillage [9].

The objective of our work is to study the influence of of rameal chipped wood (RCW) and bovine manure in the presence and absence of earthworms *Octodrilus complanatus* on the regulation soil temperature?

2. MATERIALS AND METHODS

This work is carried out on one of the lands of the experimental farm of the Technical Institute of Grand Cultures (ITGC) in the region of El Khroub (Constantine, Algeria). The study station is located in a semi-arid zone, with an average annual rainfall of 450 mm / year, an altitude of 594 m, a latitude of 6.40 East and a longitude of 36.16 North. The soil studied has on average a very low porosity, on the other hand, it is well provided with M.O. and rich in nitrogen. Moreover, the C / N ratio being more than 12, reflects poor mineralization as for the soil texture, it is on average sandy loam.

In the resort, a parcel of 100 m² was chosen. We subdivided it into 15 plots of 2 m² each. Figure 1, shows, 5 modalities, T (Control with no amendments), BRF (Rameal Chipped Wood), BRFF (Rameal Chipped Wood and Manure), BRFV (Rameal Chipped Wood and Earth worms) and BRFFV (Rameal Chipped Wood, Manure and Earth worms). In addition, for each observation, 3 repetitions were made.

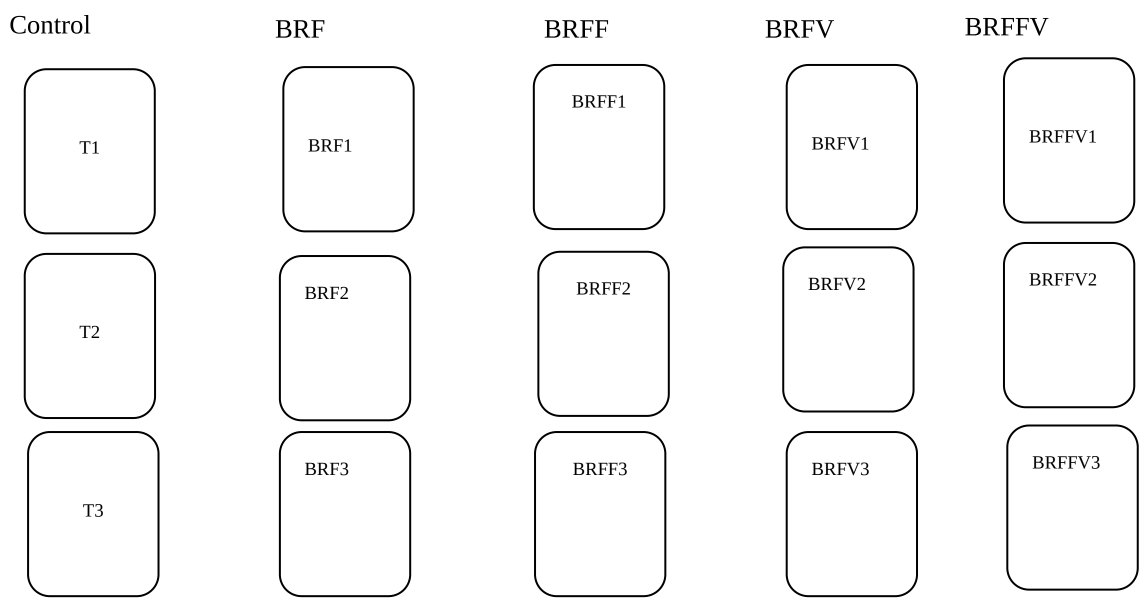

Fig.1. Diagram of the experimental plan

2.1. Choice of wastes

We chose small branches less than 7 cm in diameter from a fruit tree, the nectarine tree (Prunus persica var. nucipersica). Its twigs were pruned with pruning shears and crushed with a hammer mill to obtain chips of 2 to 5 cm3. This waste was put in sachets and transported for installation in the experimental site.

2.2. Calculation of contributions

For each plot studied with the exception of the control, a volume of 0.03 m3 / m² was added. This is equivalent to a quantity of 4 kg / m², or a height of 4 cm. Indeed, the volume that needs to be added to one hectare for a thickness of 4 cm is 40 T / ha [10]. Thus, 8 kg of energy input was put for each plot. The waste was brought in twice, the 1st input was made in March 2014 and the 2nd in April 2016. These two dates were chosen because the forming lignin contained in the rameal wood is more attackable by fungi and bacteria, the branches contain a nitrogenous material essential for the development of these bacteria and fungi.

We chose cattle manure as manure. This manure was brought in from the ITGC pilot farm, its composting time is 6 months to a year.

2.3. Choice of earthworms

The earthworms used are of the species *Octodrilus complanatus*. This choice was made because *Octodrilus complanatus* is an anecic earthworm, these large earthworms seek their food on the surface of the soil and then their distribution at depth thanks to the vertical galleries that they dig. They are called the tillers of the soil or the engineers of the soil or the intestines of the soil.

Thus, at the start of the experiment, we introduced into the plots (BRFV1, 2 and 3 and BRFFV1, 2 and 3) 60 ind / m² (biomass estimated at 240 g / m^2) *Octodrilus complanatus*.

2.4 Evolution of the soil temperature (°C)

The soil temperature (°C) in the fifteen prepared plots was measured weekly for four years (2014-2016) using a Testo 635-1 Thermo-hygrometer with a 0636 -2161 probe for 3 seasons (autumn, spring and summer) during the 3 campaigns 2014, 2015 and 2016.

2.5. Statistical processing of data

Data processing is carried out using the XLSTAT-Base 2017 software.

3. RESULTS AND DISCUSSION

3.1 Average T °C soil of plots in autumn

Concerning the average T °C soil in autumn in the plots, they are [20.3]; [19.1]; [19.6]; [19.7] and [19.9] °C respectively for T, BRF, BRFF, BRFV and BRFFV. The difference between the mean T °C sol in the plots studied is very significant (Fobs = 11.721; dof = 4 and p <0.00) (Tab.

1). This means that the plots have different T °C during the autumn (Table 1 and Figure 2). The critical value of Tukey's d: 4.102 gives us 4 classes of decreasing T °C sol, ie T (a)> BRFFV (ab)> BRFV; BRFF (b)> BRF (c) (Table 2 and Figure 3). It should be noted that the plot without input (T) is the hottest.

Table 1. Variable Anova T °C soil in Autumn

Source	DDL	Somme des carrés	Moyenne des carrés	F	Pr > F
Placettes	4	6,981	1,745	11,721	**< 0,0001**

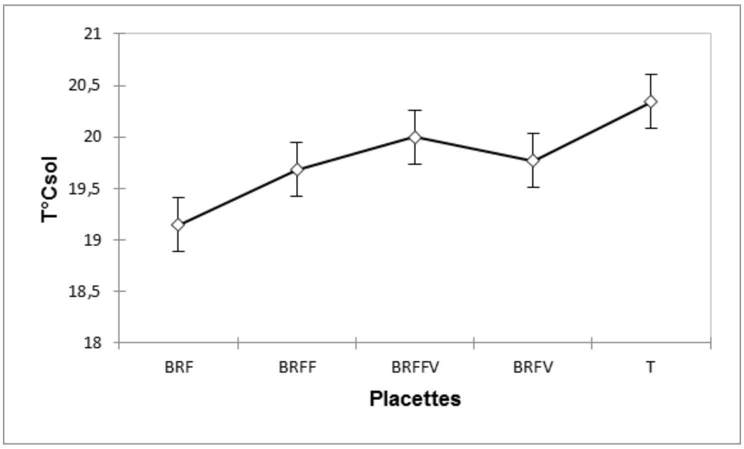

Fig.2. Variations in mean soil T °C in the plots in autumn

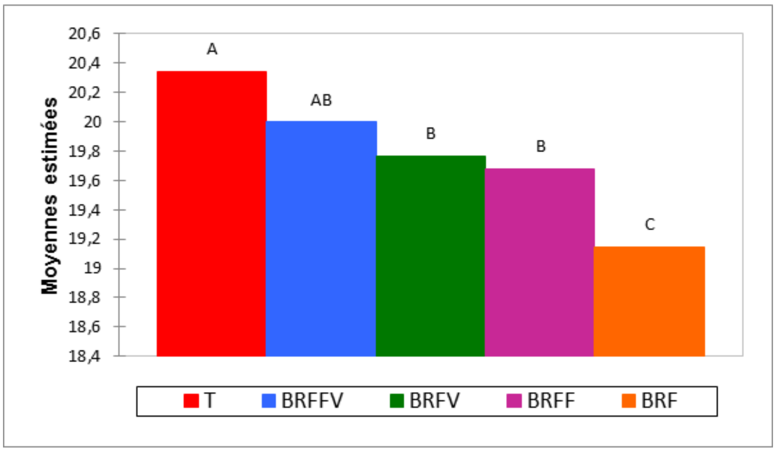

Fig.3. Classification of plots according to T °C soil for the autumn

Table 2. Classification of plots according to T °C soil in autumn

	T °C sol
T	20,342
BRFFV	19,997
BRFV	19,769
BRFF	19,681
BRF	19,145

3.2 Average T °C soil of plots in spring:

The mean T °C soil in the plots are [17.4]; [16.2]; [15.9]; [16.4] and [16.3] ° C respectively for T, BRF, BRFF, BRFV and BRFFV. The difference between the mean T ° Csoil of the plots in spring is very significant (Fobs = 20.236; dof = 4 and p <0.00) (Tab. 3 and Fig. 4). This means that in spring the plots have different soil T ° C. The critical value of Tukey's d: 4.102 indicates 4 modalities of decreasing soil T °C in spring: T (a)> BRFV (b)> BRFFV and BRF (bc)> BRFF (c) (Tab. 4 and Fig. 5).

Table 3. Anova for the T °C soil variable in the spring

Source	DDL	Somme des carrés	Moyenne des carrés	F	Pr > F
Placettes	4	10,892	2,723	20,236	**< 0,0001**

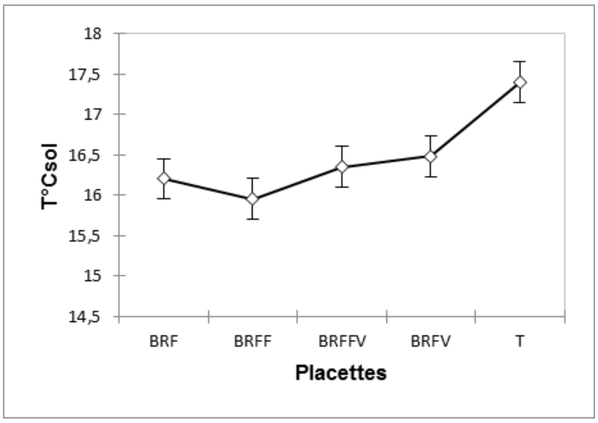

Fig.4. Variations in the mean T °C soil in the plots in the spring

Table 4. Classification of plots according to soil T °C in spring

	T °C sol
T	17,400 a
BRFV	16,484 b
BRFFV	16,354 bc
BRF	16,207 bc
BRFF	15,957 c
Pr > F	< 0,0001
Significatif	Oui

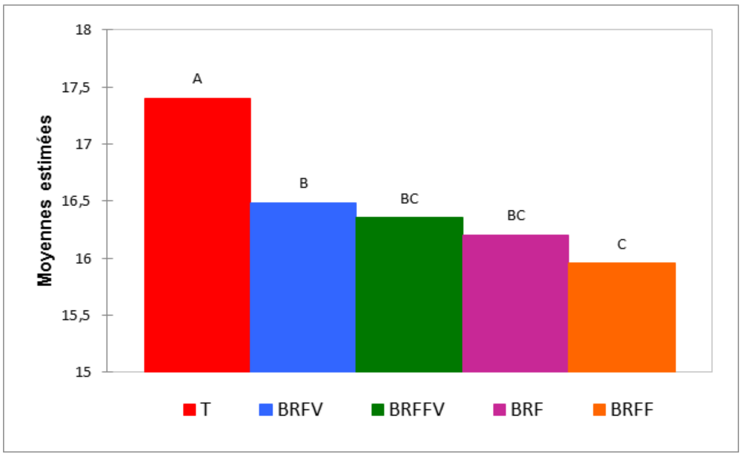

Fig.5. Classification of plots according to T ° Csoil for the spring

3.3 Average T °C soil of plots in summer

The mean T ° Csoil in the plots are [28.94]; [27.39]; [27.24]; [27.49] and [27.70] °C respectively for T, BRF, BRFF, BRFV and BRFFV. The difference between the mean T °C soil of the plots in summer is very significant (Fobs = 17.862; dof = 4 and p <0.000) (Table 5 and Figure 6). This means that in summer the plots have different T ° C soils. The critical value of Tukey's d: 4.102 indicates 2 classes of decreasing soil T ° C in summer: T (a)> BRFFV, BRFV, BRF and BRFF (b) (Table 6 and Figure 7).

Table 5. Anova for the T °C soil variable in summer

Source	DDL	Somme des carrés	Moyenne des carrés	F	Pr > F
Placettes	4	16,895	4,224	17,862	**< 0,0001**

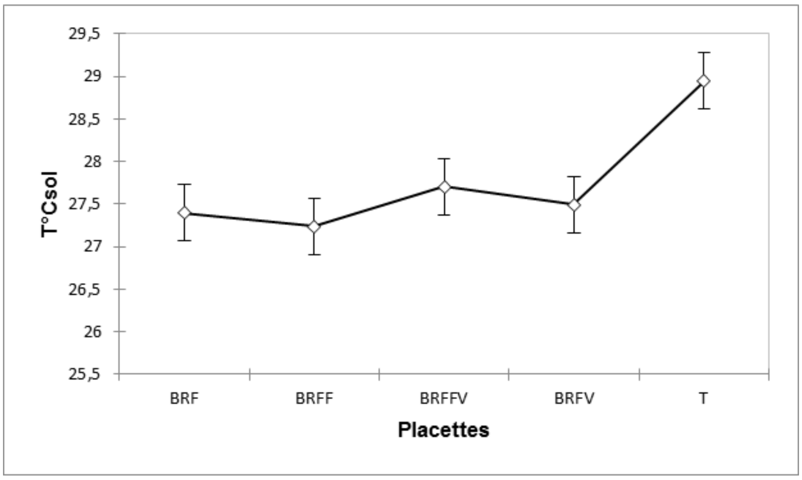

Fig.6. Variations in the mean T ° C soil in the plots in summer

Table 6. Classification of plots according to T °C soil in summer (Tukey test)

	T °C sol
T	28,945 a
BRFFV	27,706 b
BRFV	27,497 b
BRF	27,397 b
BRFF	27,241 b
Pr > F	< 0,0001
Significatif	Oui

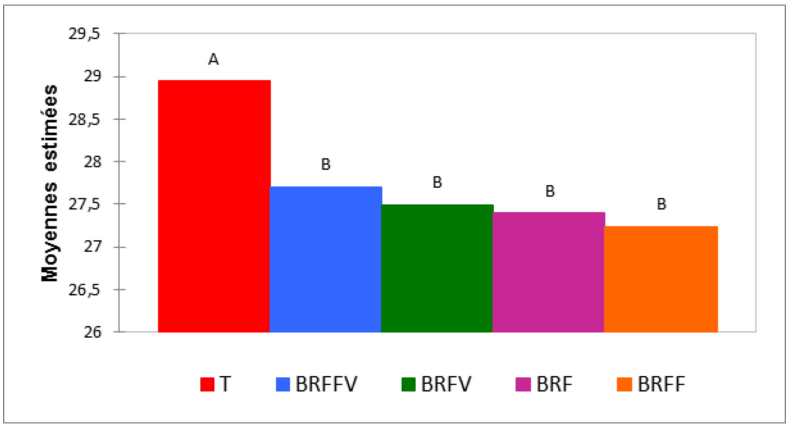

Fig.7. Classification of plots according to T °C soil for the summer

4. DISCUSSION

We have noticed that the soil temperature in summer is higher than T ° Csoil in autumn, and those of autumn are higher than those of spring. This is due to the influence of air temperature on that of the soil, as the air temperature rises, the soil temperature rises and vice versa. Indeed, [11] according to Rome et al. (2008), the variation in soil temperature generally accords with the variation in air temperature (more particularly at the surface of the soil). [12] in [11] indicated that this influence of the T ° C decreases as one moves away from the surface of the ground, it generally varies very little beyond 5 to 6 meters deep in the soil during the year, on the other hand, the temperature of the soil surface remains in phase with that of the air [11] .

In our study, it was noted that whatever the season (in autumn (Tab. 2 and Fig. 3) and in spring (Table 4 and Figure 5) and in summer (Table 6 and Figure 7), the temperature of the T (control) is always higher than that of plots covered by the BRF or the BRFFF. Indeed, the difference between the average T ° C soil of the plots is very significant.

Our results are consistent with those obtained by several authors. Thus, [13] found that the temperature is always lower in the plots under mulch or mulch than in the control which received no treatment as for [14] used organic waste, wheat mulch (Tritium aestivum L.) and soybean mulch (Glycine max L. Merrill) have different thicknesses under greenhouse and field conditions in southern England. They noticed a decrease in soil temperature compared to the control and even noticed that as the thickness of wheat straw increases, the temperature decreases [14]. In addition, [15], used straw mulch and found that the temperature of the control soil was 3 °C higher than that of the amended plots. [16], studied the effect of mulching on soil temperature using 3 types of plots (grass mulch, polythene mulch and unmulched plots). He found that grass mulch significantly lowers maximum soil temperature by 1–2 °C at a depth of 15 cm.

Our results show that RCW has a beneficial effect. Indeed, the addition of RCW or RCW and cattle manure protect the soil from solar radiation. This cover played the role of a parasol, which resulted in a decrease in evaporation and therefore a more humid soil and we went from uncultivated soil to viable soil.

5. CONCLUSION

This study was interested about the influence of the RCW and manure on the temperature of a sandy loam agricultural soil, in the presence and absence of earthworms *Octodrilus complanatus*, the study station is located in a semi-arid Mediterranean region (Algeria). However, the addition of BRF and bovine manure in the presence and absence of earthworms *Octodrilus complanatus* has a beneficial effect soil temperature. Thus, the RCW, and the manure are local materials, which can enter into the process of sustainable management. And this is necessary to limit the degradation of agricultural soils in arid Mediterranean regions.

6. REFERENCES

[1] Duchaufour Ph., 1976. Atlas écologique des sols du monde. Masson.

[2] Davet P., 1996. Vie microbienne du sol et production végétales, (edn) INRA.Paris.

[3] Lemieux G. Le bois raméal et les mécanismes de fertilité du sol. Publié par le Ministère de l'Énergie et des Ressources et la Faculté de Foresterie de l'Université Laval. Québec, 1986, 20 p.

[4] Hendrickson O. Winter-branch nutrients in the northern conifers and hardwoods. Fore. Sci., 1987, 33: 1068-1074

[5] Edmonds R L. Decomposition rates and nutrient dynamics in small-diameter woody litter in four forest ecosystems in Washington, U.S.A. CAN J FOREST RES., 1987, 17: 499- 509

[6] Allison F.E. Soil organic matter and its role in crop production. Elsevier Scientific Publishing Co. Amsterdam, 1973, 637 p.

[7] Tremblay J et Beauchamp C J. Fractionnement de la fertilisation azotée d'appoint à la suite de l'incorporation au sol de bois rameaux fragmentés : modifications de certaines propriétés biologiques et chimiques d'un sol cultivé en pomme de terre. Can. J. Soil. Sci., 1998, 78 : 275-82

[8] Hiraoka h, Misra RV et Roy R.N. Méthodes de compostage au niveau de l'exploitation agricole, FAO, Rome, 2005. 51p.

[9] Bouche M B. Les lombriciens. Bul. de Liaison. Centre Universitaire. Dijon., 1974, 27 : 13- 18

[10] Caron C et Lemieux, G. Le bois raméal pour la régénération des sols agricoles et forestiers. Echo MO, 1999, 19 : 2

[11] Rome S. Bigot S . Chaffard V et Biron P.E. Relation entre les temperatures de l'air et les temperatures du sol : l'exemple des hauts plateaux du vercors. XXIème colloque de l'Association Internationale de Climatologie Montpellier, 2008 : 555-560

[12] Gold L W. Influence of surface conditions on ground temperatures. Canadian Journal of Earth Science. 1967, 199-208

[13] Salau O A. Opara-Nadi O A et Swennen R. Effects of mulching on soil properties, growth and yield ofplantain on a tropical ultisol in southeastern Nigeria. *Soil. Till. Res*, 1992, 23: 73-93.

[14] Hadrian F C. Gerardo S B et Howard C L. Mulch effects on rainfall interception, soil physical characteristics and temperature under Zea mays L. *Soil. Till. Res,* 2006, 91: 227–235

[15] Sharma U K et Meshram K. Evaluate the effect of mulches on soil temperature, soil moisture level and yield of capsicum (Capsicum annuum) under drip irrigation system. *Inter. J. Agr. Eng,* 2015, 8: 54–59

[16] Eruola A O. Bello N J. Ufoegbune G C. Makinde A A. Effect of Mulching on Soil Temperature and Moisture Regime on Emergence, Growth and Yield of White Yam in a Tropical Wet-and-Dry Climate. *Int J Agric Forest,*2012, 2 : 93-100