Journal of Fundamental and Applied Sciences

ISSN 1112-9867

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

Research Article

EFFECT OF RAMIAL FRAGMENTED WOOD AMENDMENTS ON THE GERMINATION RATE (%) OF DURUM WHEAT

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Received: 18 September 2020 / Accepted: 24 July 2021 / Published online: 01 September 2021

ABSTRACT

The presence of organic matter in agricultural soils is an important factor in assessing the conditions of the soils. BRF and Manure are energy inputs that can improve the soil. The objective of our work is to study the influence of the contribution of Rameal Fragmented Wood (RFW) and cattle manure in the presence and absence of earthworms *Octodrilus complanatus* on the germination rate (%) of durum wheat (*Tritucum durum*) of the Hedba 3 variety. The study station is located in a semi-arid zone (Constantine, Algeria). the results obtained show that the contribution of RFW or RFW mixture and cattle manure in the presence and absence of *earthworms Octodrilus* complanatus has a beneficial effect on the the germination rate increased by 193.35% on average in the amended plots compared to the control plots.

Keywords: Constantine; Rameal Fragmented Wood (RFW); Cattle manure; *Octodrilus complanatus;* germination rate.

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doi: http://dx.doi.org/10.4314/jfas.v13i3.3

1. INTRODUCTION

Increasing agricultural production to meet human food demand, this increase which results in the intensification of agriculture using mineral fertilizers for fertilization, as well as powerful and sophisticated machinery can have adverse effects such as erosion and soil degradation, groundwater pollution, eutrophication of aquatic habitats, greenhouse gas emissions [1]. The lowering of the level of organic matter in cultivated soils has forced researchers to find sustainable techniques to overcome this phenomenon. With the development of soil ecology, the application of organic amendments has regained interest as a sustainable alternative for ecosystem management while improving physical chemical and biological of soil properties, [2]. The contribution of organic amendments to the soil can be carried out in different forms: cattle droppings directly deposited on the ground or after collection, treatment and application: the compost [3]. Thus, a Quebec technique aims to spread crushed woody branches on the soil and to incorporate them into it, to increase its organic matter content. These crushed branches are called Rameal Fragmented Wood (RFW) [4].

This soil aggregation technique was developed by a group of Canadian researchers directed by Professor Gilles Lemieux of the University of Laval in Quebec in the 1980s. This technique is now practiced in many countries with amazing results, both on sterile soils and already fertile soils [5].

In addition, the presence of organic matter in agricultural soils is an important factor in assessing it's condition. Rameal Fragmented Wood (RFW) Manure are energy inputs that can improve the soil. Rameal Fragmented Wood (RFW). Rameal Fragmented Wood (RFW) refers to the set of branches that have a diameter of less than 7 cm [6]. These branches are characterized by a low content of phenolic compounds and a relatively high nutrient content [7, 8]. In addition, RFW is an important source of carbon for degraded agricultural soils [9]. In general, organic amendments, rich in carbon, promote soil life [10].

Numerous works have shown that organic amendments rich in cellulose and lignin such as RFW have beneficial effects on soils and crops (increased yields of barley, wheat, millet, tomato, potato), in temperate environments [12-15] and in tropical environments [16-19].

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 [20].

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 [21].

The objective of our work is to study the influence of of rameal fragmented wood (RFW) and bovine manure in the presence and absence of earthworms *Octodrilus complanatus* on germination rate (%) of durum wheat. Does the addition of biowastes into the soil in the and absence of earthworms Octodrilus complanatus has in influence on the germination rate of durum wheat (Tritucum durum) of the Hedba 3 variety?

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.

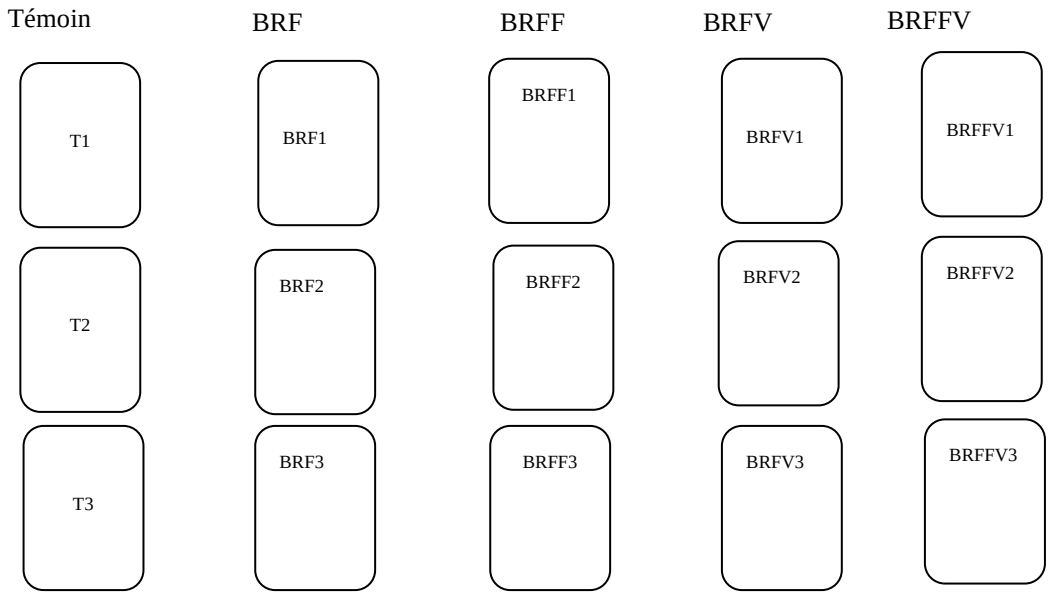

Fig.1. Diagram of the experimental plan

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 cm^3. 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 m^3 / m^2 was added. This is equivalent to a quantity of 4 kg / m^2, 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 [22]. 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. Determination of primary productivity of durum wheat (N / m²)

To know the quality of the soil after the addition of BRF and manure in the presence and absence of earthworms, we have cultivated durum wheat on the different plots and for 3 seasons (spring 2016, Fall 2016, spring 2017) up to the 4-leaf stage. In each plot we sowed 200 seeds of durum wheat (*Titicum dirum*) of the variety Hedba 3 (locale variety).

At the end of our experiment, we calculated the germination rate according to the equation:

% N wheat / m² = (number of germinated seeds/ number of planted seeds) X 100

2.5. Statistical processing of data:

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

3. RESULTS

Table 1 gives the elementary statistics studied for the 3 wheat campaigns that we carried out, N wheat / m² (Number of germinated wheat plants / m²).

Table 1: 95% confidence interval for the estimated means of the studied variable% germination (% N wheat / m²), and their extreme values in parentheses

Plots	T	BRF	BRFF	BRFV	BRFFV
%Nwheat/m²	[20,7±4,9]	[25,8±3,0]	[37,9±3,2]	[43,3±4,8]	[53,1±5,2]
Min-Max	(1,5-55,5)	(4,5-50,5)	(10,5-58,5)	(9-64)	(24,5-87)

Fig.2. Wheat seeds at the 4-leaf stage in the different types of plots (Kerrouhe, 2016)

3.1. Wheat Germination Rate (%)

3.1.1. In the plots

Concerning germination rate (%), the estimated mean (Tab. 1) is [20.7 ± 4.9]; [25.8 ± 3.0]; [37.9 ± 3.2]; [43.3 ± 4.8] and [53.1 ± 5.2]% respectively in T; BRF; BRFF; BRFV and BRFFV. The difference between the estimated means of the germination rate (%) is very significant (Fobs = 6.669; dof = 4 and p <0.00). This means that the germination rate differs from one plot to another, so there is a contribution effect (Tab.2) Moreover, Tukey's test (Tukey's critical value: 4.102), confirms the difference between estimated averages 2 to 2 (Fig. 3) and indicates 5 modalities: BRFFV (a)> BRFV (ab)> BRFF (abc)> BRF (bc)> T.

Table 2: Analysis of variance for the variable wheat germination rate (%)

Source	DDL	Sum of squares	Average of squares	F	Pr > F
Plots	4	6197,967	1549,492	6,669	**0,001**
Harvests	2	6025,344	3012,672	12,967	**< 0,0001**
Plots*Harvests	8	2511,767	313,971	1,351	0,257

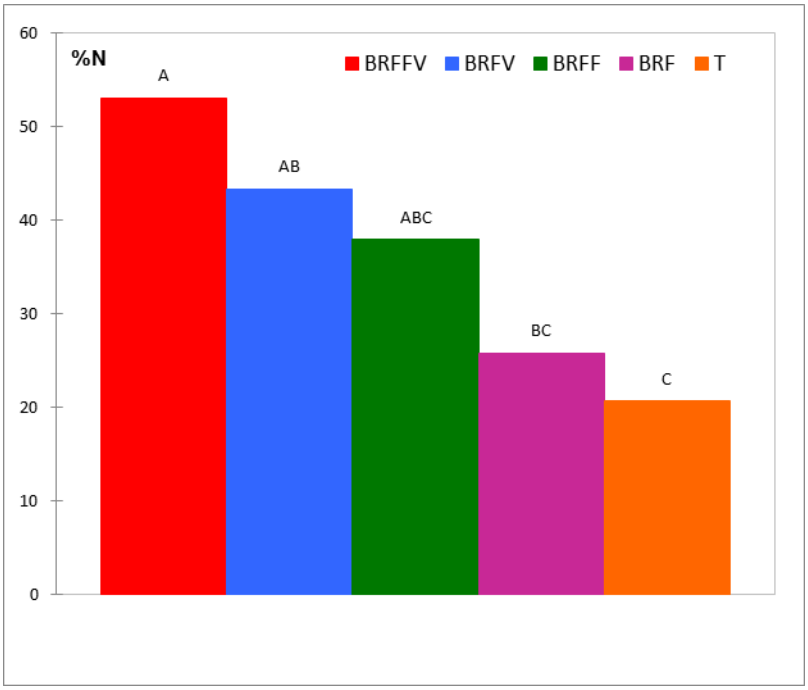

Fig.3. Classification of plots according to the germination rate of wheat (% NWheat) (Tukey test)

The germination rate (%) is higher compared to that of the control of 32; 23; 17 and 5% respectively in BRFFV, BRFV, BRFF and BRF. Thus, the composition RFW, Manure and earthworms, stimulates the production of wheat.

3.1.2. According to the seasons (S)

Concerning the germination rate (%) for the different wheat seasons performed, the estimated average is: 29.0 52.5 and 27.0% respectively for campaign S1, S2 and S3. The difference between the season averages is very significant (Fobs = 12.967; dof = 2 and p <0.000) (Tab. 2). Tukey's test (Critical value of Tukey's d: 3.486) indicates 2 modalities S2 (a)> S1 and S2 (b) (Tab. 3). This means that the germination (%) in the 2nd season (53%) is more important than that of the 1st (29%) and 3rd season (19%).

Thus, the RFW added with manure and earthworms is the best composition for a better germination rate and the 2nd season (S2) is higher than S1 and S3.

Table 3: Classification of wheat harvests according to the germination rate (% N wheat) (Tukey test)

	%N	
R2	52,500 a	
R1	29,033 b	
R3	27,000 b	
Pr > F	< 0,0001	
Significant	Yes	

4. DISCUSSION

For the germination rate % we noted (Tab. 1) a very significant difference between the different types of plots. Thus, we noticed that the BRFFV and BRFV plots have the highest% germination followed by BRFF, BRF and that of the control plots is the lowest (Fig. 3). For the seasons there is a very significant difference for the% germination (Tab. 1). Indeed the 2nd season is more important (Tab. 3), this increase in the germination rate in the amended plots compared to the unamended control plots is explained by the fact that the addition of RFW or the mixture of RFW and manure as a surface layer decreases the evaporation of water from the soil (prevents water rising by capillary action), it absorbs rainwater and limits leaching which helps to better retain soil moisture therefore wetter soil which retains an important quantity of water, in addition, RFW is recognized by its buffering effect on soil temperature, according to Greenly and Rakow (1995), these factors are essential for germination. In addition, the addition of anecic earthworms of the species *Octodrilus copmlanatus* contributed to increasing the porosity of the soil (Tab. 1) which again means good water retention and good soil aeration, as well as the slightly high rate of organic matter (Tab. 1) may explain the achievement of the highest rates of germination in the BRFV and BRFFV plots. These results are in agreement with those of N'dayegamiye et Dubé (1986), who indicated that the addition of RFW with or without slurry contributes to the increase in yields. These authors observed that the contribution of RFW, reduced wheat yields by 20 to

80% for the 1st harvest and for the 2nd harvest there was a significant increase in wheat yields of the order of 20 to 190. %. And when they made a 2nd contribution of RFW, they noted at the 3rd harvest an increase in barley yields of around 10% and the 4th harvest an increase in wheat yields of around 30 at 70% compared to the control. Furthermore, Soumare et al. (2002), observed that the addition of RFW induces a reduction in tomato yields for the 1st harvest, on the other hand an increase of around 40 to 60% for the 2nd harvest. In addition, Robert et al. (2014), with the addition of RFW, noted a 200% increase in tomato yield compared to the control. Furthermore, Zaater et al. (2018), on a study of the influence of the mixture of RFW of 2 tree species (*Lucaena leucocephala* and *Olea europaea*) noted a 100% increase in the rate of potato germination. Also, for our study, the contribution of BRF from nectarine tree (*Prunus persica var. Nucipersica*) and bovine manure, significantly stimulates the germination rate (%) of durum wheat (*Tritucum durum*) of the Hedba 3 variety. in our study, the germination rate increased moderately by 193.35% in the amended plots compared to the unamended control plots.

Thus, Jan et Amanullah, (2011), had reported that application of manure improves growth and increases wheat yield. Andriamananjara et al. (2016), had found that the use of manure increases rice yield. Soremi et al. (2017), reported that the use of manure helps increase yields.

Furthermore, [28] have reported that the addition of manure alone contributes to increased wheat and corn yields, but the addition of posthuma species (Vaillaint) earthworms to manure has not showed big differences in performance. However, Padmavathiamma et al. (2009), have reported that using earthworms with organic amendments increases yield. These authors used five species of earthworms; *Eudrillus eugineae*, *Eisenia foetida*, *Perionyx sansibaricus*, *Pontoscolex corethrurus* and *Megascolex chinensis*, they found that *Eudrillus eugineae* gave the best results regarding yields.

5. CONCLUSION

This study was interested in the influence of the RFW and manure on 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 on the germination rate (%) of durum wheat (Tritucum durum) of the Hedba 3 variety. Thus, the BRF, 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.

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How to cite this article:
Kerrouche I, Bazri KEM Zeltni AES, Ouahrani G. Effect of ramial fragmented wood amendments on the germination rate (%) of durum wheat. J. Fundam. Appl. Sci., 2021, *13(3), 1193-1205.*