Interactive comment on "Does *Jatropha curcas* L. show resistance to drought in the Sahelian zone of West Africa? A case study from Burkina Faso" by P. Bayen et al.

For the article se-2015-2 entitled "Does *Jatropha curcas* L. show resistance to drought in the Sahelian zone of West Africa? a case study from Burkina Faso".

Dear editor,

We highly appreciate the valuable and constructive comments made by the referees on our manuscript for its improvement. We have taken all the comments into account and where applicable, we modified the manuscript accordingly. The changes are highlighted in the text to allow easy tracking. Please note that reviewer's comments are in bold while our responses are in italic.

Please feel free to contact us again if you have any questions regarding our responses.

Thank you and best regards

Anonymous Referee #1

1. General comment

Generally in Burkina Faso, the local name of Jatropha curcas in Plateau Central region of Burkina Faso shows a defiance of plantation of this species by local people because of it toxicity. Jatropha (Jatropha curcas) is an oil producing shrub, which is easy to grow and thrives in desert climates. It can grow on abandoned or sandy soils and a dried cutting pushed into the soil will take just two days to take root, producing seed within a year. In Sub saharian countries (Burkina Faso, Mali,….) this plant is traditionally cultivated in hedges usually around gardens, to protect the soil and surrounding crops from wind and water erosion.

In the managed degraded land with WSC techniques of Burkina Faso, the recommendations are to plant multipurpose trees chosen by local people to protect them against animal feed. I am not sure if this plant would be planted in managed soils by people even the seeds are used to produce oil for machine and mould into balls of soap, for dermatological product used for skin problems. This experiment shows the unsuitable of Jatropha curcas to restore denuded land in the Sahelian zone but not in sandy soil. But another experiment conduct in Niger is opposite. A trial of the ten accessions for Jatropha curcas was carried out at regional Agricultural Research Center of Maradi in Niger, with aim to evaluate the performance of this plant accessions. The results revealed that there is no significant difference between accessions tested for height and diameter. All the accessions were a survival rate up to 80% in sahelo-saharian conditions with fruit production. The yield value of 511 and 445 kg per hectare respectively

obtained from Katil 13 and GB 14 in 2012. (in Habou et al. J. Appl. Biosci. 2014. Évaluation du Potentiel de dix accessions de Jatropha Curcas L (Euphorbiaceae) au Niger).

Answer: we read the publication by Habou et al. (2014) on the performance of Jatropha in two accessions in Niger. We think the aims, experimental settings and climatic conditions of this study were different to ours. We tested the growth performance of Jatropha curcas on barren, degraded and unproductive land in the Sahelian and Sudanian area of Burkina Faso. Our results were in line with the findings of Sop et al. (2012) stating that Jatropha do not thrive on degraded land as propagated in the literature and therefore cannot be considered as a solution for restoration of barren lands in the sahelo-sudanian context of Burkina Faso. Maybe we would have achieved a different result if we did consider to plant Jatropha on agricultural and productive lands.

...If most of seedlings died in the first years after planting due to soil condition maybe you have to consider if plantation survival was not affected by negative environmental effects local biological conditions like termites and rabbits etc.

Answer: we did not noticed any destructions of our plants by termites and rabbits and therefore concluded that the seedlings died because of poor soil conditions.

There may well be 'varieties' which are more cold and dryness tolerant than others. What are the varieties used in this experiment?

Answer: The seedlings used in this study came from Pama in eastern Burkina Faso. Pama is in the Sudanian area with rainfall pattern differing from that of the Sahelian area. Seed provenance may have well also influenced the results obtained in Dagandé (Sahelian area) where all the seedlings died. It is possible that genotypes adapted to Sahelian conditions would have led to different results. This need to be investigated further.

We have now included the potential impact of seed genotype on the survival rate of Jatropha in Dagandé, in the discussion at Page 9, lines 27-32: It is important to stress that the seeds of Jatropha used for this study were collected in Fada N'gourma and Pama situated in the Sudanian area and receiving a better rainfall regime than in the Sahel. The effect of seeds' provenance on the outcome of the study in Dagandé is therefore unclear. It is not to exclude that other genotypes from the Sahel, more adapted to dryer conditions, may have led to different results. This aspect needs to be investigated further in future studies.'

In Figure 1 on Phytogeographic domains and geographic locations of 2 the experimental sites, the maps' legend is none readable and it is better to take off name of Africa and Burkina out of map and in Burkina Faso map insert the name of the two sites Dagandé and Namoungou or Site 1 and Site 2.

Answer: Suggestion accepted. Figure 1 has been modified according to the suggestion of reviewer 1.

In Figure 2 on Mean rainfall and mean temperatures record for the weather station of Dori (Sahelian zone) and Fada N'Gourma (Sudanian zone), near the experimental sites, between 1983 and 2013, it seems of lack of temperature data from 2009 to 2013 for Namoungou site. So it would be opportune to limit graphic to 2009.

Answer: No we have all rainfall and temperature data for both sites from 1983 and 2013. Temperatures in Namoungou were constant at ca. 29.3°C between 2009 and 2013. This explains the flat pattern observed on the graph.

In figure 4 according to the Effect of treatments on soil water content at different depth levels in October 2012 the use of the same scale for soil water content in percentage would be better to compare the difference between treatment and the two sites.

Answer: We have followed the suggestion of reviewer 1 and we have modified the graph accordingly. A revised version of Fig. 4 is provided.

2. Specific comment

Why did the holes, 10-15 cm depth, instead off 15-25cm in literature?

Answer: Some previous research in Burkina Faso (Zougmoré et al., 2003; Kagambèga et al., 2011a; Kagambèga et al., 2011b) used the depth 10-15 cm. Our objective by using the same depth, was to allow comparability of the results.

How the plantation was made in half-moons with holes dug in the half moon hole and witch dimensions?

Answer: For plantation, we dug in the middle of each half-moon a small pit of 10 x15cm in which we planted the seedling. Only half-moon holes are used to collect water and not the pits in which we are planted.

Where did the plantation made in half-moons, in the pits or in the earth ridges?

Answer: All plantations were made in the middle of the half-moons and not in the earth ridges.

The bibliographic references in sub Saharan region according to Jatropha curcas could be improved by others papers in Niger, Mali and Senegal.

To our knowledge only a few research papers have assessed the performance of Jatropha curcas L. on encrusted and barren soil in Niger, Mali and Senegal. All publications from Sahelian countries we knew about after a thorough search were considered in our manuscript. We have added the research by Habou et al., (2014) to the reference list.

Anonymous Referee #2

In general: Although the topic of the paper is an interesting and should be told in literature, this paper is in its current form not acceptable for publication in SOIL. See comments below.

Abstract: Explain site specific terms, explain statistical terminology and interpret them for the reader, now the reader needs to figure out by themselves what it means.

Answer: We believe the abstract is not the appropriate place to give basic definitions, since the number of words is restricted. We think figure 1 well shows where the Sahel and Sudanian areas are situated in Burkina Faso.
Regarding the statistics employed, from our perspective, we did not use any special and complicated terminology. The statistics used are basic and classical statistics procedures in scientific context that helps to explore differences between different samples. We explain in the methods the choice of the employed statistical procedures.

Introduction: In general not bad, although not enough references form Burkina Faso or other Sahelian countries in my opinion…
Answer: The literature on Jatropha in the Sahelian context is very scarce. We gave our best to take into consideration all Jatropha related publications we knew of, in this study…

Furthermore, it needs to be rewritten to be more concise and omit repititions. Especially page 4 needs to be rewritten completely…

Answer: we have rewritten page 4 and we have specifically deleted some sentences that seemed to be redundant. We think the page now reads well.

In addition the authors need to explain already here site specific terms to the reader (e.g. Sudano-Sahelian region)

Answer: We have added some lines in the method part to explain a bit more the difference between the Sahelian and the Sudanian areas (see lines 14-15, page 5).

Methods: Please explain why these different types of statistical analysis was needed to assess these data, it seems unnecessary…

Answer: Statics are necessary to know if the differences we see are significant. Which is a condition in scientific studies.

Analysis of variance (ANOVA) is a statistical test used to analyze the differences between group means. ANOVA provides a statistical test of whether or not the means of several groups are equal, and therefore generalizes the t-test to more than two groups., ANOVAs are useful in comparing (testing) three or more means (groups or variables) for statistical significance (source: Wikipedia).

We used ANOVA in order to test the effects of independent factors (treatments and sites) on the response which is in this study was the growth parameters of the seedlings (survival rate, height and diameter).

Before performing an ANOVA, a number of assumptions must be fulfilled. For example, the data must ne normally distributed. This was checked using the Shapiro-Wilk test of normality. Data were afterwards transformed to ensure normality. Another assumption of ANOVA is 'homogeneity of variance' in the data. This was checked using Levene test.

A Tukey HSD (Honest Significant Difference) test was used to determine differences between treatment means and between sampling times. This test compares all possible pairs of means.

P 7 line 6: measurements instead of measures…

Answer: This was corrected in the manuscript.

Discussion/References: I think you need to explain the notifications of the statisics that you put in brackets. Not all reader will know what it means, nor will they know if the numbers given to it are good or bad…

Answer: We believe this manuscript would be very long if we would explain every statistical expression used in the run of this paper. p or F values and degree of freedoms (df) are classical information that must be given whenever an ANOVA is performed. This allows the reader to check sample size, number of treatments, and the level of significance of a conducted test. These definitions are available in standard statistic books.

Some comments are very general: really common knowledge (like p 8, line 23-26; page 9, line 7-10) …

Answer:

p.8, line 23-26: here we attempted to explain the difference in soil water content observed between Zai and half-moon treatments. We do not understand what is 'very general' in our explanation. We find that it is an important result. The reviewer could have been more specific…

…Also the English needs to be revised by an English editor. There are many places where there is strange working, so needs to be rephrased…

Answer: Our paper was edited by a native speaker from the USA, Dr. Cleve Hick who may be contacted at clevehicks@hotmail.com*. In case there are specific linguistic problems that are pointed out we would be happy to correct them.*

…**In addition the paper is very repetitive in what is said. In this very short paper, the authors tell many times about the same things. One thing I really want to stress: the authors mention that all seedlings died due to soil constraints or soil conditions. This really needs explanation, especially in a journal called SOIL.**

Answer: We have suppressed the mention 'due to soil conditions' because this assertion is not supported by our data. As a consequence of that we have also deleted lines 9-11, page 10.

The authors also mention that it is noteworthy that all the plants in the Sahel site died and that this may be an indication that it is not so suitable for these conditions. I think you missed a lot of literature on several topics:
- Soil and water conservation (see a lot of work of Leo Stroosnijder and his students)
- On Jatropha in other studies - On soil physics and hydrology - On agronomic studies on survival of plants in relation to water availability

Answer: We do not understand the point made by reviewer 2. We think we have considered most of the literature that were relevant to our topic.

Conclusions: a bit repetitious, and anyway should be rewritten after revising the document.
Answer: We have shortened the conclusion and removed redundancy. The conclusion now contains only 165 words.

Table 1: explain what letters mean in the caption Figures: Make figures all consistent: same font and font size and all border in the same format Fig 1 is nice, but very small font.

Answer:

In table 1, letters meaning have been mentioned below the table. For all figures we have now used the same scale and the same font size for better comparison of the treatments and the two sites. We have also made the legend of the maps more readable.

We have provided new figures that integrate the changes.

Anonymous Referee #3

This manuscript presents data from performance of *Jatropha curcas* at two different climatic zones with two different methods of soil restoration. The presented results are important and novel, but I have some concerns about the presentation of the manuscript.

My first concern has to do with the title. The authors use the term "drought" in the title and I think this term is misused because drought is a prolonged period of abnormally low rainfall.

The authors should use a proper term to describe the climatic zone.

Answer: We understand the concern of reviewer 3 related to the use of the term 'drought'! 'Drought' here is used as a sort of response to the alleged 'resistance of Jatropha to drought', which is abundantly mentioned in the literature on Jatropha. In our paper 'drought' was meant for 'aridity' which characterizes the Sahelian region, where annual rainfall period is limited to three months. To us the title is justified by the fact that all plants died in the Sahelian region, which is dryer than the Sudanian area where most seedlings survived...

My second concern has to do with the introduction. The introduction lack consistency and logical linking. The problematic of the research is not well defined. It looks like the authors want to consider soil restoration and Jatropha performance; but the title of the manuscript did not show that.

Answer: We have attempted to make clear in the introduction that the aim of the study was to test the growth performance of Jatropha under different soil and water conservation techniques.

The finality of the research is to explore if Jatropha, which is said to be drought resistant and to be able to growth on poor soil conditions, could be used for restoration of degraded and barren lands in Burkina Faso. That is the link between Jatropha's performance and soil restoration...

Is *Jatropha curcas*. a pioneer species? Why did you consider it for plantation on barren soil?

Answer:

We answered this question already in the introduction. Jatropha is not a pioneer species.

We have considered Jatropha curcas L. for plantation on barren soils because Jatropha can produce biofuel and the plant is claimed to be drought-resistant and can be used for reclamation of marginal and degraded lands in (semi-)arid regions. These characteristics make Jatropha attractive for West African countries, which suffer from drought, land degradation, rural poverty, etc. Burkina Faso faces severe deforestation and land degradation which have led to large expanses of barren and unproductive lands. The idea behind this research was to test if Jatropha may be successfully used for rehabilitation/restoration of these barren/impoverished lands while providing biofuel and direct financial benefits to rural communities. That is the rationale for choosing Jatropha curcas…

My third concern has to do with the results and discussion parts. This part is poorly written and need to be more developed. The effects of the treatment on the soil moisture contend was not included in the objectives of the study. You should mention it in the objectives of the study.

Answer: we have added to the introduction (p.5, line 4-5) that 'More specifically, the research assesses the effect of different treatments on soil moisture content…'

Overall, I found that this manuscript could be interesting if the authors define clearly the problematic of their study and describe clearly their objectives.

Answer: We have made the problematic of the study more explicit and we have made the objectives clearer with the addition into the introduction of the sentence '…more specifically, the research assesses the effect of different treatments on soil moisture content…'.