Effects of partial fertilizer substitution by organic fertilizer on growth of peanut at seedling stage

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Abstract. In response to the Ministry of agriculture's action plan for chemical fertilizer reductions and organic fertilizers instead of fertilizers and discuss the optimum consumption and proportion of peanut biochar-based fertilization. Six different fertilization treatments were set up: C40, C50 (standard consumption), C60, C40+M, C30+M and C20+M. Seeding height, chlorophyll content and total biomass were also measured on 6th, 2017. The results showed that C20+M treatment had the highest plant height and the highest biomass in Peanut Seedlings, while the content of chlorophyll increased with the amount of biochar applied.

1. Introduction
Large amounts of chemical fertilizer have been used in our country since 1970s, and the rapid growth of agricultural fertilizer has played an irreplaceable role in promoting the development of grain and agricultural production, but there are also many problems. Excessive input of chemical fertilizer not only results in a great waste of resources, but also increases the risk of environmental pollution [1]. Therefore, combined application of organic and inorganic fertilizers has become one of the most active fields in fertilizer application research [2]. Biochar is an organic substance rich in stable carbon, which is obtained by oxygen limited pyrolysis and carbonization. Its agricultural application is considered as an effective technical approach to increase agricultural production and carbon sequestration [3]. However, what kind of consumption and proportion of the biochar-based fertilizer and organic fertilizer is the key scientific and technical issue in the development of combined application of organic and inorganic fertilizers. This experiment was conducted to investigate the effects of different application with biochar, biochar and organic fertilizer on the plant height, chlorophyll content (SPAD) and biomass of peanut at seedling stage. In order to explore the optimum dosage and proportion of biochar-based fertilizer and organic fertilizer and to provide scientific basis for reducing fertilization while increasing efficiency and organic substitution of some chemical fertilizer.
2. Materials and methods

2.1. General situation of the experimental field
The experimental field is located in the Televillage of Fuxin city and Liaoning Province. It belongs to the continental monsoon climate in the north temperate zone, and is a typical semi-arid region. The average annual precipitation is about 450mm, and concentrated in 6~8 months, accounting for 60%~70% of the annual rainfall so periodic droughts often occur. The soil in this area is sandy loam.

2.2. Experiment material and design
The cropping system of the peanut research field is one year per annual with continuous cropping, and the variety is Baisha 1016, with a planting density is 175 thousand holes per hectare, 2 plants were planted at each hole. Six treatments were set up in the experiment: (1) C40: Peanut biochar-based fertilizer of 600kg/hm²; (2) C50: Peanut biochar-based fertilizer of 750kg/hm²; (3) C60: Peanut biochar-based fertilizer of 900kg/hm²; (4) C40+M: Peanut biochar-based fertilizer of 600kg/hm² and organic fertilizer of 1090kg/hm²; (5) C30+M: Peanut biochar-based fertilizer of 450kg/hm² and organic fertilizer of 2160kg/hm²; (6) C20+M: Peanut biochar-based fertilizer of 300kg/hm² and organic fertilizer of 3240kg/hm². Each treatment is repeated 3 times, with a plot area of 20m², randomly arranged. The fertilizer is peanut biochar-based specific fertilizer (10-13-13), provided by Shenyang agricultural university and the organic fertilizer are high temperature compost made by chicken manure. All the fertilizer is mixed and then applied as the base fertilizer.

2.3. Items and methods of measurement

2.3.1. Plant height: 5well-distribute peanut plants were choose in each plot, and the stem height was measured according to peanut biological survey standard.

2.3.2. Chlorophyll content: A portable chlorophyll degerminator was used to determine 10 leaves in each plot. The leaves were the latest and fully expanded leaves and each leaf was taken as the middle part (be careful not to measure the veins).

2.3.3. Total biomass: In each area, a representative 2-hole peanut was selected. The root soil was removed and the ground (stem leaves) and underground (root or root and pod) were measured and the number of plants was recorded at the same time.

2.4. Data analysis
The experimental data were analysed by Excel 2007 and SPSS 16.

3. Results

3.1. Effects of different biochar and organic fertilizer formula on plant height of peanut at seedling stage.
As can be seen from Figure 1, the range of peanut seedling height is 7.88-8.96cm.In the treatment of using biochar-based fertilizer, with the increase of application dosage, peanut seedling height increased, but the difference was not significant. In the treatment of organic fertilizer instead of biochar-based fertilizer, compared with C50(standard consumption), C30+M treatment is lower in height while C40+M treatment increased the plant height by 0.76cm, but none of them show the significant difference.
Figure 1. The effect of different treatment on plant height.

Figure 2. The effect of different treatment on chlorophyll content (SPAD).

The average plant height of C20+M treatment is 8.96cm, absolutely higher than other treatments. So C20+M (the organic fertilizer NPK to replace 60% of the carbon-based fertilizer dosage in the NPK benchmark) can effectively promote the growth of peanut plant in seedling stage.

3.2. Effects of different biochar and organic fertilizer formula on chlorophyll content of peanut at seedling stage.

Through the determination of peanut seedling leaves of SPAD, we found that the level of biochar-based fertilizer and chlorophyll content of fertilizer was positively correlated. In the treatment of using biochar-based fertilizer, with biochar-based fertilizer increased the chlorophyll content increased gradually. The SPAD value of C60 treated leaves was the highest, which was 34.9, which was significantly different from other treatments. The chlorophyll content of C30+M and C40+M treatment was still slightly higher than that of C50 treatment, and there was no significant difference between them.

3.3. Effects of different biochar and organic fertilizer formula on total biomass of peanut at seedling stage.

Biomass is an important prerequisite for evaluating high yield and high-quality production of crops [6]. With the increase of the application of organic fertilizer, the biomass accumulation of peanut at seedling stage showed an upward trend. Among them, C20+M treatment has the biomass accumulate of 123.6kg/m2, which is significantly higher than other treatments. The reason may be that organic inorganic cooperation is beneficial to improve the nutrient supply level and utilization efficiency of peanut seedling stage, thus improving biomass.
Figure 3. The effect of different treatment on total biomass.

4. Conclusion
The plant height of C20 + M in peanut seedling stage was significantly higher than that of C50 (standard consumption), which was 8.96cm. The chlorophyll content in the seedling stage increased with the increase of the peanut biochar-based fertilizer application, however, the SPAD value of the leaves of C30 + M and C40 + M was higher than that of C50. The C20 + M treatment was significantly higher than the other treatments of 126.6kg/m² in the determination of peanut seedling biomass. To sum up, during the peanut seedling stage the organic fertilizer NPK to replace 60% of the carbon-based fertilizer dosage in the NPK benchmark is the best proportion and the application combined of organic fertilizer and peanut biochar-based fertilizer is an effective measure to improve the fertilizer use excessive status.

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