# Effect of Superabsorbent Polymer Composite Filled Carbon Fiber Towards the Germination of Abelmoschus Esculentus

Saidatul Shima Jamari, Suriati Ghazali, and Wan Siti Nadiah Wan Yaacob
Fakulti Kejuruteraan Kimia dan Sumber Asli, Universiti Malaysia Pahang, Lebuhraya Tun razak, 26300, Gambang, Kuantan, Pahang
Email: {sshima, suriati, wan_nad90}@ump.edu.my, yahoo.com

***Abstract*—As agriculture activities are becoming major sector that contribute a lot of income to Malaysian economy, the sustainability of the soil and environment need to maintain to ensure the soil fertility is not affected by this growing sector. The application of superabsorbent polymer filled carbon fiber on agriculture will ensure the feasibility of the biodegradable composite thus maintain the soil fertility. Superabsorbent polymer filled 0.5 and 0.1 weight percent of carbon filler applied to soil to study how it affects the plant growth of okra. After 21 days of plantation, the okras germinated from the soil mixed with the SAP were higher from the control. It shows that the addition of SAP with or without carbon filler contributes positive effect to the soil environment. Trend of plant grow taken after 7th and 14th days of plantation shows that the additional function of carbon to improve the physical properties of soil (soil conditioner), other than the organic filler to increase the biodegradability of SAP. In conclusion, superabsorbent polymer filled carbon fiber will help to improve the quality of the soil and help to fertilize the okras growth.**

***Index Terms*—superabsorbent polymer, carbon filler, abelmoschus esculentus**

## I. INTRODUCTION

Agriculture activities have becoming a major sector in Malaysia in contributing to the economic growth. It can be classified into two major parts which is food and industrial commodities. Food sectors are including paddy, vegetables, fruits, meats and fish while on the main industrial commodities side are palm oil, rubber and cocoa. Increasing demand of the agriculture product has made export activities increase thus contribute in Malaysia's financial growth. During the financial crisis in 1997, Malaysia industrial sector faces severe downfall. Thus, agricultural sector lead the Malaysia's economy by acting as a savior of the Malaysian economy as its contribution towards GDP increased from RM 17.1 billion in 1995 to RM 18.2 billion in 2000 ($8^{th}$ Malaysia Plan), which makes government to reemphasize on agricultural sector at that time [1].

As the agriculture sector keep growing, sustainability of the soil and environment, it is very important to maintain the soil fertility. Several alternatives, e.g. superabsorbent polymer (SAP) are implemented to improve the soil environment to obtain high production of plant. Superabsorbent polymers are normally use as a soil additive; either as reservoir of nutrients or water retainer in the soil. Conventionally, the SAP for soil application is synthesized from the polymerization process of acrylic esters, polyacrylamide and other unsaturated monomers. Superabsorbent polymers have influence on water infiltration rate in soil, bulk density, soil structure and the rate of evaporation from the soil surface. This property is very important to encounter the impacts of dehydration and reduce impacts of drought stress in crops [2].

Similar with other polymer materials, the SAP also has a drawback, which is low biodegradation rate. The biodegradation rate of superabsorbent polymers in soil depends on the dimensions of soil particle and amount of organic matter. Also, with decreasing oxygen in soil will also reduce the activities of bacteria and biodegradation rate of super absorbent polymers [3]. Therefore, researches on producing biodegradable SAP composite are actively done [4]-[6]. In this work, organic carbon material was chosen as the filler due the value added of the carbon element in soil.

Carbon is a vital substance and normally produced from the interactions of ecological processes. Carbon have the ability to improve the physical properties; by increasing the cation exchange capacity (CEC) and water-holding capacity, of soil. The carbon filler synthesized via hydrothermal method [7] using oil palm empty fruit bunch as a feedstock into the SAP composite will assist the hydrogel to decompose itself when it is applied on the soil.

## II. MATERIALS AND METHODS

The verification work was classified into two major parts; effect of the carbon filler ratio in SAP and effect of the SAP filled carbon material ratio in soil towards the plant growth. Several mixtures at different ratios of soil and the SAP filled carbon material were carried out. The superabsorbent polymer filled carbon material composite with control sample (no carbon filler), 0.5 wt% Carbon

Manuscript received January 1, 2015; revised May 1, 2015.



doi: 10.12720/joaat.2.2.156-159

and 1.0 wt% Carbon were used. In different container, 0.25 and 0.5 wt% of superabsorbent polymer per weight percent of soil was mixed for each type of superabsorbent polymer composite. Table I indicates the percentage of the soil mixture for the okra growth and each mixture were carried out in triplicate.

TABLE I. PERCENTAGE OF THE SOIL MIXTURE FOR THE OKRA GROWTH

| Mixture of substance (wt%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Soil | 100 | 99.75 | 99.75 | 99.75 | 99.5 | 99.5 | 99.5 |
| SAP + 0 wt% C | 0 | 0.25 | 0 | 0 | 0.5 | 0 | 0 |
| SAP + 0.5 wt% C | 0 | 0 | 0.25 | 0 | 0 | 0.5 | 0 |

Firstly the mixture components were weighted separately depending on the percentage fixed. Then, the combinations for each condition were mixed homogeneously to ensure the entire ingredients are fully blended. After that, the seed pot (10 x 8.5 ϕ x 5.5 ϕ) cm was filled with the mixture almost to the top, leaving approximately 2 cm ± 0.1cm space from the rim. Water the soil thoroughly before sprinkled the radish seeds (two to three seeds) on the mixture. Finally, cover the seeds within thin layer and water the surface to moisten mixture. The same procedures were repeated for all mixtures and at the seed pots. The plants were watered with 60 ml water every two days and placed in the greenhouse to be exposed to the sunlight. After 7 days of growth, the plants were thinned to an individual plant per pot. The height of plant grow was recorded for every 4 days and finally, the plants were removed from pots after 30 days of first watering.

A

B

C

Figure 1. Pictures of okra after seven days of cultivation for SAP with no carbon filler ( **A** = control , **B** = 0.25 wt%, **C** = 0.5 wt%).

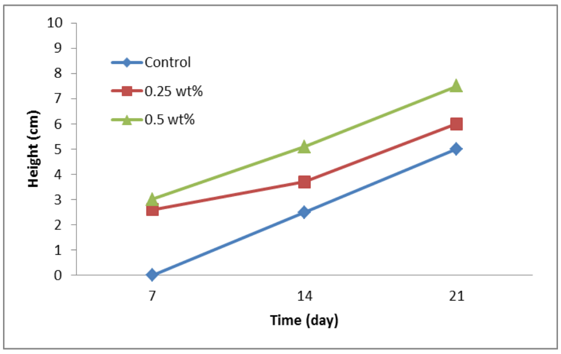
## III. RESULT AND DISCUSSION

### A. *Effect of SAP filled Carbon Material (SAP + C) Ratio in Soil Mixture*

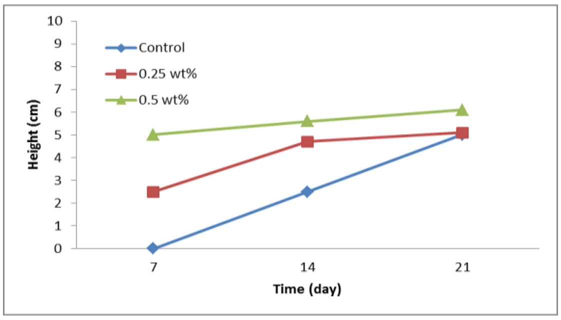
The study on the okra growth in germination stage at two different mixtures, 0.25 and 0.5 wt% were carried out. It was reported in Nnadi & Brave (2011) and Buchholz & Graham (1998) that the appropriate SAP concentration applied in soil is between 0.1 – 0.5 wt%. The SAP able to function efficiently between this range as if it is lower than 0.1 wt%, the effect as soil additive is negligible while if higher than 0.5 wt%, the soil can become too soft when it is completely saturated [9], [10].

Fig. 1 shows the pictures of okra started to growth in the soil mixtures 7 days after the planting. Based on the physical observation, the okra added with SAP growth faster (Fig. 1b and 1c), in term of height and leaves size, compared to the control. The ability of SAP as nutrients and water retainer, which the plant absorbed from the SAP according to the requirement, can be demonstrated.

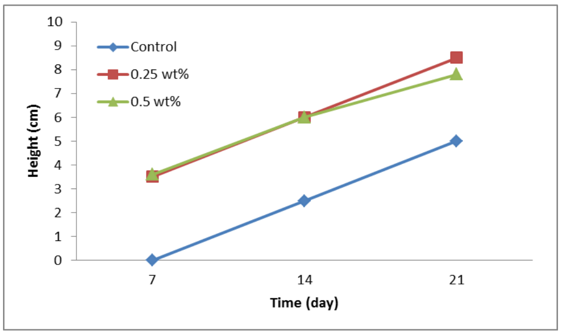
The increment trends of okra height from the 7$^{th}$ to 21$^{st}$ days of cultivation were plotted in Fig. 2. Generally, the okras germinated from the soil mixed with the SAP were higher from the control. It shows that the addition of SAP with or without carbon filler contributes positive effect to the soil environment. In addition, similar trend can be observed on the okras height planted in the mixtures of soil for SAP + 0 wt%C and SAP + 0.5 wt%C (Fig. 2A and Fig. 2B) compared to the SAP + 1.0 wt%C (Fig. 2C). This indicate that the amount of SAP filled with 1 wt% carbon added to the soil mixture was not affected to the okras growth.




A




B




C

Figure 2. Average height of okra for 21 days. ( **A** = SAP + 0 wt%C , **B** = SAP + 0.5 wt%C, **C** = SAP + 1.0 wt%C)

### *B. Effect of Carbon Ratio Filler in SAP Towards the Plant Growth*

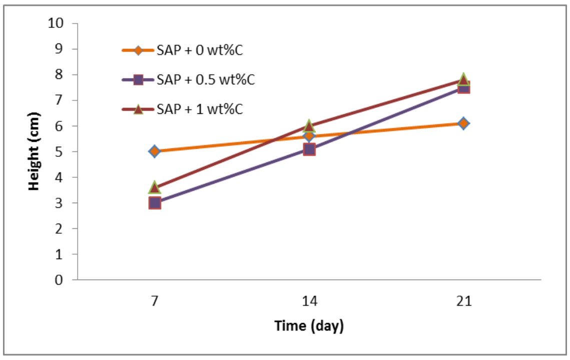



Figure 3. Average height of okra for 21 days at 0.5 wt% SAP in soil mixture.

Comparative study on the okras development at different percent carbon filler added in the SAP was recorded in Fig. 3. The progress of the okra germinate on the first 7$^{th}$ days of planting was faster for the SAP without filler addition as the height is 25 – 30% higher than the SAP with filler addition. However, the height recorded changed dramatically after 14$^{th}$ days of planting for the soil mixed with SAP incorporated with carbon filler. These trends verified the additional function of carbon to improve the physical properties of soil (soil conditioner), other than the organic filler to increase the biodegradability of SAP.

## IV. Conclusion

From the result discussed, the application of superabsorbent polymer filled carbon fiber helps okras to grow faster besides the addition of carbon filler give positive effect to the soil. In conclusion, superabsorbent polymer filled carbon fiber can be used as replacement to chemical fertilizer to fertilize the plant growth and help in maintain the soil fertility. In future, detail investigation, such as effect of carbon and SAP addition in soil environment, will be implemented.


## Acknowledgement

The authors wish to sincerely acknowledge the budget and equipment supports from Kementerian Pengajian Tinggi (KPT) Malaysia under grant RDU 131420 and technician support from Fakulti Kejuruteraan Kimia dan Sumber Asli, Universiti Malaysia Pahang, Malaysia and also to Dr. Haji Mohd Yuhyi bin Mohd Tadza from Fakulti Kejuruteraan Awam dan Sumber Alam, Universiti Malaysia Pahang, Malaysia for analysis instruments support.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**Saidatul Shima Jamari** received Doctoral degree in Chemical Engineering (Process and Material) from University of Sheffield, UK. Now, she is a senior lecture at Faculty Chemical and Natural Resources, Universiti Malaysia Pahang, Pahang, Malaysia. As a lecturer and researcher, her focus is to study in biomass source as a renewable energy.

**Suriati Ghazali** received Doctoral Degree from Universiti Sains Malaysia, Pulau Pinang, Malaysia in Material Engineering. Now, she is a senior lecturer at Faculty Chemical and Natural Resources, Universiti Malaysia Pahang, Pahang, Malaysia and her focus is in study of superabsorbent polymer and nano silver particle composite.

**Wan Siti Nadiah Wan Yaacob** graduated from Universiti Malaysia Perlis, Perlis, Malaysia in Bachelor Degree in Materials Engineering in 2013. She is now a Master degree student in Chemical Engineering at Faculty Chemical and Natural Resources, Universiti Malaysia Pahang, Pahang, Malaysia. Her focus on study is in superabsorbent polymer composite for agricultural application.