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優勝作品專輯

作品編號 **030019**

參展科別 **化學**

作品名稱 **Stop the Spread of Desertification by Agar**

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作者照片

Abstract

1. Purpose of the research

The purpose of this research is to prevent the desertification by using my original "agar sheets". The dry regions, in other words, the desert has already occupied about forty percent of the surface of the earth (**Figure 1**). In addition, it is said that land of seven million hectares turn into desert every year. However, we can reproduce the green-bosomed earth by using appropriate means, because this desertification originated in excessive farming, excessive pasturing, and deforestation caused by human beings. I learned "Cape Erimo's Green Construction Method", which has succeeded in planting trees in the coast of Japan by using seaweed, and this method led me to use the agar to prevent the desertification, which is a familiar Japanese food made from seaweed. I think that it is possible to prevent the desertification of any conditioned lands by using my original "agar sheets."

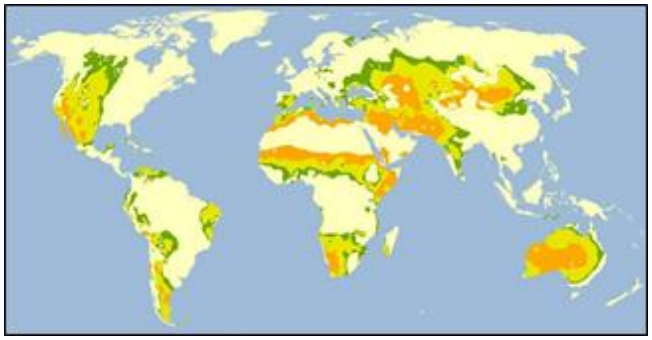

Figure 1. Distribution of dry regions

Arid Semiarid Dry sub humid

2. Procedures

(1) Preparation of my original agar sheets

① Materials and instruments

pure water, strip agar (**Figure 2**), glutaraldehyde (GA), a mixer, an autoclave, a dry heat sterilizer

② Typical procedure

Figure 2. Strip agar

Shown in **Figure 3**, agar was grounded into powder (a), and 3 g of the powder of agar was put into a 100 mL-beaker (b). After 20 mL of water was added into it (c), the mixture was heated in an autoclave at 121 ºC for 20 minutes to solve the agar (d).

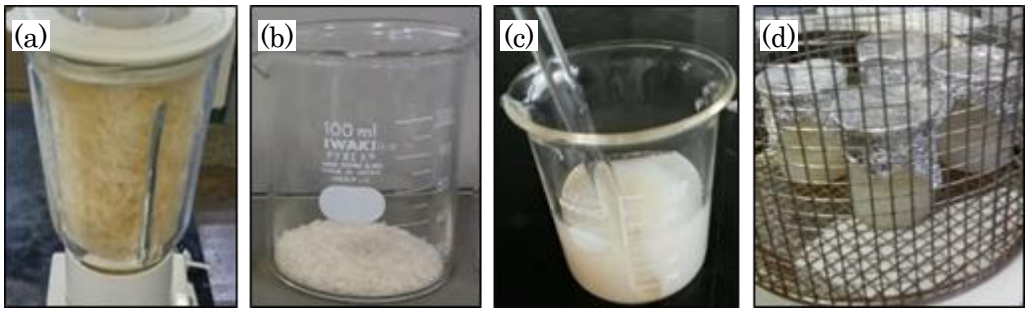

Figure 3. 1st step of the preparation of agar sheets

Shown in **Figure 4**, after 75 μL of GA (a) was added in the beaker with stirring, the reaction mixture was poured it into the metal trays (b), and dried in a dry heat sterilizer at 60 ºC (c) until it completely dried up (d).

Figure 4. 2nd step of the preparation of agar sheets

(2) Determination of the tensile strength of the agar sheet

To obtain the strongest agar sheets, the tensile strength of the agar sheets with various ratios of GA to agar were determined.

① Materials and instruments

Four agar sheets with different ratios of GA cut in width of 5 mm and our original equipment (**Figure 5**)

② Procedure

Two metal poles were set in; one was suspended from wood pole with kite string, and suspended the other with agar. The bucket was connected with lower pole with kite string, and water was added in it in order to measure the strength of the sheet's (**Figure 5** (c)). The weight of the bucket and water, when the agar sheet could not withstand and finally cut off, was measured five times for each sheet. I used the average of three value except the maximum and the minimum.

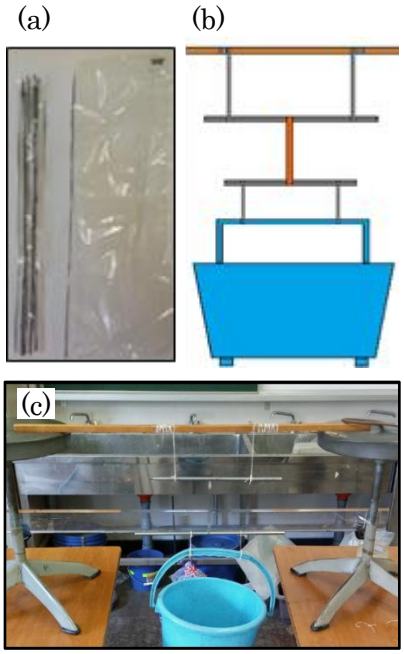

Figure 5. (a) agar sheets (b) and (c) Equipment for measuring the tensile strength of the agar sheets

(3) Determination of the permeability of the agar sheets

The time taken for water to pass through the agar sheets was measured, by using copper sulfate as an indicator.

① Materials and instruments

Agar sheets crosslinked by GA, copper sulfate, my original equipment (**Figure 6**)

② Procedure

Shown in **Figure 6**, the appropriate amount of copper sulfate was put on the glass plate and covered by agar sheets, and 1 mL of water was poured on it (a). By taking the pictures every one minutes, the permeability of the agar sheets was observed (b).

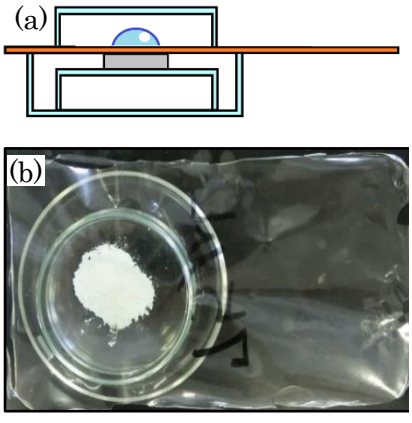

Figure 6. Equipment for measuring the permeability

(4) Determination of the biodegradation of the agar sheets

The agar sheets with GA, buried in the corner of the schoolyard in April last year, were dug out, and their appearance and touch were compared with those states before it was buried.

(5) Confirmation of growth of Chinese milk vetch

I checked whether or not the agar sheets and GA prevent the growth of the plant. I chose Chinese milk vetch because it belongs to bean family and has a root nodule bacteria, which is expected to have a high efficiency to green.

Figure 7. seeds of Chinese milk vetch

① Materials and instruments

agar sheet (with GA and without GA), Chinese milk vetch seeds (**Figure 7**), river sand, red clay, planters

② Procedure

I prepared three planters to grow the Chinese milk vetch (**Figure 8**). In these planters, red clay, river sand, and seeds were put in turn. Agar sheets with GA was spread in the planter A, and agar sheets without GA was spread in the planter B. Anything was not put in the planter C. The surface of each planter was covered with sand. To the plants of each planter were added 100mL of water every other week. Amount of water was estimated from data that the average of annual rainfall is less than 200mL in the desert. The frequency of pouring water was planned every other week, because it doesn't rain equally every day there. One month later, the three planters were apart to observe the state of roots and the agar sheet.

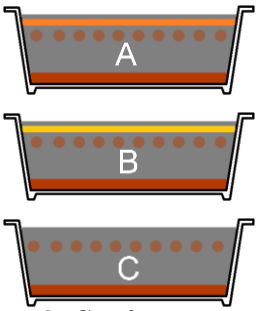

Figure 8. Confirmation of growth of Chinese milk vetch

(6) Confirmation of growing hairy vetch

I checked whether the agar sheet could preserve water in the soil and then contribute to growing plants. Hairy vetch was selected because it belongs to bean family like Chinese milk vetch and is expected to have a high efficiency to green. Water absorbable polymer, which has been used against desertification, was used to compare with agar sheets.

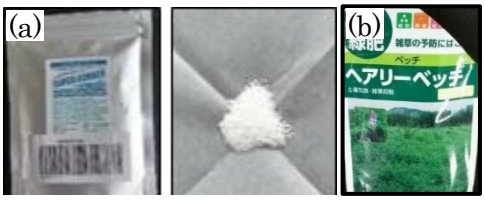

Figure 9. (a) Water absorbable polymer (b) seeds of hairy vetch

① Materials and instruments (**Figure 9**).

agar sheet (with GA), water absorbable polymer, Hairy vetch seeds, river sand, red clay, planters

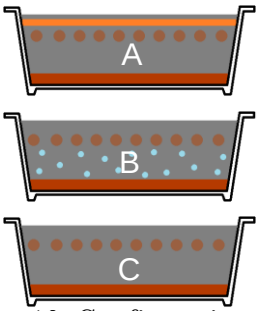

Figure 10. Confirmation of growth of Hairy vetch

② Procedure

I prepared three planters to grow the Hairy vetch (**Figure 10**). In these planters, red clay, river sand, and seeds were put in turn. Agar sheets with GA was spread in the planter A, and water absorbable polymer were added in the planter B. Anything was not put in the planter C. The surface of the planters were covered with sand. The weight of water absorbable

polymer put in planter B was equal to that of agar sheets in the planter A. After 700mL of water was added to each planter when I put the seeds in the planters, water was not added. This procedure is done to see that the plants can grow only in the sand that can preserve water. 700 mL is the maximum amount that is preserved in the planter C, which has no materials in it. One month later, three planters were apart to measure weight of grown plants. The weight is measured twice to compare, depending on growth conditions. First is right after taking apart. Second is after freeze drying the plants.

3. Results

(1) Determination of the tensile strength of the agar sheet

I found that the agar sheet with 75μL of GA was the strongest (**Figure 11**).

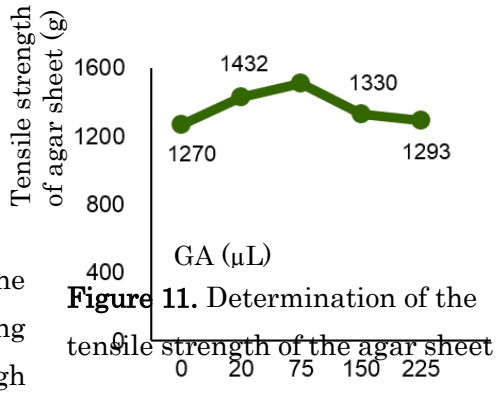

Figure 11. Determination of the tensile strength of the agar sheet

(2) Determination of the permeability of the agar sheet

The agar sheet has highly permeability because I could see the change color of copper sulfate clearly one minute after pouring some water (**Figure 12** (a)–(e)). Accordingly, water goes through the sheet placed on the soil immediately without remaining in the sheet. This means that it is highly possible to use the small amount of water efficiently.

Figure 12. The permeability of the agar sheet

(3) Determination of the biodegradation of the agar sheet

When I dug agar sheet out, it was worn and ragged. The strength of agar sheet is clearly degraded after being buried (**Figure 13** (b)), compared to the strength of agar sheet which is before buried ((**Figure 13** (a)). It was already known that agar has biodegradation, so I thought that the agar sheet with GA would probably have biodegradation.

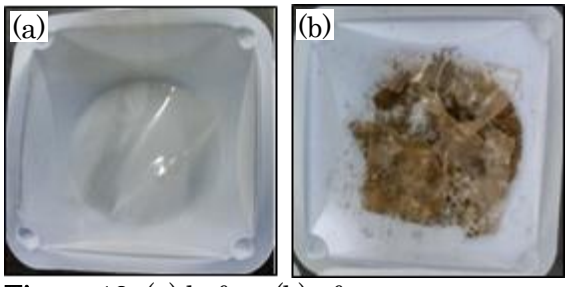

Figure 13. (a) before (b) after

(4) Growing Chinese milk vetch

The planter A and B germinated earlier than planter C by three weeks (**Figure 14** (a)). And when I took the planter A or B, sand on the surface of agar sheet dried, but under the agar sheet it is still wet (**Figure 14** (b)). And roots penetrated the agar sheet (**Figure 14** (c)). As the result, I found that neither the agar sheet nor GA prevented the plant from growing. And, I used two types of agar sheets; one is with GA, and the other is without GA. Both of them had the same effect on preserving water in the soil. I thought that Chinese milk vetch germinated earlier with the agar sheet because agar sheet prevented water from evaporating and preserving the amount of water necessary to germinate.

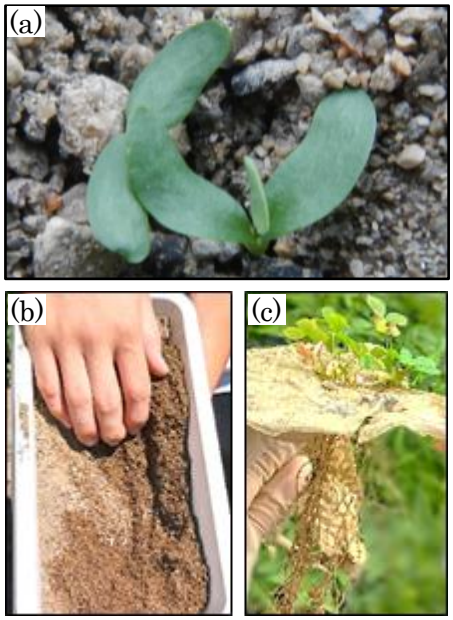

Figure 14. the condition of apart

(5) Growing Hairy vetch

The planter A died later than planter B and C; planter A died in four weeks, planter B in 3.5 weeks and planter C in 3 weeks (**Figure 15**). The weight is measured twice to compare, depending on growth conditions. First is right after taking apart. Second is after freeze drying the plants. Regardless of the condition which is right after taking apart or after freeze drying, the weight is heavier as follows: GA, water absorbable polymer, none (**Figure 16**). From the result, I found that agar sheet promoted the growth of the plants by preventing evaporation. According to figure 16, the difference between before and after dry freezing is the biggest when agar sheet is used. This means that the plants have a large amount of water. Based on this experiment, in the case of growing plants, I found that agar sheet was better than water absorbance polymer.

Figure 15. the condition of apart

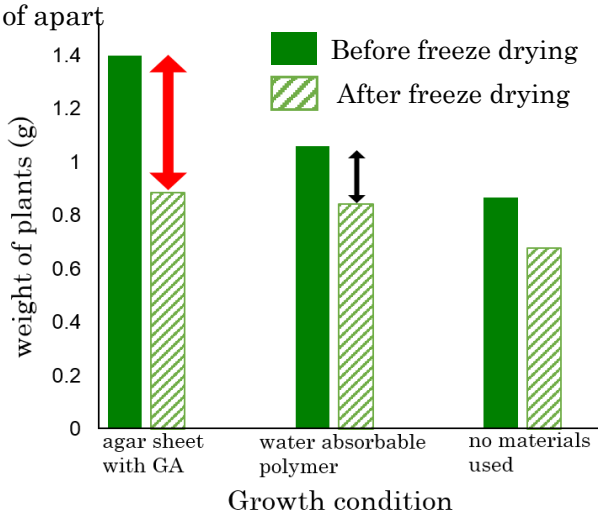

Figure 16. growing hairy vetch

4. Conclusions

First, agar sheet helps the germination and growth of a plant after germinating. Second, Agar sheet is more efficient than conventional stuff. So I believe that use of agar sheet is the best way to stop the spread of desertification.

【評語】030019

The research work is very important to prevent desertification of the earth. The author synthesized Agar sheet polymer to protect water form vaporizing, such that the plant growth is much taller then the controlled experiment, in which the Agar sheet polymer was removed. The idea synthesized material should severve attention to save water resource.