

## **Electronic supplementary information**

### **Optimizing the Interaction between Poly (vinyl alcohol) and Sandy Soil for Enhanced Water Retention Performance**

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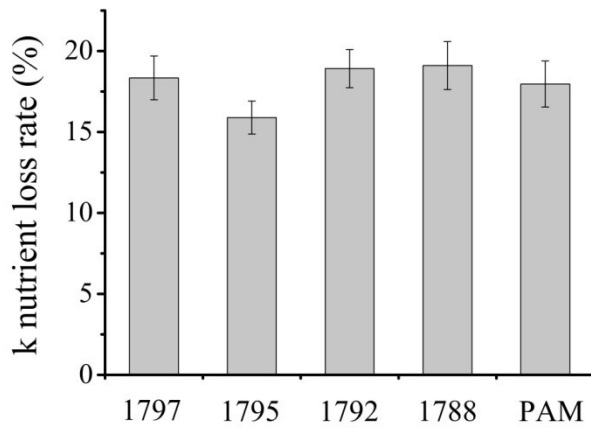
## 1. Measurement of K nutrient Loss Rate in Sandy Soil

KCl (the mass fraction of K is 52.35%) was selected as the model fertilizer. The procedure to determine the K nutrient loss rate in sandy soil added with PVA or PAM is as following: 150 g sandy soil were mixed thoroughly with 3 g of PVA of different degree of hydrolysis or PAM and 0.048g KCl and then placed in a PE breaker. The bottom of the breaker was opened with a small hole, sealed with nonwoven fabrics. The sandy soil mixture samples were watered with distilled water until saturated, and then 20mL distilled water was sprayed over the top of the soil. After the water seeped out from the bottom of the breaker, it was collected and its volume was recorded (marked as  $V_k$ ). Next, the collected solution was filtered through 0.45  $\mu\text{m}$  filter and a clear solution was obtained. The K concentration ( $C_k$ ) was measured by the atomic absorption spectrophotometer (Hitachi Z-5000). The K nutrient loss rate (KNLR%) in sandy soil was evaluated as the following:

$$\text{KNLR}\% = \frac{C_k V_k}{M_k} \times 100 \quad (\text{S1})$$

Where  $M_k$  is the weight of K element added to the sandy soil.

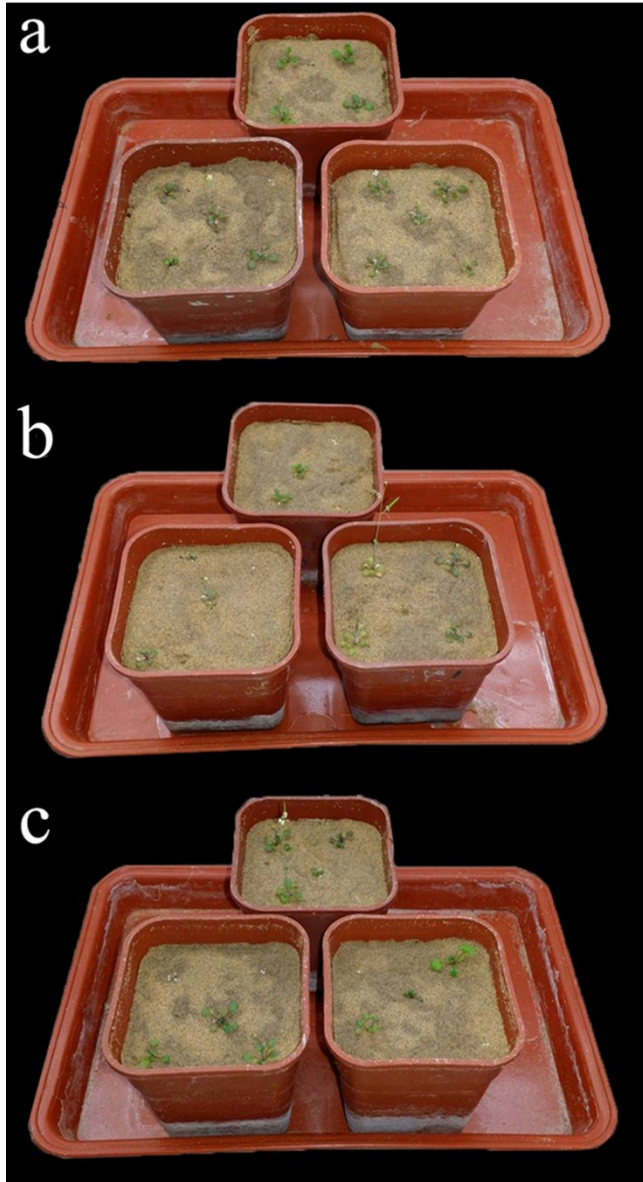
Fig.S1 showed the loss rate of K nutrient in sandy soil added with PVA with different degree of hydrolysis and PAM. It can be seen that the difference of K nutrient loss rate among the samples is not very significant (the biggest gap is only 3%) compared to water content. Therefore, we think the main contribution of PVA is still the water retention. Certainly, in the future, we may also consider combining water retention and nutrient retention together.



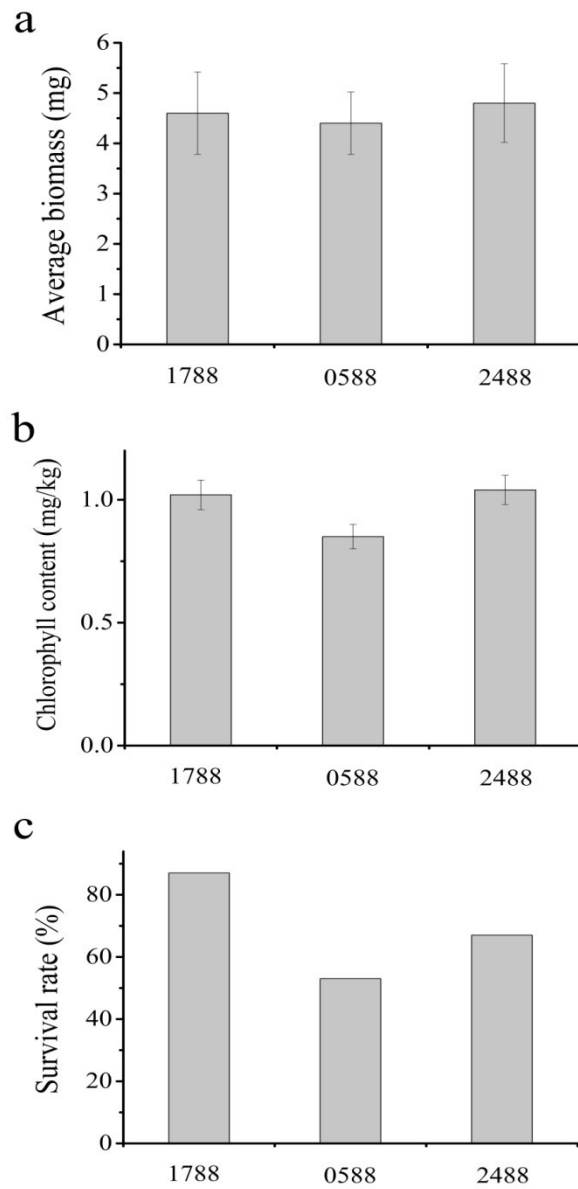
**Fig. S1** K nutrient loss rate of sandy soil samples added with PVA with different degree of hydrolysis and PAM.

## **2. Plant Growth Condition in Sandy Soil added with PVA with different degree of Polymerization**

Fig. S2 showed the optical photos of *Arabidopsis thaliana* planted in sandy soil added with PVA 0588, 1788 and 2488 (the degree of hydrolysis are all 88% and the polymerization degree are 500, 1700 and 2400, respectively). It is observed that there was no significant difference between the growth conditions of plants in sandy soil added with the three kind of PVA. The results of the average biomass, chlorophyll content and survival rate of the plants confirmed these observations (Fig. S3). The average biomass and chlorophyll content of *Arabidopsis thaliana* grown in sandy soil added with PVA 2488 were both almost the same as that with PVA 1788, but the chlorophyll content of plants with PVA 0588 was significantly worse than that with 1788. The survival rate of the plants with 0588 (53%) and 2488 (67%) were worse than that with 1788 (87%), either. Therefore, taking the survival rate, average biomass and chlorophyll content into account, 1700 polymerization degree was the best.



**Fig. S2** Optical images of *Arabidopsis thaliana* grown in sandy soil samples added with (a) 1788 (b) 0588 (c) 2488.



**Fig. S3** (a) The average biomass (b) chlorophyll content and (c) survival rate of *Arabidopsis thaliana* grown in sandy soil samples added with PVA 1788, 0588 and 2488.