Salak (*Salacca zalacca* (Gaertner.) Voss.) – The Snakefruit from Indonesia
Preliminary Results of an Ecophysiological Study

R. Lestari and *G. Ebert*
Fachgebiet Obstbau, Landwirtschaftlich-Gärtnerische Fakultät,
Humboldt–Universität zu Berlin

INTRODUCTION

The genus of *Salacca*, which is known as SALAK or SNAKE FRUIT, is found naturally in Indonesia and other South East Asian countries. In Indonesia, salak is widely cultivated in the lowlands throughout the islands. There are many SALAK cultivars, each of those has its particular taste and fruit characteristics. An important cultivar for the Indonesian market and very prospective for export is PONDOH. Currently, there is an increasing interest in investigating SALAK production techniques and postharvest properties in Indonesia. However, very limited studies on the ecophysiological aspects have been done so far. The objectives of this study are to investigate the effect of water stress on net CO_2 assimilation rate (P_n), stomatal resistance (R_s), growth and leaf water potential (Ψ_l) of salak seedlings at different environmental conditions in the greenhouse and in growth chambers.

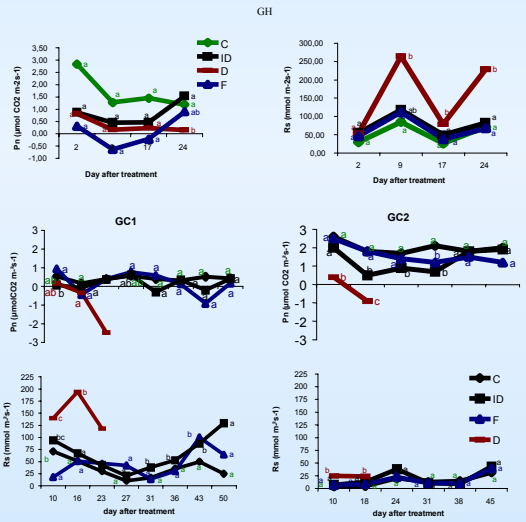
Table 1. Environmental conditions during the measurement in the greenhouse and in the growth chambers

Location	Air Temperature (°C)	Leaf Temperature (°C)	PAR* * (µmol $m^{-2}s^{-1}$)	Relative Humidity (%)	CO_2 concentration (ppm)
Greenhouse (GH)	25 – 43	23 - 47	144 - 2058	13 - 70	258 - 383
Growth Chamber 1 (GC1)	24 - 32	24 - 34	43 - 98	28 - 70	260 - 319
Growth Chamber 2 (GC2)	21 - 26	22 – 27	136 - 253	28 - 70	317 - 441

** PAR = Photosynthetic Active Radiation

RESULTS

Fig.1. Net CO_2 assimilation rate (P_n) and stomatal resistance (R_s) of salak seedlings at different water stress conditions (Control (C), Flooded (F), Intermediate Drought (ID) and Drought (D)) in GH, GC1 and GC2



Net CO_2 assimilation rate and stomatal resistance of seedlings in the greenhouse and growth chambers

P_n of salak seedlings in GC1 was very low due to the low light intensity in this chamber. The other environmental factors, i.e. high temperature and low air humidity resulted in a stomatal closure, which caused the decrease of P_n. No differences were found between C and P_n of other stressed plants except F and ID in the middle of study in GC2, D in GC2 and D at day 24 in GH (Fig. 1.). D plants wilted and died after 3 weeks in GC1 and after 2 weeks in GC2 indicating the high susceptibility of plants to drought. R_s of all plants in GC2 was relatively constant at a low level, i.e. under 45 mmol $m^{-2}s^{-1}$, and it was lower as compared to R_s of plants in GC1 and GH. Only R_s of D plants was significantly different compared to R_s of the treatments in GH and GC. R_s of ID in the middle of study and F at day 43 were also significantly different compared to C in GC1, but no difference was found at the end of the study.

Plant growth and Leaf water potential (Ψ_l) at different plant growth chambers

The shoot dry weight of D significantly differed from the other treatments (C, F and ID), but there was no significant difference in root dry weight among all treatments in GC1. Shoot length and leaf area of D were significantly lower compared to other treatments (C, F and ID). No significant differences were found of leaf growth for all watering treatment plants growing in GC2 and only shoot growth of D was significantly different compared to those of C and F.

In GC1 and GC2, Ψ_l of F was higher compared to Ψ_l of C at week 6, while Ψ_l of ID was lower compared to Ψ_l of C. Compared to seedlings growing in GC1 (C, F and ID), Ψ_l of plants with same treatment growing in GC2 were much lower. ID of GC2 decreased almost three times compared to C, while ID in GC1 decreased only about half times to C.

MATERIALS AND METHODS

Salak seeds cultivar *Pondoh* were germinated in sand flats in a greenhouse at Berlin-Dahlem. After 1.5 months seedlings with 2 leaves (about 25 cm long) were transferred to single pots (16 x 12 cm), which were filled with compost: sand = 2:1. The water stress treatments applied to the plants were: (1) Control plants (C), sufficient water supply daily; (2) Flooding the plants (F) during the entire measuring period; (3) Intermediate drought (ID), watering only once in a week and (4) Drought (D), watering only in the 2nd week of the study in the greenhouse or without water supply during the period respectively in the growth chambers.

The data of P_n and R_s were measured using a portable photosynthesis system (CI-301PS, CID Inc., USA) in the greenhouse (GH) and in the chambers (GC). For the experiments in the growth chambers (GC1 and GC2), conditions of twelve hours photoperiod were arranged, relative humidity was uncontrolled in GC1 and controlled at 70% in GC2. Shoot length and leaf area were recorded before and after the experiment with a ruler and leaf area meter. Dry weight of shoots and roots were determined only for the experiment at GC1. The leaf water potential of 2 –3 fully developed leaves per plant and 2 plants were measured using the scholander bomb at week 6. Except D treatment plants were measured only at week 2 in GC2 and at week 3 for plants in GC1 namely at wilting conditions.

Female Flower

Salak Plant

Salak in Bunches

Male Flower

Salak Fruit

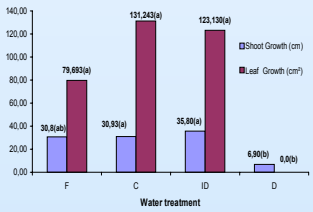


Fig. 2. Shoot and leaf growth of salak seedlings under different water stress conditions (C, F, ID and D) during 7 weeks in GC1

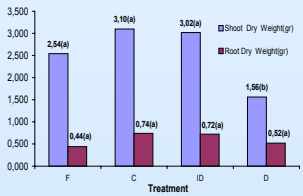


Fig.3. Shoot and root dry weight of salak seedlings under different water stress conditions (C, F, ID and D) in GC1

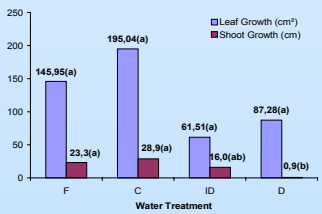


Fig. 4. Shoot and leaf growth of salak seedlings under different water stress condition (C, F, ID and D) during 6 weeks in GC2

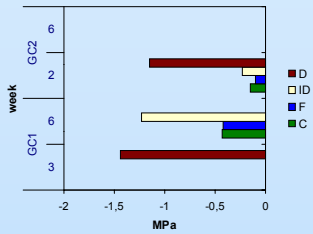


Fig. 5. Leaf water potential of salak seedlings under different water stress conditions (C, F, ID and D) in GC1 and GC2

CONCLUSION

We found out that, salak belongs to a group of drought susceptible and flood-tolerant species. The experimental plants wilted within 2-3 weeks of drought, but could stand until 7 weeks flooding conditions. No differences in P_n, R_s and plant growth were found among control, intermediate drought and flooded plants at the end of the study. The stressed plants showed some adaptation abilities to water logging stress, such as a decrease in leaf size and the formation of new roots.