Space Rice Seeds Experiment – Present and Future

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Research Background

- Rice (*Oryza sativa* L.) has been used for half of the world's population as the main Asian food
- Rice is an important crop in Malaysia covering about 600,000 ha with an average yield of 3.0 to 5.2 t/ha

Main paddy producing granary areas:

1. **Muda Agricultural Development Authority (MADA);**
2. **Kemubu Agricultural Development Authority (KADA);**
3. **Kerian-Sungai Manik Integrated Agriculture Development Area;**
4. **Barat Laut Selangor Integrated Agriculture Development Area;**
5. **Seberang Perak Integrated Agriculture Development Area;**
6. **Penang Integrated Agriculture Development Area;**
7. **North Terengganu Integrated Agriculture Development (KETARA)**
8. **Integrated Agriculture Development Kemasin Semerak**

Source: Food and Agriculture Organization (FOA)

- Currently, rice production is under the threat of climate change - extreme weather: El Niño

Minister of Agriculture and Agro-based Industry said that while the figures would only be known once the paddy was harvested, it is expected that production will be affected by at least ***5%*** *(New Straits Times Online, 8 April 2016).*

≈ RM 99 million ≈ USD 25 million
≈ 1.65 million capita consumption / year

- Development of seeds have higher yielding, more nutritious, and drought and climate resilient are most challenges for scientists and agronomists
- Three different types of seeds exist:
  i. *Open pollinated seeds* - produced from natural, random pollination
  ii. *Hybrid seeds* - cross-breeding two parent plants that have desirable traits
  iii. *Genetically modified seeds* - one or two genes with the desired traits from *any* living organism are transferred directly into the plant's genome (Renee Cho, 2013)

Space seeds:

- Aerospace provides a special environment with strong cosmic radiation, microgravity, weak geomagnetic field and super vacuum, etc., which might affect plant growth and development as well as induce genetic changes of crop seeds (Liu et al., 2008)
- Space-related researches concerning with the effects of microgravity conditions on plant growth in space already have been carried out by many scientists around the world (Correll et al., 2013; Inglis, 2014; Nasir et al., 2014; Paul et al., 2013., Ruyters and Braun, 2014)
- However, these experiments in real microgravity in space are rare, expensive and limited by time, similar experiments can be conducted on the ground by using microgravity simulator (Herranz et al. 2013)

- Various kinds of ground-based facilities and equipment have been developed to simulate condition of microgravity:

  i. Drop tower
  ii. Parabolic flight
  iii. Random positioning machine
  iv. Clinostat

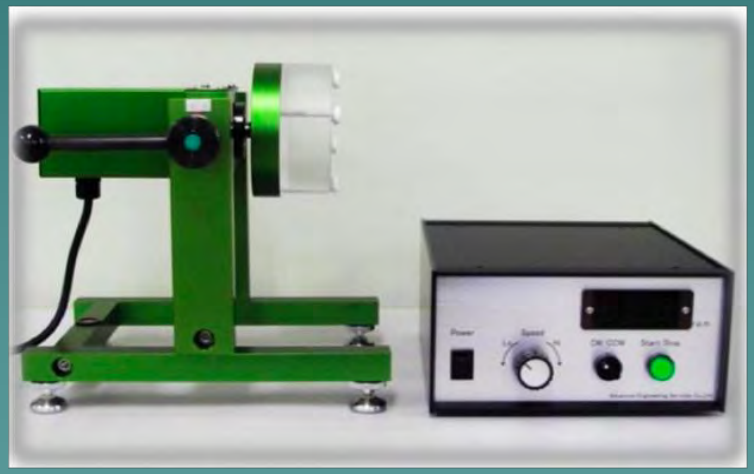
Present experiment

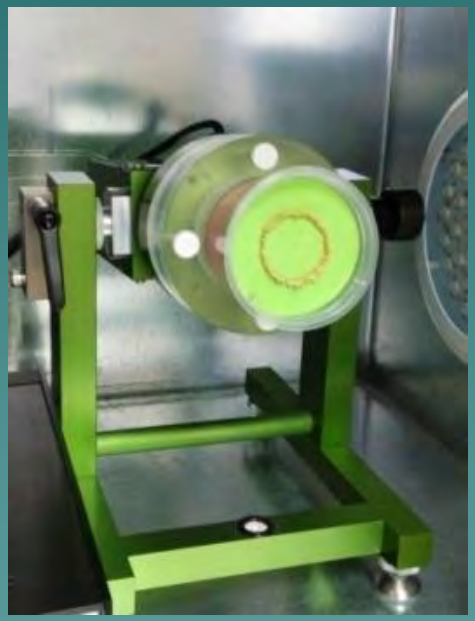
Study the Effects of Microgravity Simulation on Selected Malaysian Rice Seed

Objectives:

1. To study the effects of one - dimensional (1D) clinorotation on MR 219 rice seed
2. To analyse growth performances of the clinorotated rice seed

i. Clinorotation of rice seed sample: 2 RPM for 10 days





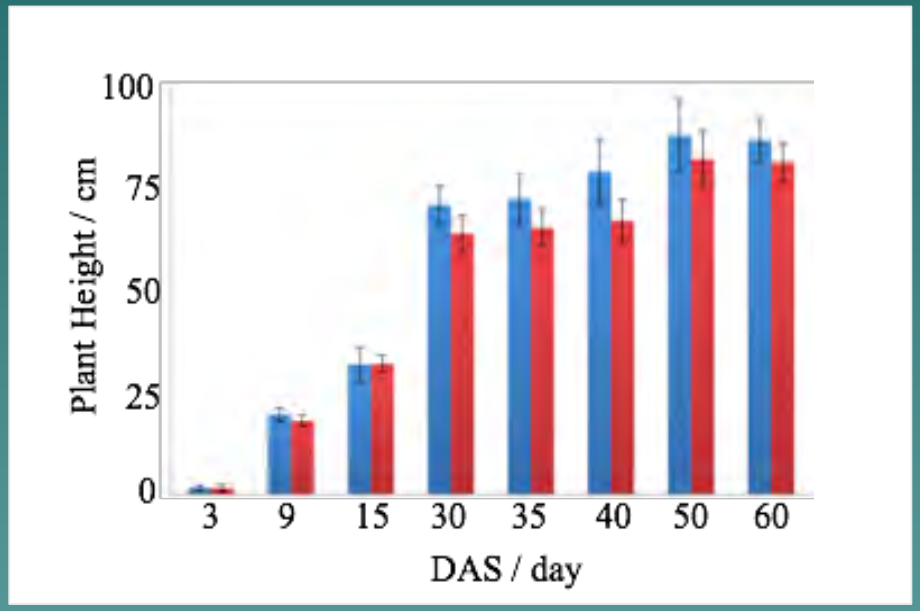
ii. Plant growth performances analysis

- Plant height
- Leaf width
- Chlorophyll content – SPAD value

SPAD value measurement

Result:

a) Height

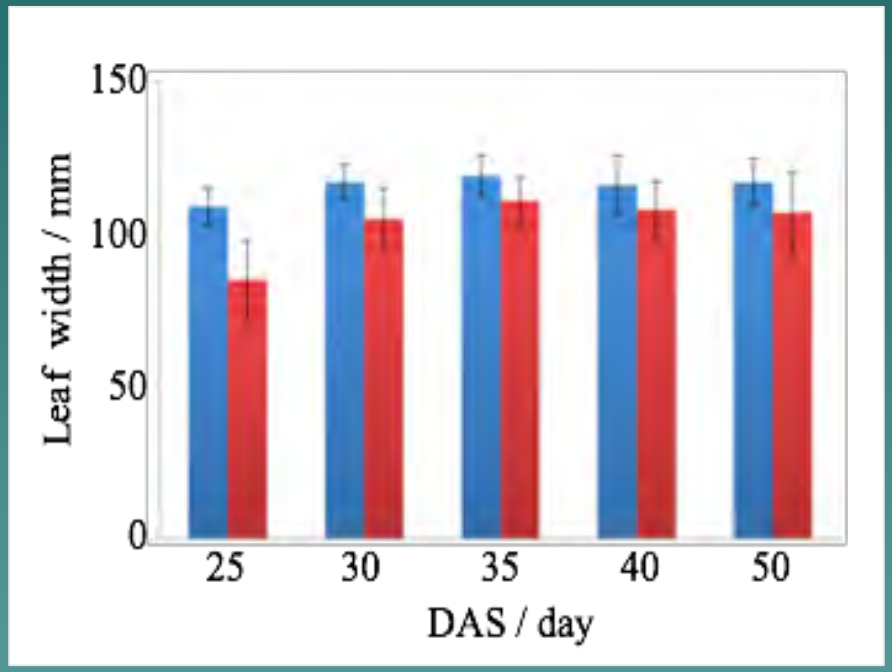


Clinorotated

Control

No difference was found in height of clinorotated and control during seedling state (15th DAS) but it increased on 30th DAS until 60 DAS

b) Width

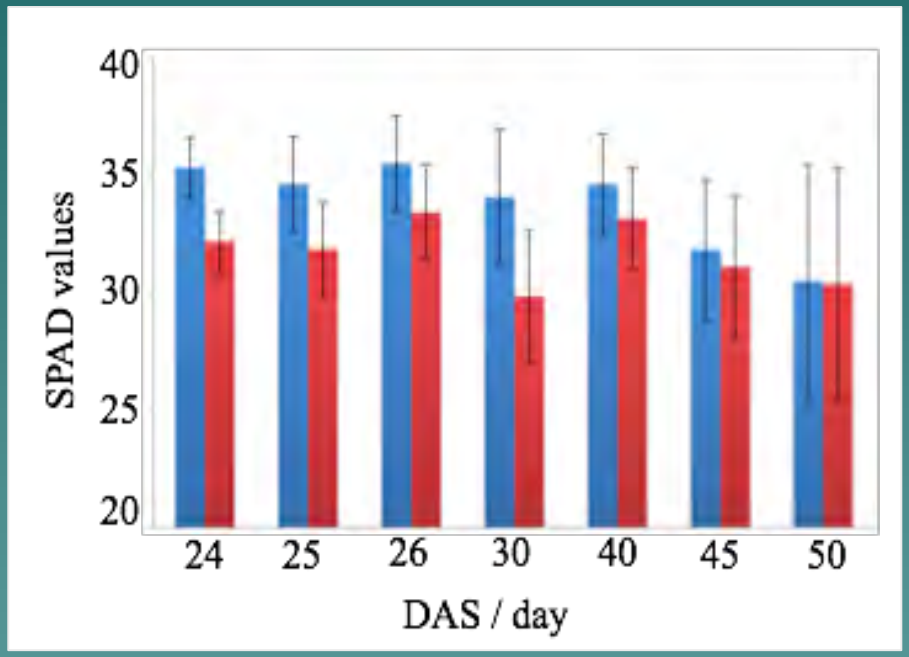


Clinorotated

Control

Leaves of clinorotated are wider than control

c) Chlorophyll content – SPAD value



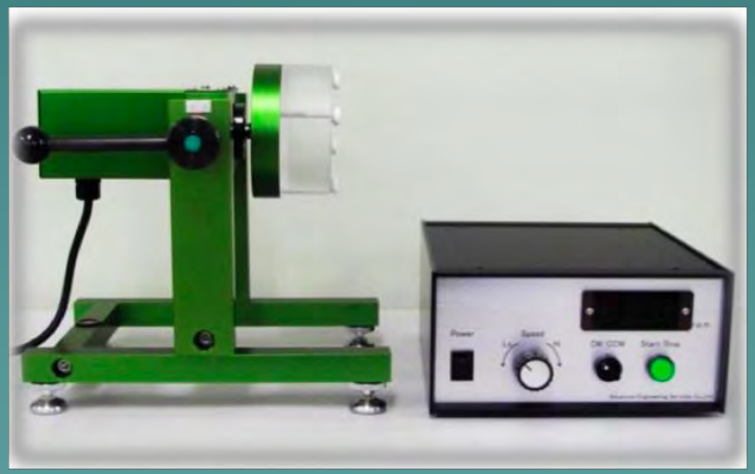
Clinorotated

Control

SPAD value higher in clinorotated than controls (24th-40th DAS) but no significant difference on 50th DAS.

Present experiment 2

i. Clinorotation of rice seed sample: 10 RPM for 10 days



ii. Seedling analysis: Height

21 Mach 2016

After 10 days (30 Mach 2016)

No.	Clinorotated (cm)	Control (cm)
1	8.3	4.5
2	10.3	6.5
3	8.1	4.5
4	5.0	4.5
5	10.5	5.0
6	2.9	4.7
7	9.6	2.9
8	7.0	4.4
9	13.3	6.3
10	5.7	3.9
11	9.0	5.9
12	8.8	4.9
13	5.3	4.9
14	9.0	5.9
15	4.3	4.3
Average	7.8	4.9

Transplanting seedlings to a tray

After 15 days (15 April 2016)

Future experiment:

- To study the effects of microgravity exposure on selected Malaysia rice seed in space

EFFECTS OF MICROGRAVITY EXPOSURE ON MC11 CHILLI SEED

1. Effects of space microgravity on plant growth performances of MC11 chilli seed

i. A packet containing 100g of dry seeds were taken to and kept at the (ISS) from February until June 2011 – ***Space seed***

MC11 seeds in the International Space Station (ISS)

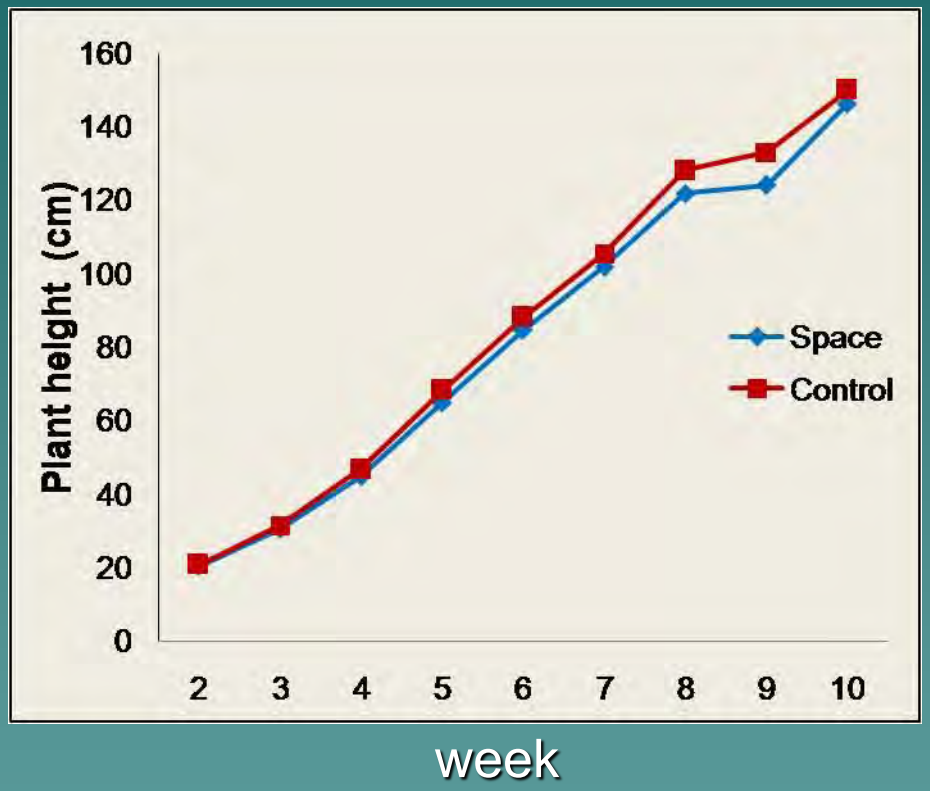
ii. Control seeds was kept at the Seed Quality Laboratory of Planting Material, Seed and Livestock Breed Production Unit in MARDI Headquarters, Serdang, Selangor at 5^0C

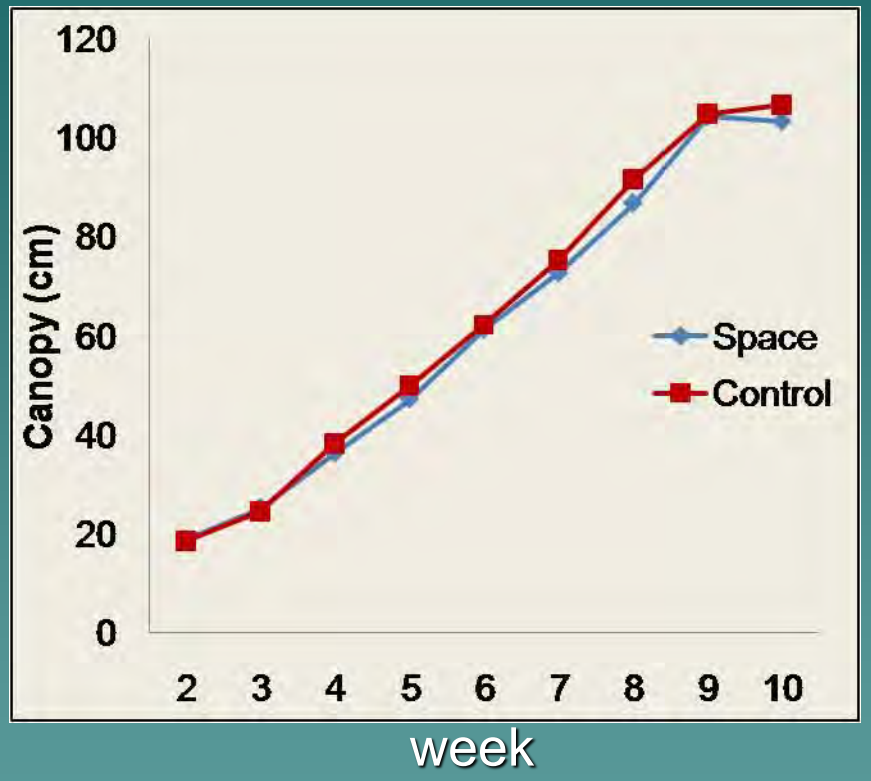
iii. Space seeds were quarantined at the Post Entry Quarantine Unit (PEQ), at Department of Agriculture (DOA), Serdang, Selangor from July until December 2011

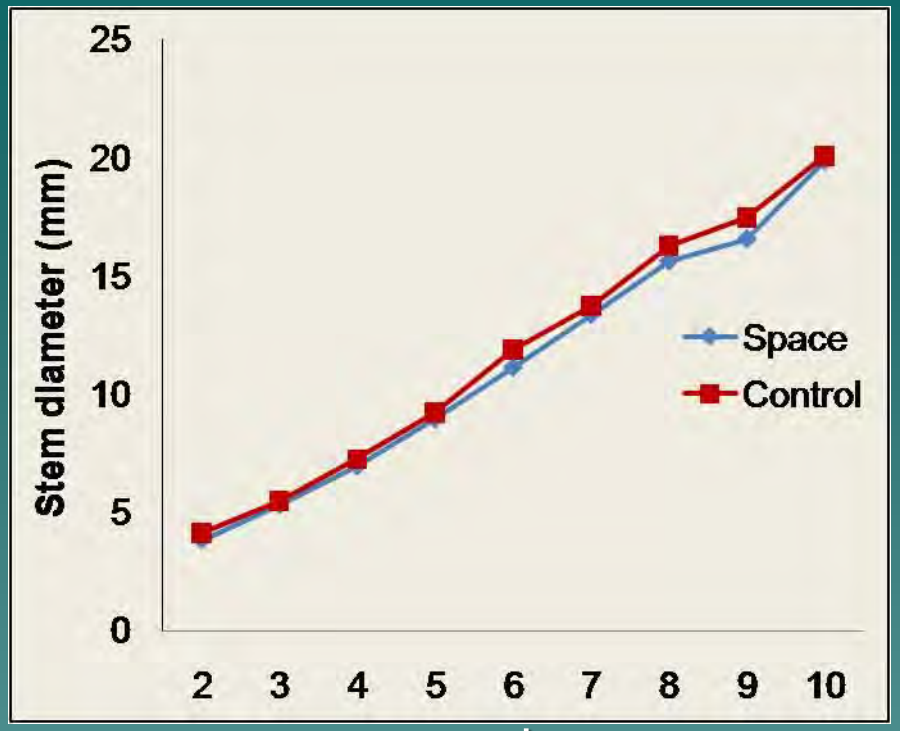
iv. Plant growth performance analysis

- Plants were grown using the fertigation system in a rain-shelter with netted surround
- Plant height and canopy, and stem diameter were recorded weekly

Results:


Plant height (cm)
160
140
120
100
80
60
40
20
0
2
3
4
5
6
7
8
9
10
Space
Control
week


Canopy (cm)
120
100
80
60
40
20
0
2
3
4
5
6
7
8
9
10
Space
Control
week



- Plant growth pattern during a 10-week growth period was very similar in space and control plants
- Plant height, canopy and stem diameter were not much different

Conclusion

- Exposing the MR 219 rice seeds to simulated microgravity produced different plant growth performances (i.e. plant height, leaf width and chlorophyll content)
- Further space experiment need to be carried out for evaluating the result of effects of microgravity simulation on selected Malaysian rice seed

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THANK YOU