Investigating clover growth in different environments

GLOBE students

Borg Zaac, Calleja Neil, Falzon Martina, Farrugia Anamika, Grech Rhea Marie, Hili Jacob, Le Prevost Dean, Micallef Adam, Mifsud Hailey, Mifsud Thewma Jade, Pace Maegan, Quinto Benjamin, Quinto Samuel, Refalo Amea-Jo, Xerri Kate

GLOBE teachers

Ms Janice Cini & Ms Sandra Parnis

Gozo College Peter Paul Grech Kercem Primary School

Malta

25th February 2025

Summary

Gozo College Kercem Primary School joined the GLOBE Program in October 2024 through the GLOBE Bloom and Buzz Project. This project highlights the crucial role of bees as pollinators. As part of the initiative, participating schools received 10 flowering plants and shrubs to create pollinator-friendly habitats. While transforming their school garden into a pollinator haven, students at Kercem Primary decided to expand their efforts by planting additional species, including clover. To investigate the ideal conditions for seed germination, students identified three different sites: a sunny location in the school garden, a shaded area under a carob tree, and an indoor container. Following GLOBE protocols we monitored germination and collected data throughout the study. This hands-on investigation provided students with valuable insights into the environmental conditions necessary for successful seed germination. Moreover, their participation in the GLOBE Bloom and Buzz Project enhanced their awareness of the vital role of bees as pollinators in sustaining biodiversity.

Keywords: seed germination, plant growth factors, hands-on learning

Reserach Question

Gozo College Kercem Primary School, located on Gozo, the sister island of Malta (see Figure 1) joined the GLOBE Program in October 2024 through the GLOBE Bloom and Buzz Project, a national citizen science initiative coordinated by GLOBE Malta in collaboration with Europe Direct Gozo. This project emphasises the role of pollinators, particularly bees, in maintaining healthy ecosystems. As part of the initiative, all participating schools received 10 flowering plants and shrubs to establish pollinator-friendly gardens. While setting up our pollinator garden we decided to add more plants, including clover.

Figure 1 The Maltese Islands

As we engaged in this process, we became curious and started asking many questions. We wanted to explore the factors influencing plant growth, particularly how environmental conditions affect seed germination. This led us to investigate the growth of clover seeds and came up with the following research question:

- Under which conditions do clover seeds grow best?

We formulated the hypothesis that clover seeds will grow faster outside in the sun. To test our hypothesis, we identified three different sites for sowing the clover seeds:

- Site 1 - in the soil, in a sunny spot in the school garden,
- Site 2 - in a container in a south-facing corridor inside the school, and
- Site 3 - in a container in a shaded area underneath a carob tree.

These locations (see Figure 2) were carefully selected to compare the effects of different environmental conditions on germination and growth. The aim was to examine how light, temperature and various environmental factors influence the growth of clover, providing insights into the impact of different growing conditions. Moreover, the study aimed to determine which environmental conditions were most suitable for seed sprouting and plant growth, addressing our research question.

Figure 2 Location of Study Sites

Research Methods

The clover seeds were sown on the same day and using GLOBE protocols, we monitored, observed, and recorded seed germination and growth rates.

Materials used

- Clover Seeds
- 2 greenhouse containers
- Potting and garden soil
- Infrared Thermometer
- Ruler
- Datasheets
- Clipboard and pen

Procedure

We began by preparing the containers and a small garden bed for planting. The containers were filled with potting soil, while the garden bed was carefully prepared by loosening the soil to create a suitable environment for seed germination. Next, we sprinkled a small number of clover seeds on the soil surface, spacing them approximately 1–2 inches apart in the containers and arranging them in rows in the garden bed. Finally, we watered the seeds, ensuring the soil remained moist but not overly saturated, providing optimal conditions for growth.

Data Collection

Over the course of several days going into the weeks, we observed, measured and recorded the sprouting and growth of new leaves / plants in each of the 3 sites (Figures 3, 4 and 5). Following GLOBE Protocols, we measured the air temperature (Atmosphere Protocol) and soil surface temperature (Pedosphere Protocol) of each site. Readings were always taken withtin the same timeframe, between noon and 12.15pm from the 19th November till the 19th of December 2024. Moreover, we recorded sprouting and measured plant growth and height (Biosphere Protocol) using a ruler. Leaf colour was also recorded for the three different environments. All data collected was recorded on the datasheet (see Appendix).

Figure 3 Data collection from study site 1 – School Garden

Figure 4 Data collection from study site 2 – South Facing Corridor (inside)

Figure 5 Data collection from study site 3 – Underneath Carob Tree

Results

The screenshots below show data uploaded on the GLOBE website during the observation period between November and December 2024 (Figures 6, 7, 8, 9, 10 and 11). We collected daily readings of air temperature and soil surface temperature following GLOBE Protocols guide.

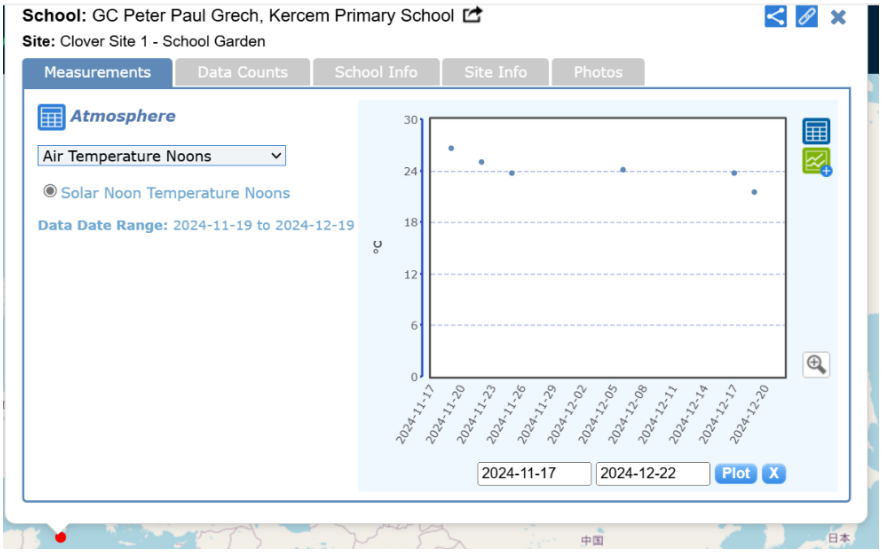

Figure 6 Air Temperature (Site 1) plot of VIZ GLOBE

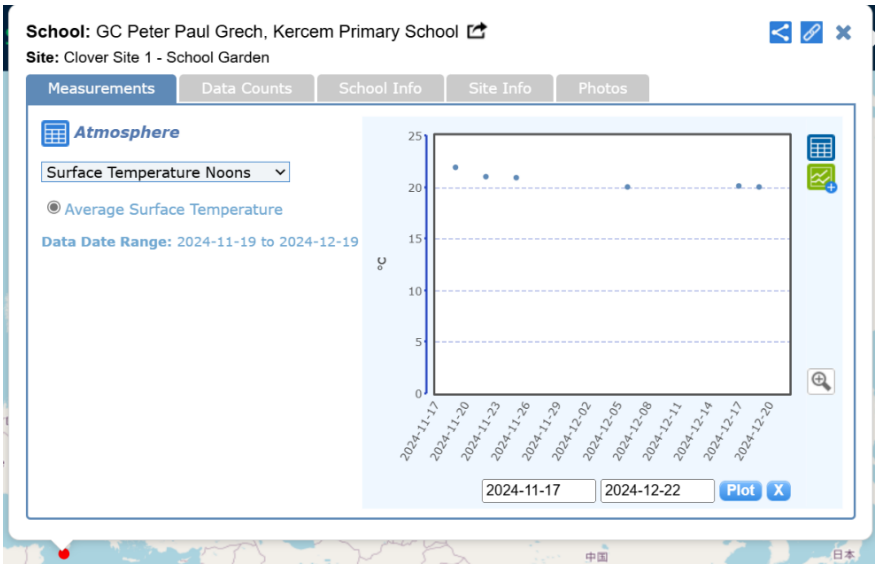

Figure 7 Surface Temperature (Site 1) plot of VIZ GLOBE

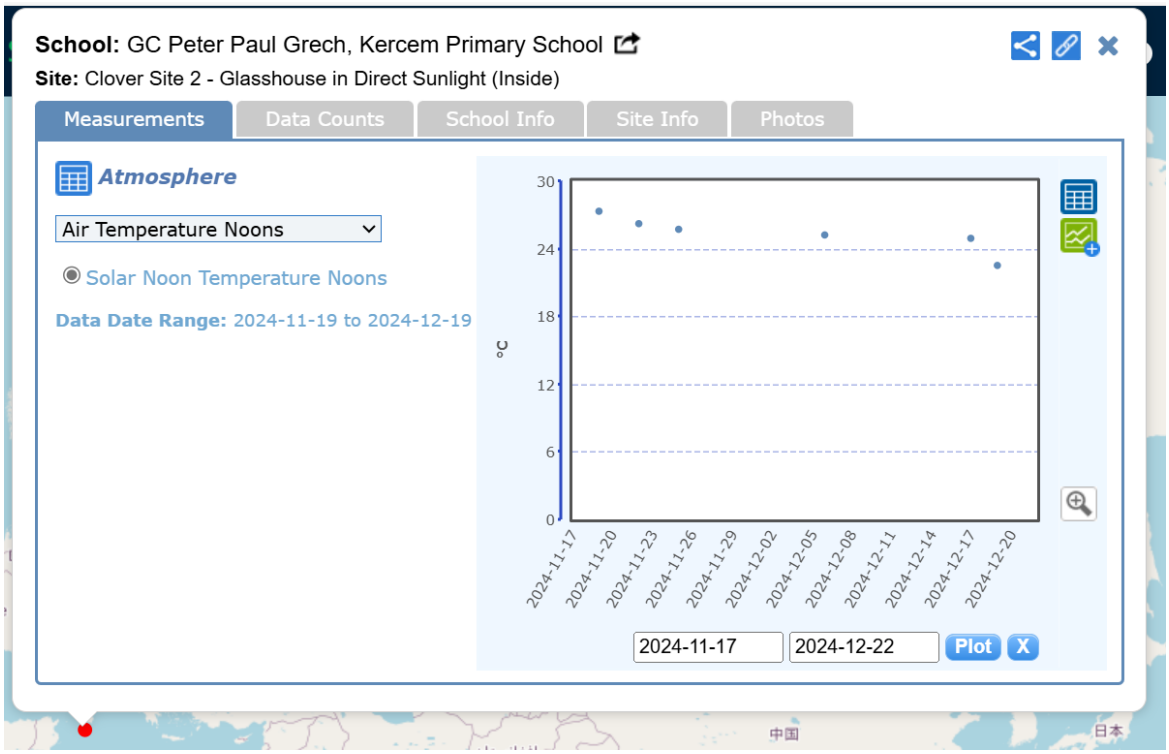

Figure 8 Air Temperature (Site 2) plot of VIZ GLOBE

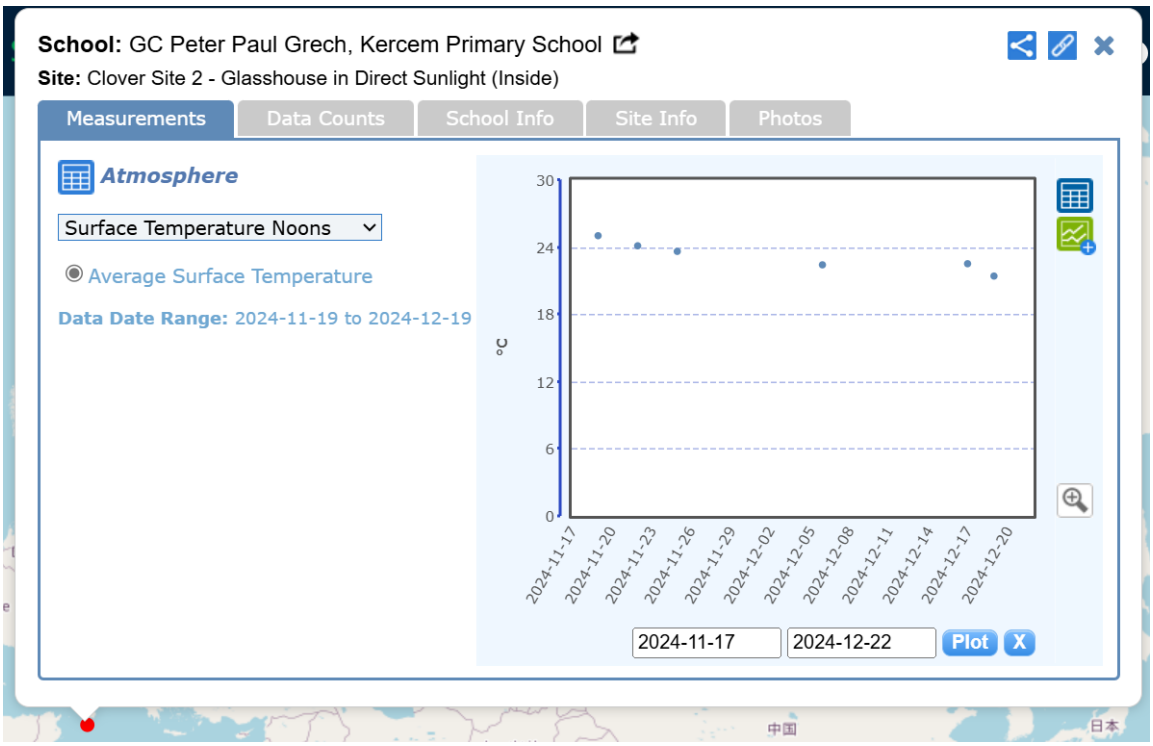

Figure 9 Surface Temperature (Site 2) plot of VIZ GLOBE

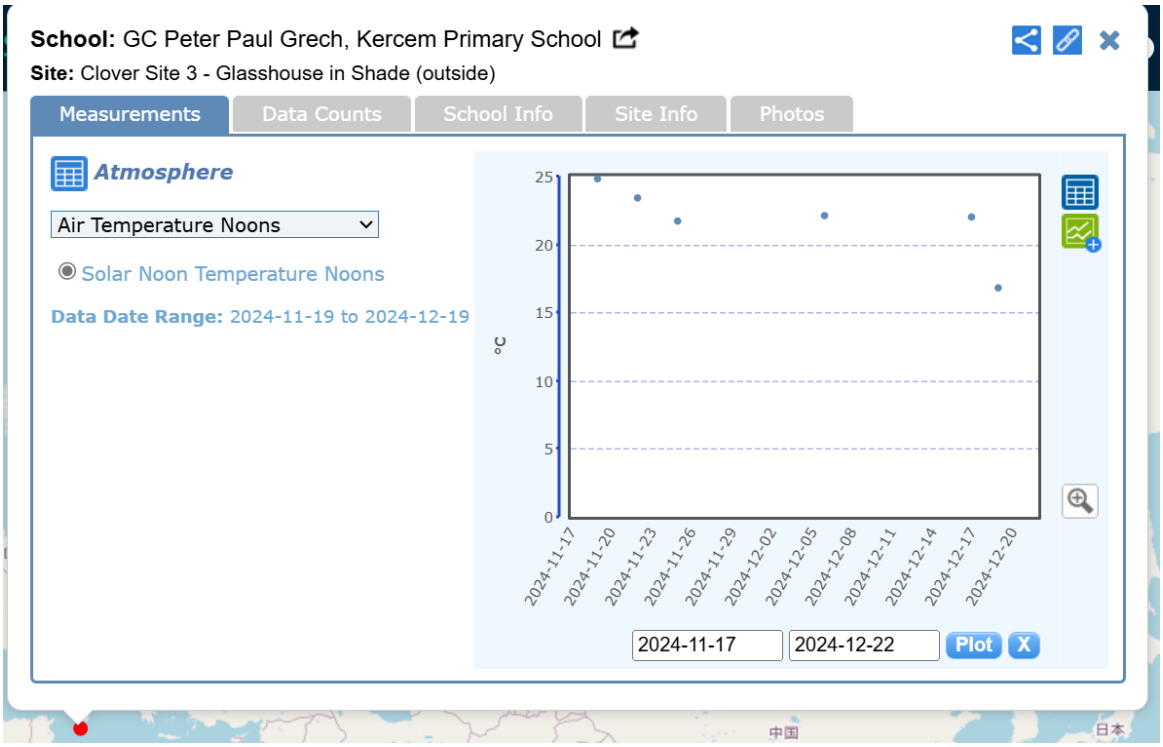

Figure 10 Air Temperature (Site 3) plot of VIZ GLOBE

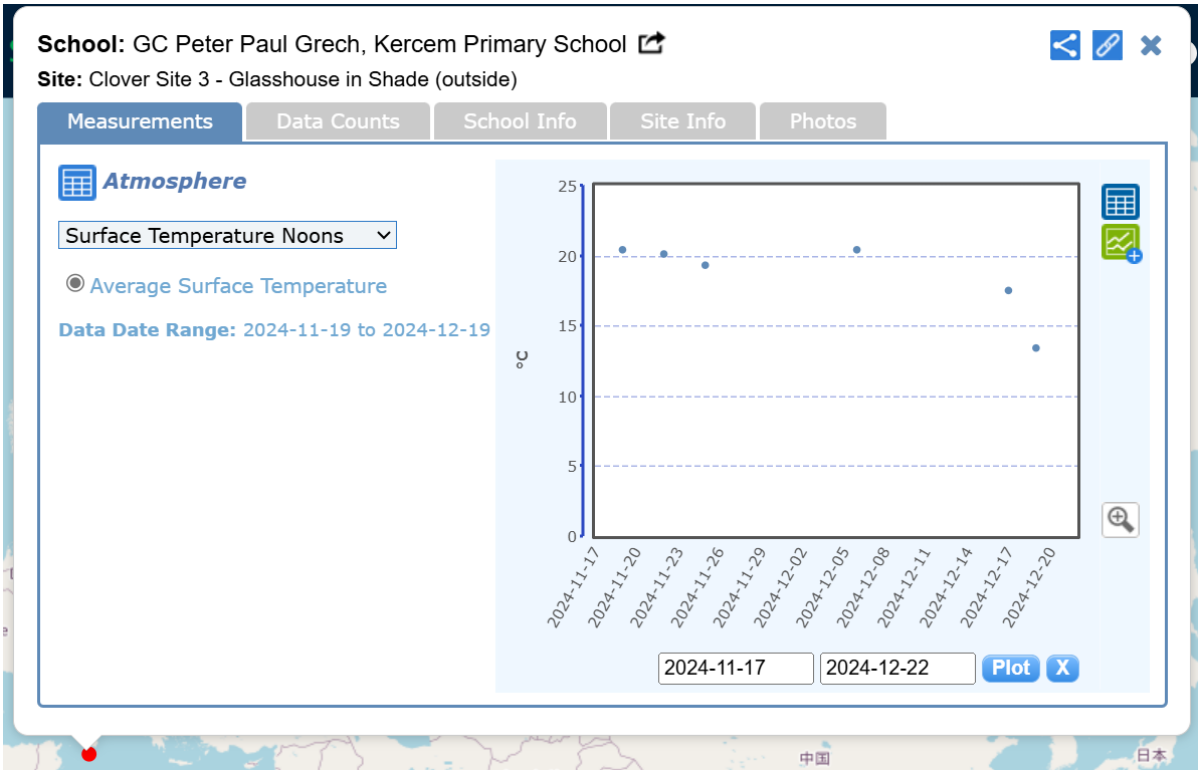

Figure 11 Surface Temperature (Site 3) plot of VIZ GLOBE

Conclusion

This investigation provided valuable insights into the ideal conditions for clover seed germination and plant growth. Our initial hypothesis, which predicted that clover seeds would grow faster in an outdoor sunny location, was ultimately rejected. Instead, the data collected and observations made throughout the study indicated that the indoor greenhouse proved to be the most suitable environment for seed germination. The controlled conditions of temperature, moisture, and sunlight facilitated rapid and successful sprouting, resulting in healthy young plants.

However, an interesting observation emerged as the plants continued to grow. Once the seedlings in the indoor greenhouse reached a height of approximately 7.5 cm, their growth stopped. This suggested that while the greenhouse provided ideal conditions for germination, it lacked other essential factors needed for sustained growth, such as adequate space, soil nutrients, and root expansion. In contrast, the plants in the outdoor garden, particularly those in Site 1, continued to grow beyond this stage, as they had access to better soil nutrients, water, and space for root development.

These findings emphasize the importance of considering both germination and long-term growth conditions when cultivating plants. While controlled environments like greenhouses can optimize early-stage development, outdoor settings may provide better conditions for continued growth and maturation.

Through this hands-on investigation, students not only gained a deeper understanding of seed germination and plant growth requirements but also developed critical scientific inquiry skills by testing their hypothesis, collecting data, and analyzing results. Additionally, this study reinforced the significance of pollinator-friendly habitats and sustainable gardening practices in supporting biodiversity.

Acknowledgement

This research would not have been possible without the support of Ms Ramona Mercieca, GLOBE Deputy Coordinator for Malta.

References

GLOBE Science Data Visualization https://vis.globe.gov/GLOBE/ (Accessed February 2025)

GLOBE teacher guide https://www.globe.gov/ (Accessed October 2024)

Badge Descriptions

I am a Data Scientist

GLOBE students carried out an investigation where they observed and recorded the sprouting and growth of clover seeds and plants. We did this study to investigate the ideal conditions for seed germination. Firstly students identified three different sites: a sunny location in the school garden, a shaded area under a carob tree, and an indoor container. Following GLOBE protocols they monitored germination and collected data throughout the study. This hands-on investigation provided students with valuable insights into the environmental conditions necessary for successful seed germination. All data used in this investigation was collected by the students and uploaded to the GLOBE database.

I make an Impact

Through the GLOBE Bloom and Buzz Project, we received 10 flowering plants and shrubs to create pollinator-friendly habitats. Our GLOBE students planted these plants and shrubs and are taking care of the plants. Simultaneously we are urging the wider community to plant more bee friendly plants, eliminate cutting down of wildflowers and together with the Local Council we are working on planting a Community Herb Garden. To further emphasize the importance of letting wild flowers bloom, we created posters to be turned into signs and hung along our village streets to show the importance of wildlife conservation.

I am a STEM storyteller

This investigation was presented by our GLOBE students during the Best of GLOBE Europe and Eurasia on 4th of February 2025. The students had the opportunity to share their findings and received feedback from NASA scientists and researchers. Their investigation was recognised as one of the best entries and received the Scientific Inquiry Award. Moreover, they also presented it during the morning assembly amongst our school community and shared it on our school Facebook page. Our story was also shared on the Ministry for Education website [Young Scientists from Gozo College Kercem Primary earn International Recognition – The Office of the Permanent Secetary]

School Name: Peter Paul Grech Primary School Xewkija Gozo Malta GLOBE students : Yr 5

Clover Seed/Plant	In Garden soil Site1	Glasshouse in Sunlight Site 2	Glasshouse in Shade Outside Site 3
Coordinates	36·040744 N, 14·228653 E	36·040832 N 14·228651 E	36·040843 N 14·228876 E
Date: 19/11/24 Day: Tuesday Observation:	Dry Seed Air temperature 26·6 °C Surface temperature 21·9 °C	Dry Seed Air Temperature 27·3 °C Surface Temperature 25 °C	Dry Seed Air Temperature 24·8 °C Surface Temperature 20·4 °C
Date: 22/11/24 Day: Friday Observation:	No difference Observed A.T. 25 °C S.T. 21 °C	20 seeds have sprouted + started to grow green leaves A.T 26·2 °C S.T. 24·1 °C	1 seed just sprouted A.T. 23·4 °C S.T. 20·1 °C
Date: 25/11/24 Day: Monday Observation:	Only 4 seeds just sprouted Green leaves spotted A.T. 23·7 °C S.T 20·9 °C	Nearly all seeds have become 3cm plants with bright green leaves. A.T. 25·7 °C S.T. 23·6 °C	Half of the seeds have become 1cm plants with light green leaves. A.T. 21·7 °C S.T 19·3 °C
Date: 6/12/24 Day: Friday Observation:	Several seeds have sprouted and 1st ones to sprout are 2cm. A.T. 24·1 °C S.T. 20 °C	Plants look strong and healthy and are all 4cm long A.T. 25·2 °C S.T 22·4 °C	A few more seeds sprouted and older ones are 2cm long. A.T. 22·1 °C S.T. 20·4 °C
Date: 17/12/24 Day: Tuesday Observation:	More plants are growing the longest being 5cm. A.T. 23·7 °C S.T. 20·1 °C	Plants are bright green and 6·5cm long. A.T. 24·9 °C S.T. 22·5 °C	Light green plants reached about 5·5cm. Look thin + weak. A.T. 22·0 °C S.T. 17 °C
Date: 19/12/24 Day: Thursday Observation:	Most of the seeds have grown into healthy 6cm plants. A.T. 21·5 °C S.T 20·0 °C	Plants are bright green and reached 7·5cm. A.T. 22·5 °C S.T. 21·4 °C	Plants have grown into 6cm pale coloured plants. A.T. 16·8 °C S.T 13·4 °C