



#### ABSTRACT:

Sweet basil (*Ocimum basilicum* L.) is a warm season herb usually propagated from seeds. Establishment of basil is difficult as seed germination may be limited, particularly during field seeding at cold soil temperature. The germination of six cultivars ('Italian Large Leaf', 'Italian Large Leaf' 35X, 'Nufar', 'Genovese', 'Genovese Compact Improved' and 'Aroma 2') of sweet basil seeds were tested over temperatures ranging from 0 to 50 °C using a one dimensional thermo-gradient table. Germination among cultivars was more variable at low temperatures (0- 20°C). At low temperatures the mean time to germination (MTG) increased to greater than 25 days for some cultivars. Germination declined sharply and had a sudden termination at high temperatures above 40°C for all six cultivars. There were statistical differences among the cultivar base temperatures for germination, with base temperatures ranging between 9.8 to 13.2°C. The optimal and ceiling temperatures for germination were similar and did not differ statistically among the cultivars compared in this study. The average optimal temperature for all cultivars was 35°C, while the average ceiling temperature was 43±1.3°C. Stored seeds (>5 years) had lower seed vigor and lower germination percentage, also lower ceiling temperature compared with the fresh seeds of same cultivar, but the base temperatures were same for both new and old seeds.

#### INTRODUCTION:



Sweet basil (*Ocimum basilicum* L.) is a frost sensitive low-growing herb that belongs to the family Lamiaceae (mint family). Basil is cultivated extensively in Mediterranean countries and in various regions with temperate and hot climates. In US, basil is mainly cultivated in AZ, CA, NM, FL and NC. It can be grown outdoors or in greenhouses.

Scientific studies in vitro have established that compounds in basil oil have potent antioxidant, anticancer, antiviral, and antimicrobial properties. It is used in traditional medicine in China, India and etc.

Fig 1. Basil plant

Basil propagates from seed, its production requires a stable and secure supply of high viability, vigorous seeds in order to success stands establishment as well as the production and quality. Seed germination testing is important to assess quality. Temperature is one of the most important factors controlling seed germination. The temperature responses of basil have not been widely studied. Seed germination is often analyzed on thermo-gradient tables so that germination can be tested across a wide range of temperatures simultaneously.



Fig 2. Basil product in VA

#### MATERIALS AND METHODS:

- Six sweet basil cultivars:
  1. 'Italian Large Leaf' ('ILL')
  2. 'Italian Large Leaf' 35X ('ILL' 35X): 5+ years old 'ILL'
  3. 'Nufar': disease resistant 'ILL' type
  4. 'Genovese': traditional Italian basil
  5. 'Genovese Compact Improved' ('GCI'): for containers and pack sales
  6. 'Aroma 2': a disease resistant 'Genovese' type
- 4×25 seeds of each cultivar at each temperature.
- Seeds were placed in 11×11×4 cm transparent covered plastic boxes (without feet), on top of two thicknesses of germination blotter paper, the blotters were saturated with 15 ml distilled water.
- Standard AOSA germination testing procedure, grow in dark in one dimensional thermo-gradient table (Elias et al., 2012).

Fig 3. A linear, thermo-gradient table with two circulating bathes connected through opposite ends of the table.

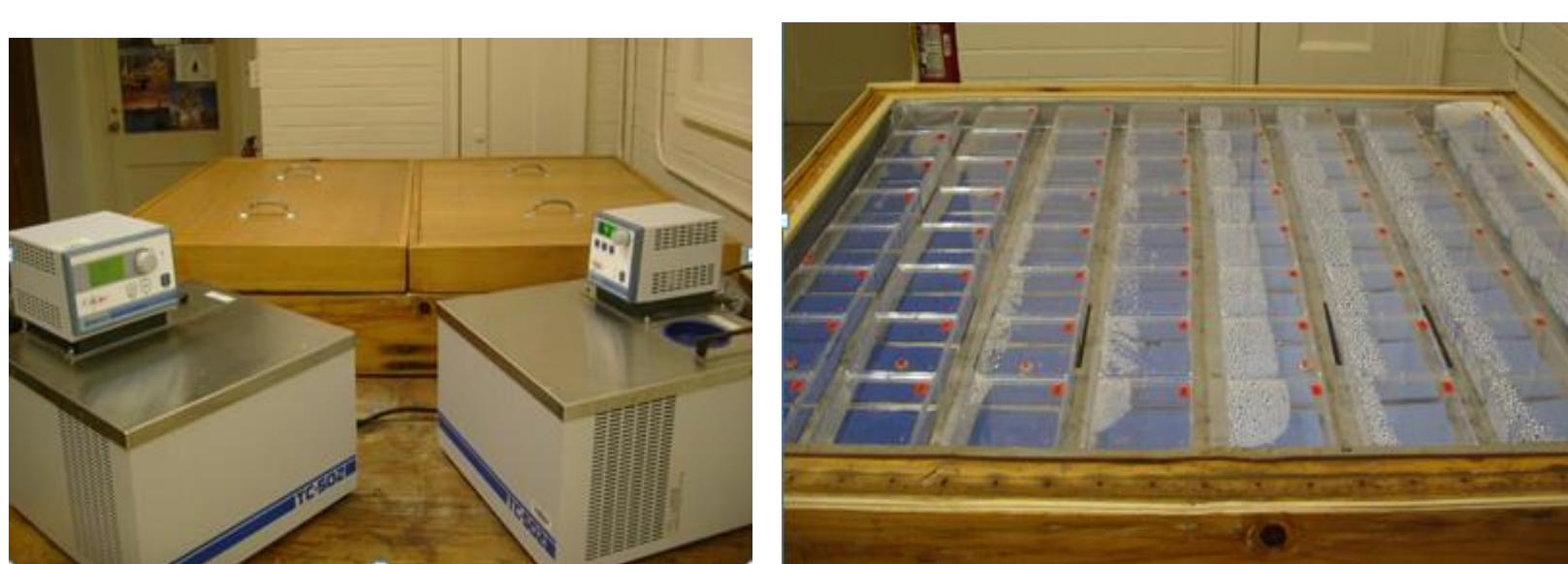


Fig 4. Temperature were measured using WatchDog® data loggers.



- Germination was scored as radical emergence of at least 1 mm at 24-hour intervals until no further germination had occurred for 3 days (Jett, Welbaum et al., 1996)
- Germination Data Analysis:
  - Germination percentages
  - MTG (mean time to germination):  $\sum(N_i T_i) / \sum(N_i)$  (Nelson and Paris, 1988), where  $N_i$  is the number of new germinated seeds at time  $T_i$  after imbibition calculated from four replications of 25 seeds each
  - GR (germination rate) = 1/ MTG

#### RESULTS:

Table 1. Base ( $T_b$ ), ceiling ( $T_m$ ) and optimal ( $T_o$ ) temperatures for germination of 6 sweet basil cultivars.

Cultivar	$T_b$ (°C)	$T_m$ (°C)	$T_o$ (°C)
'ILL'	11.9	43.6	35
'ILL' 35X	12.3	40.4	35
'Nufar'	9.8	44.1	35
'Genovese'	10.9	43.4	35
'GCI'	10.8	43.3	35
'Aroma 2'	13.2	43.3	35
Mean	**	43.0±1.3	35
		NS	NS

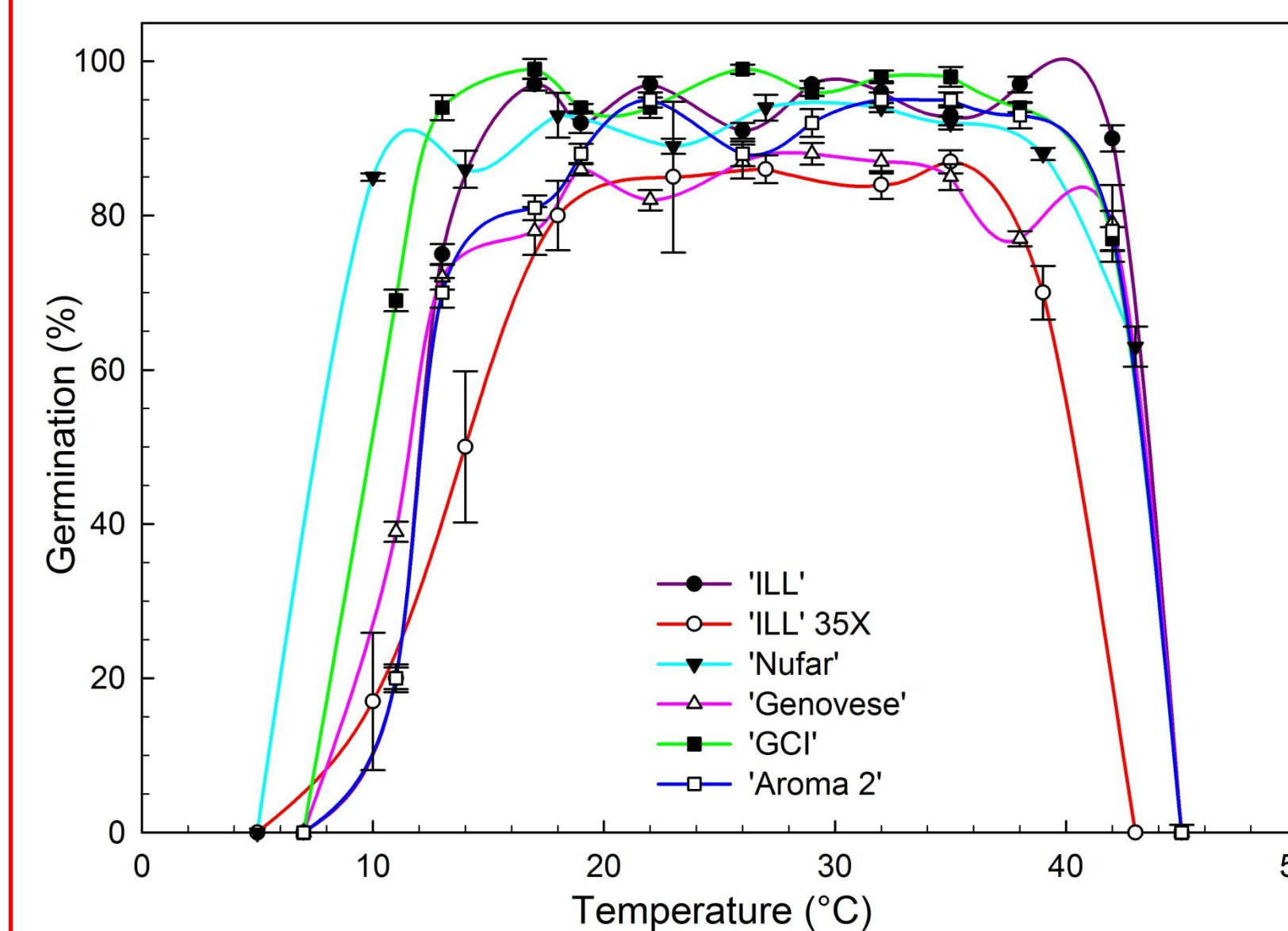


Fig 5. Germination percent of all 6 cultivars.

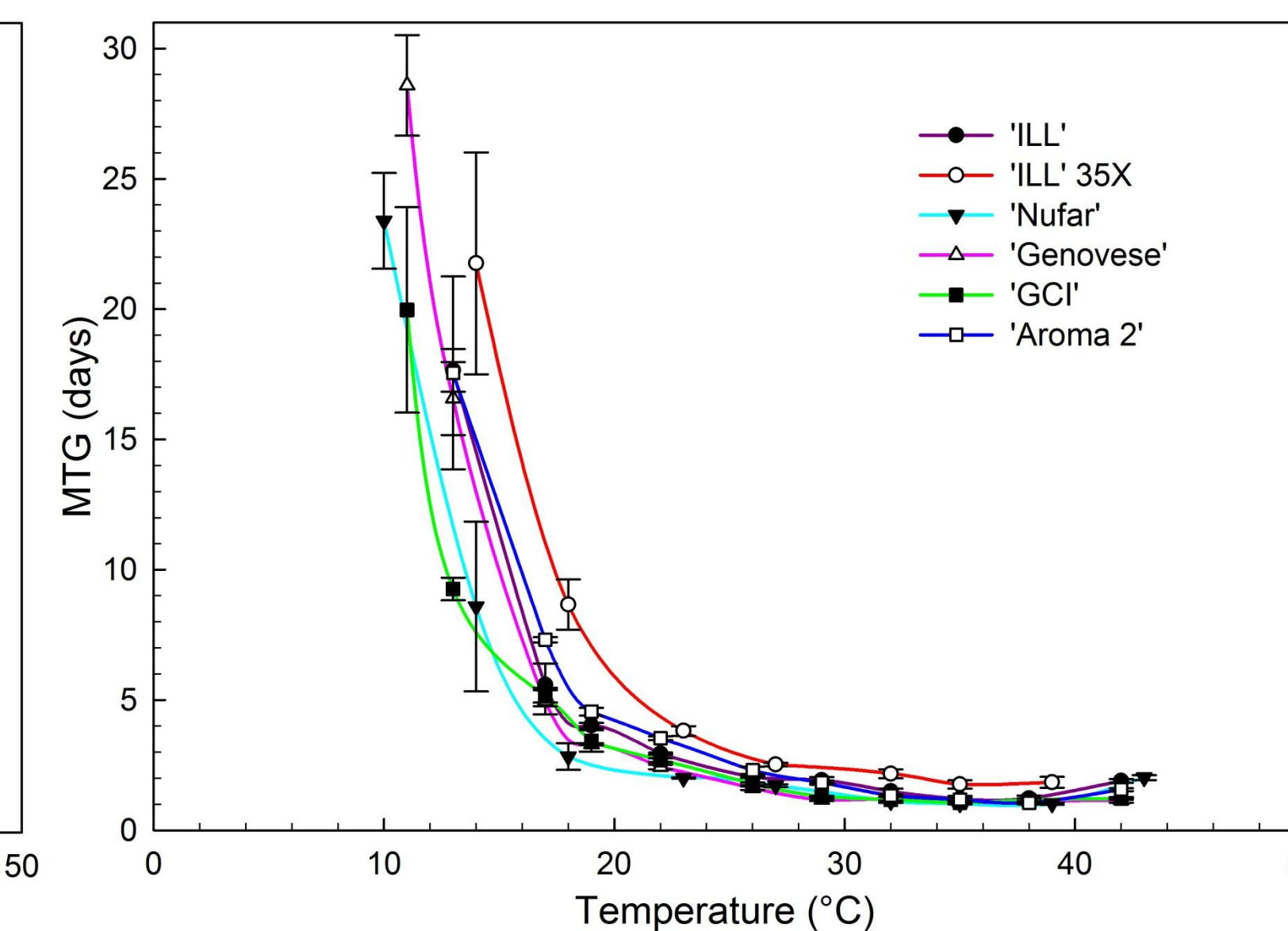


Fig 6. MTG (Mean time to germination) of all 6 cultivars:  $\sum(N_i T_i) / \sum(N_i)$ .

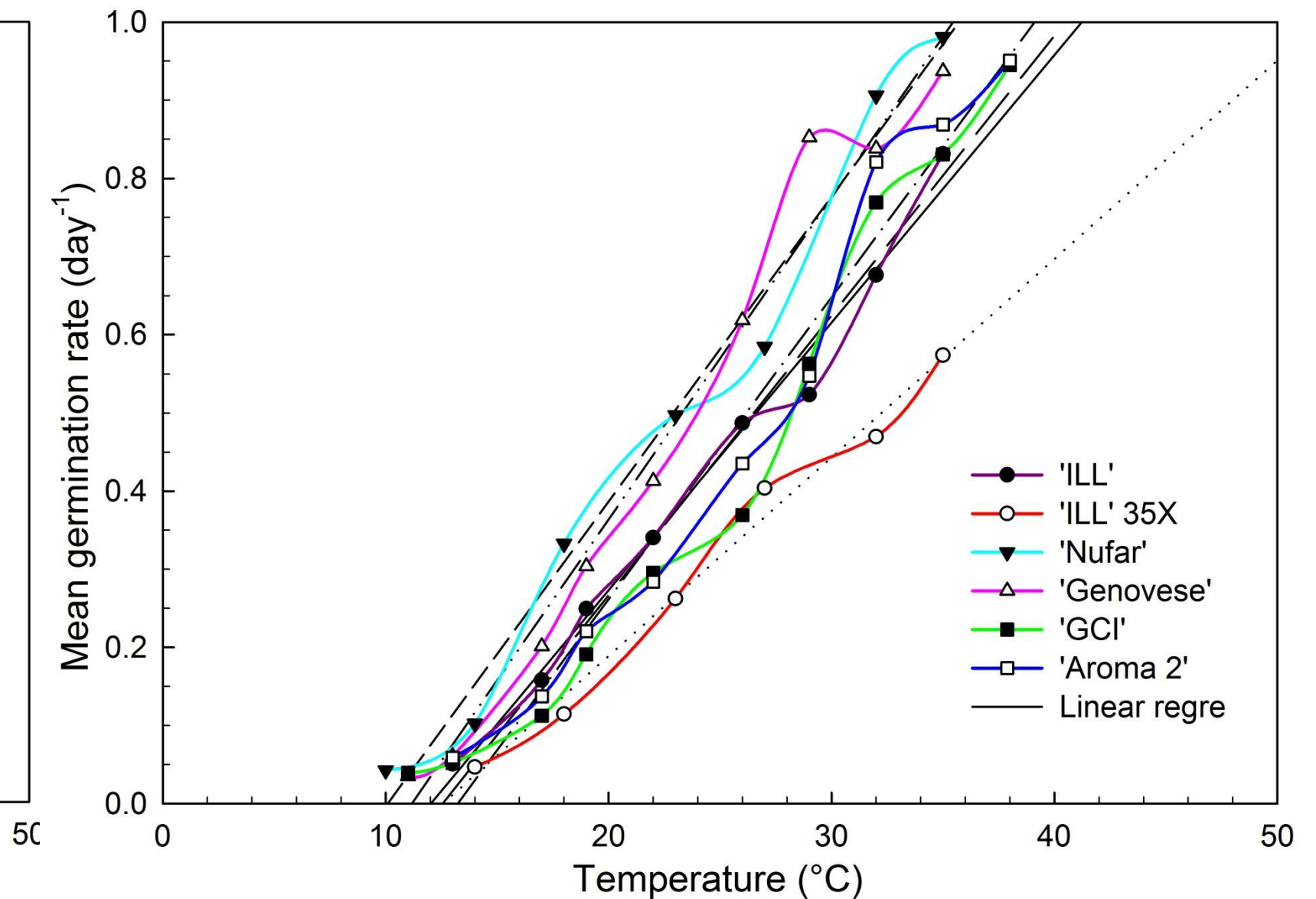
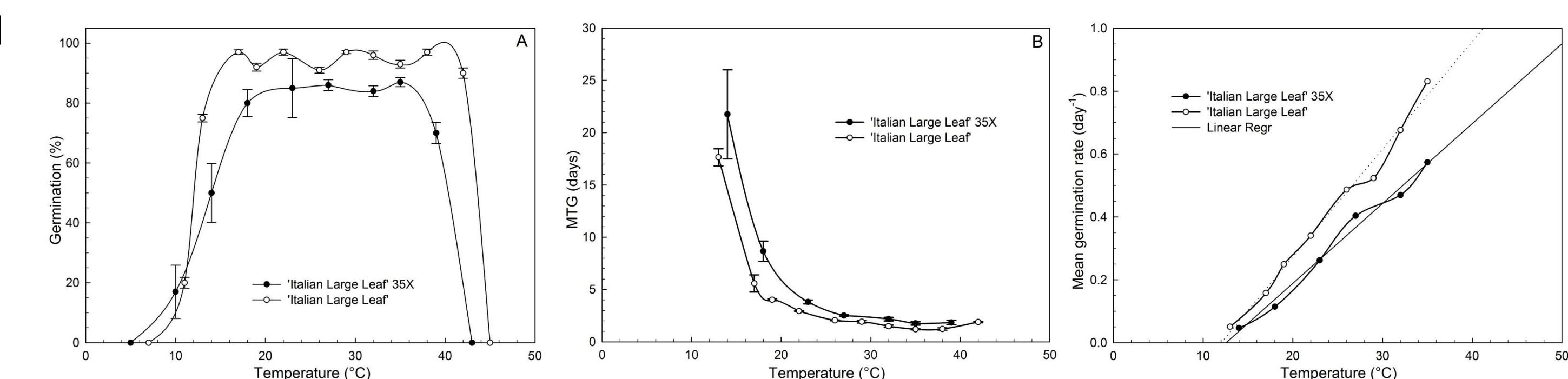


Fig 7. Germination rate from the starting to maximum with regression of all 6 cultivars.

#### DISCUSSION AND CONCLUSIONS:

- Effects of temperature were in the range of those in earlier studies: basil seed germinated 13 – 30 °C, > 80% after 4 days (Putievsky, 1983). But in the current study, seeds germinated over a wider temperature range (10 – 44 °C).
- Base temperature ( $T_b$ ) for most cultivars was above 10 °C.
- Aging during storage reduced germination percentages and slowed germination but did not change the base temperature.
- At low temperatures, germination was very slow, which may cause problems during field establishment.
- $T_b$  was significantly different among cultivars.

Fig 8. Comparison of old and fresh seeds of same cultivar:



#### REFERENCES:

- Elias, S. G., Copeland, L. O., McDonald, M. B., and Baalbaki, R. Z., 2012. Seed testing: principles and practices. Michigan State University Press: East Lansing.
- Jett, L. W., and Welbaum, G. E., 1996. Effects of matrix and osmotic priming treatments on broccoli seed germination. Journal of the American Society for Horticultural Science, 121: 423-429.
- Nelson, H., Paris, H. S., 1988. Effect of fruit age, fermentation and storage on germination of cucurbit seeds. Scientia Horticulturae, 35: 15-26.
- Putievsky, E., 1983. Temperature and daylength influence on the growth and germination of sweet basil and oregano. Journal of Horticultural Science, 58: 583-587.

#### ACKNOWLEDGEMENTS:

Special thanks to Dr. Roger Harris and Velva Groover, Department of Horticulture, Virginia Tech for their help in completing this project. Thanks to Dr. Dawn DeVos for providing the seeds of 'ILL' 35X.