

Is Trichome Presence and Oil Content Linked in *Ocimum* (Basil) Cultivars?

Grace Hansen, Taryn Dorn, M. Elizabeth Conley and Ellen T. Pappozzi*

Department of Agronomy & Horticulture
University of Nebraska-Lincoln Lincoln, Nebraska 68583-0724

Introduction

Basil is one of the few medicinal herbs that can be grown as an annual plant and thus suitable for year-round production. The genus has multiple species, some of which are prized for culinary, medicinal or sensory uses. Other species/cultivars are planted as ornamentals. During preliminary experiments which involved growing basil for fresh and oil production during the winter, it was noted that the quantity of essential oil varied from cultivar to cultivar. The oil in basil comes from specialized trichomes located on the leaves and flowers. With this link in mind, investigations were undertaken to determine if there was a relationship between the presence/absence of trichomes on the adaxial and abaxial leaf surfaces of pesto (sweet) and specialty basils and the quantity of oil produced from their leaves.

Materials and Methods

Nine cultivars of basil (Amethyst Improved, Cinnamon, Dolly, Eleonora, Kapoor Tulsi, Lime, Neapolitano, Spicy Globe, and Sweet Thai) were grown in a double-layer polyethylene greenhouse with under-bench heating during the winter in Nebraska. A capillary mat system was used for basic fertigation, with the application of 100 ppm N from 20N-4.4P-16.6K plus 9 g of 12N-3.1P-14.9K slow release fertilizer. Two plants were grown in a 6-inch standard pot filled with soilless mix.

For each cultivar, the second pair of fully expanded leaves from a terminal leaf whorl was selected. Using a dissecting microscope set at a magnification of 3.5 times, both the adaxial and abaxial leaf surfaces were observed. On the abaxial side, a clear grid of 25-mm squares was overlain on either side of and along the midvein. Two rows of the center-most seven squares on one side of the midvein were observed for trichomes and photographed. The procedure was then replicated on the adaxial side and for a second leaf selected for a total of 2 leaves per plant for 2 plants. Trichomes were then counted within each 25-mm square (Figures 1-4).

For oil determination, 100 grams of dried basil leaves were steam distilled. Oil volume was determined by drawing the oil from the distillation hydrosol using a 5-ml pipette calibrated in 0.10 increments.

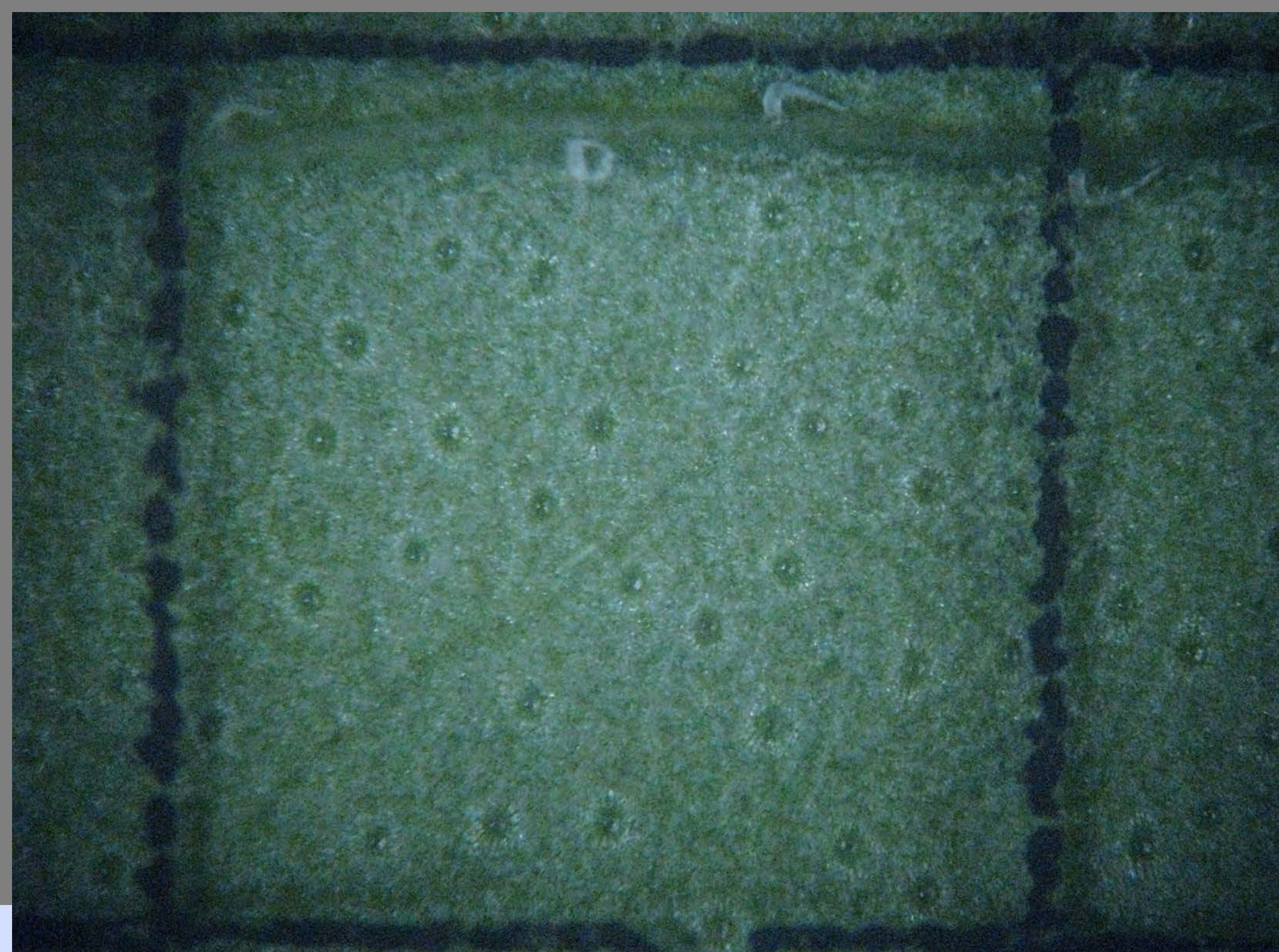


Figure 1. Close-up view of peltate oil trichomes on the abaxial surface of a specialty basil ('Cinnamon') leaf magnified 42 times.

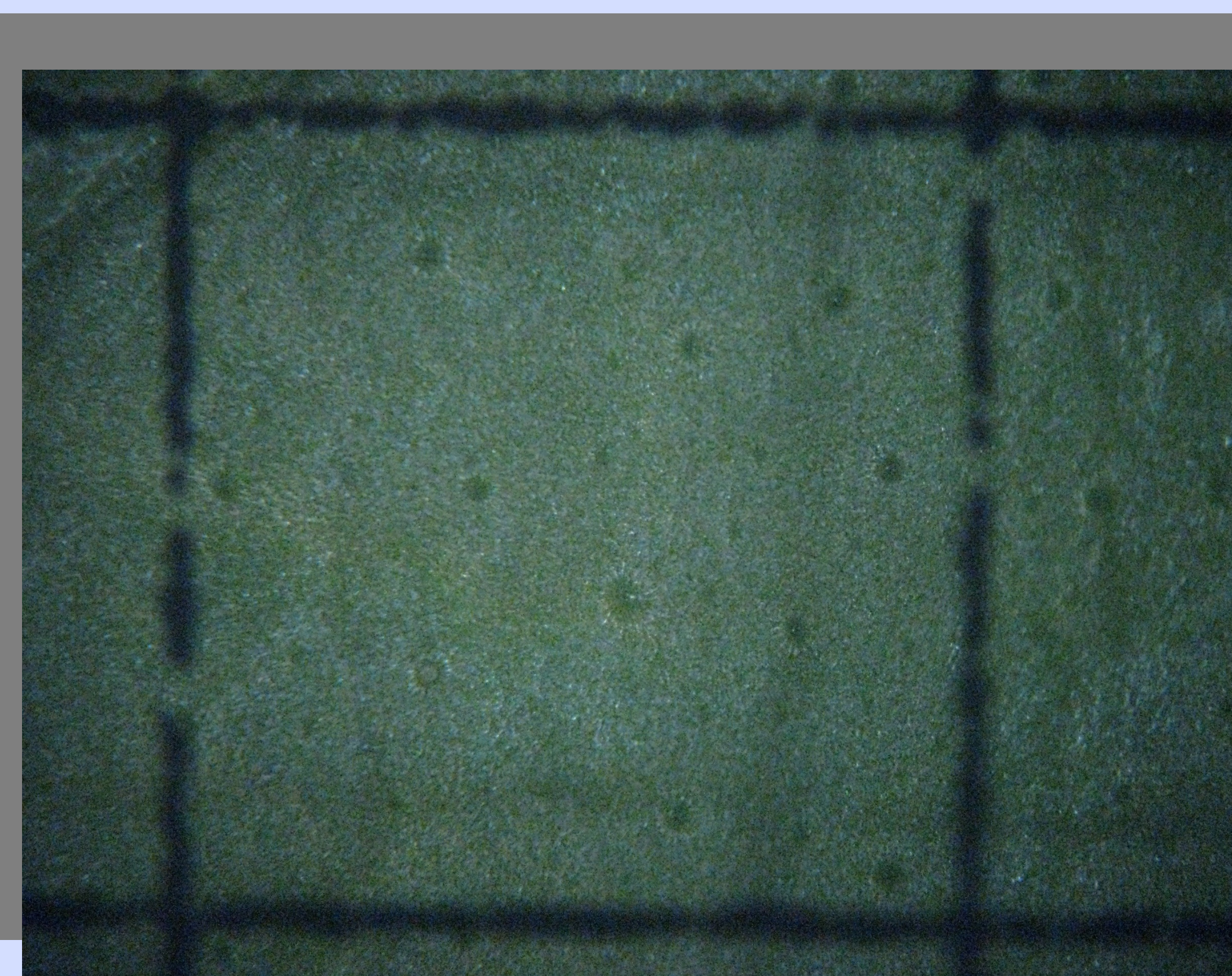


Figure 2. Close-up view of peltate oil trichomes on the abaxial leaf surface of a pesto basil ('Dolly') leaf magnified 42 times.

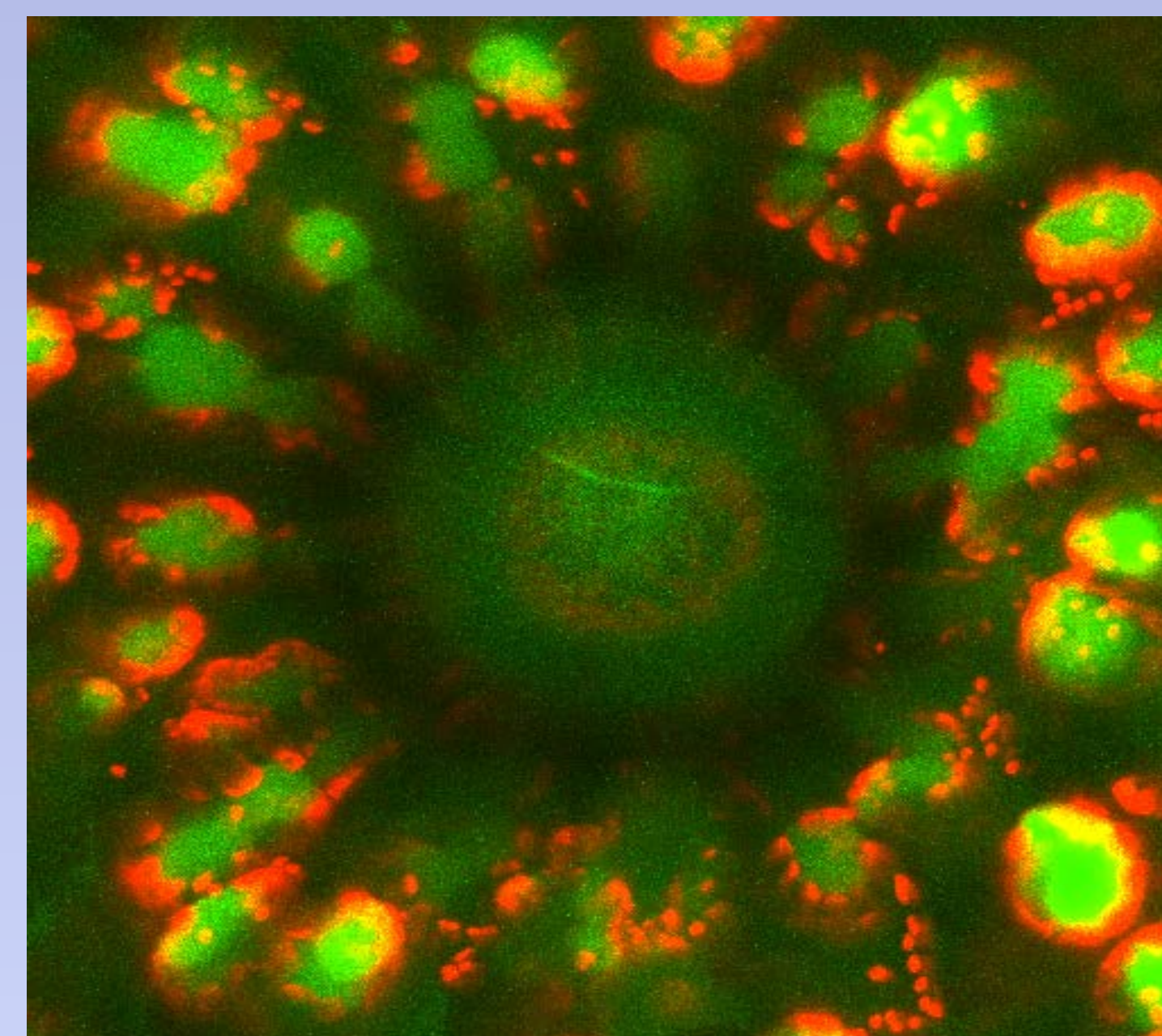


Figure 5. Confocal micrograph of a peltate oil trichome on a pesto basil ('Eleonora') leaf magnified 60 times.

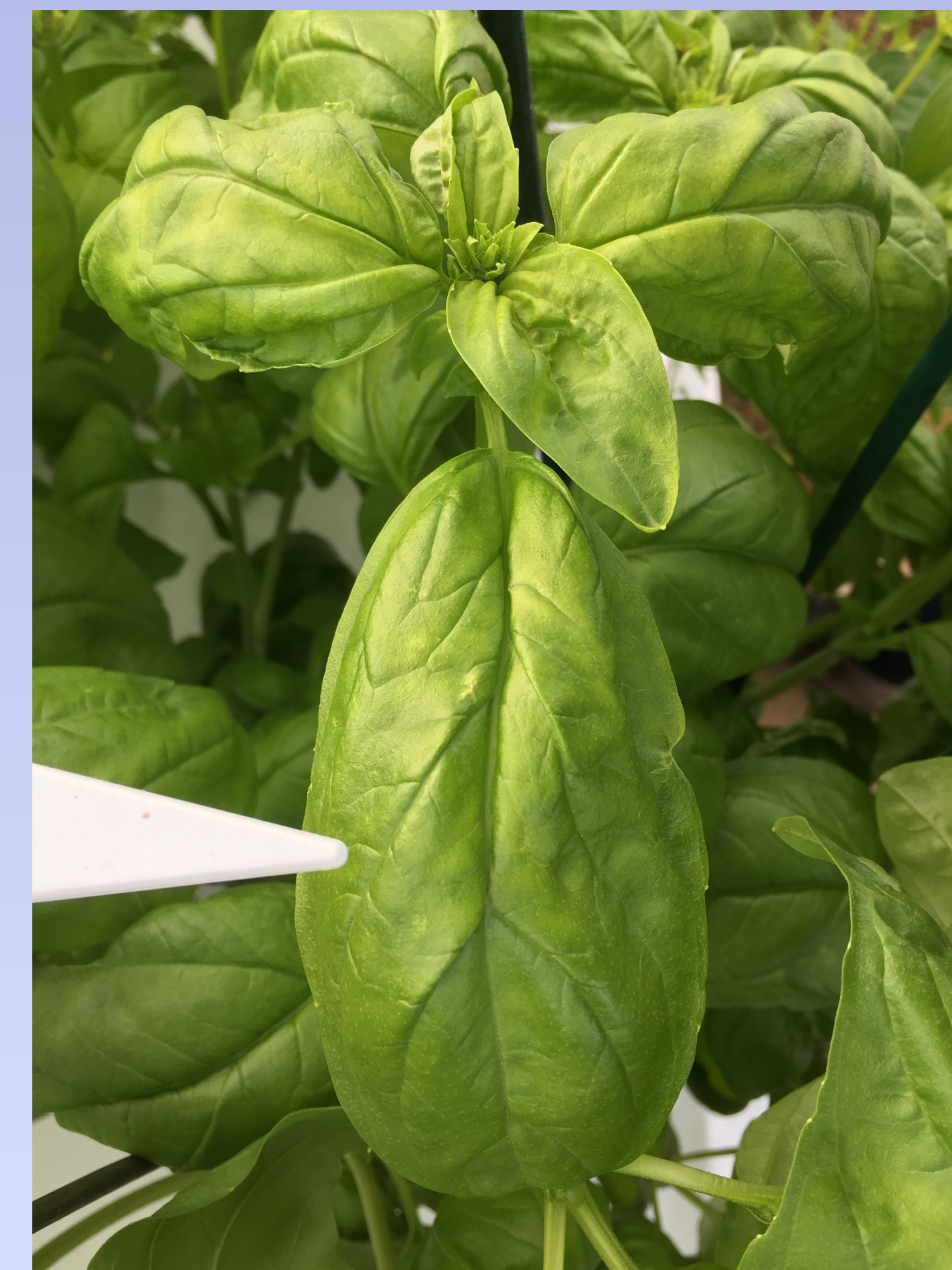


Figure 4. Close-up view of sampled area of the leaves from a pesto basil ('Dolly').

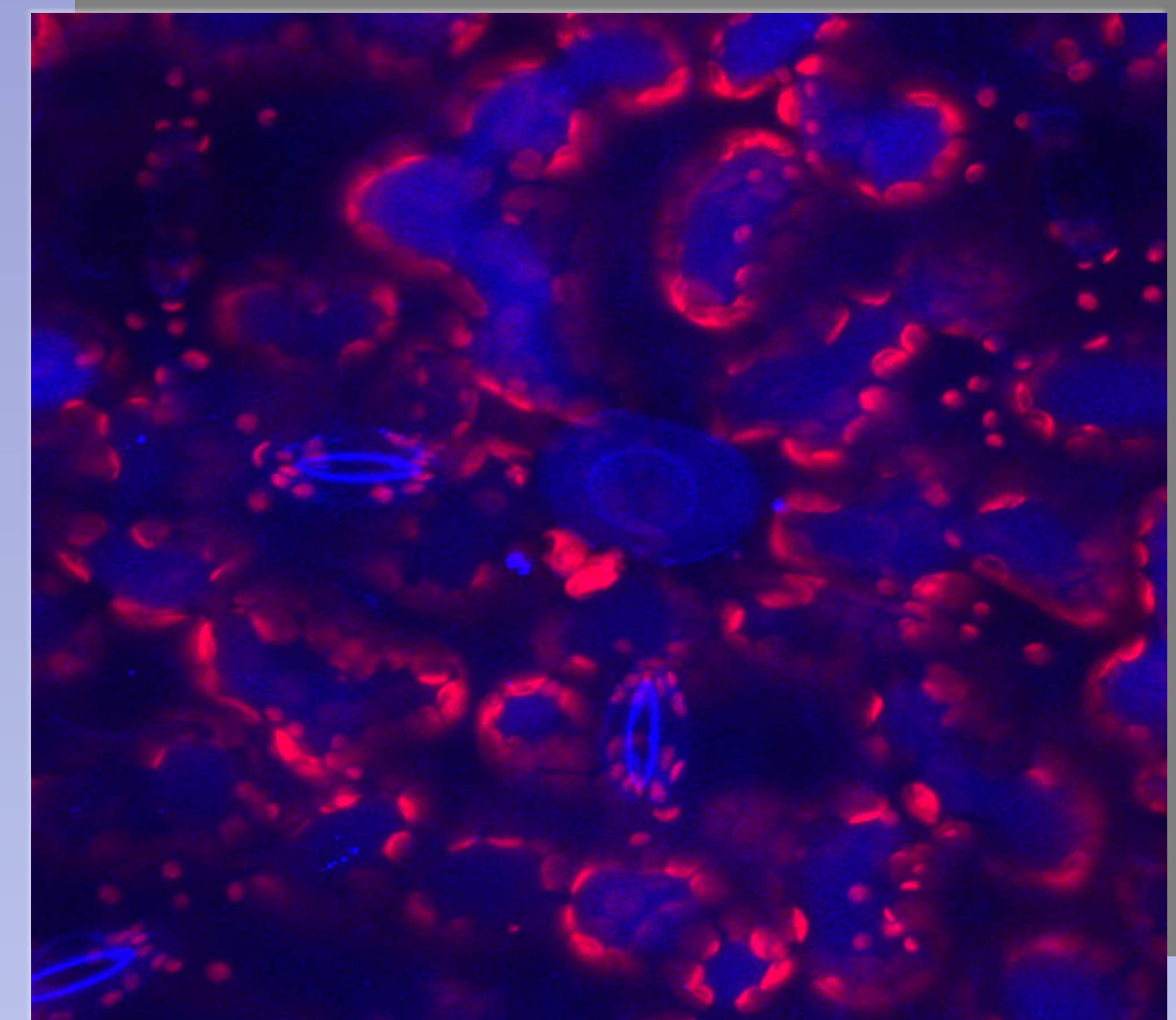


Figure 6. Confocal micrograph of another oil trichome found on the specialty basil leaf of 'Kapoor Tulsi' magnified 60 times.



Figure 3. Close-up view of the sampled area of the leaves of a specialty basil ('Cinnamon').

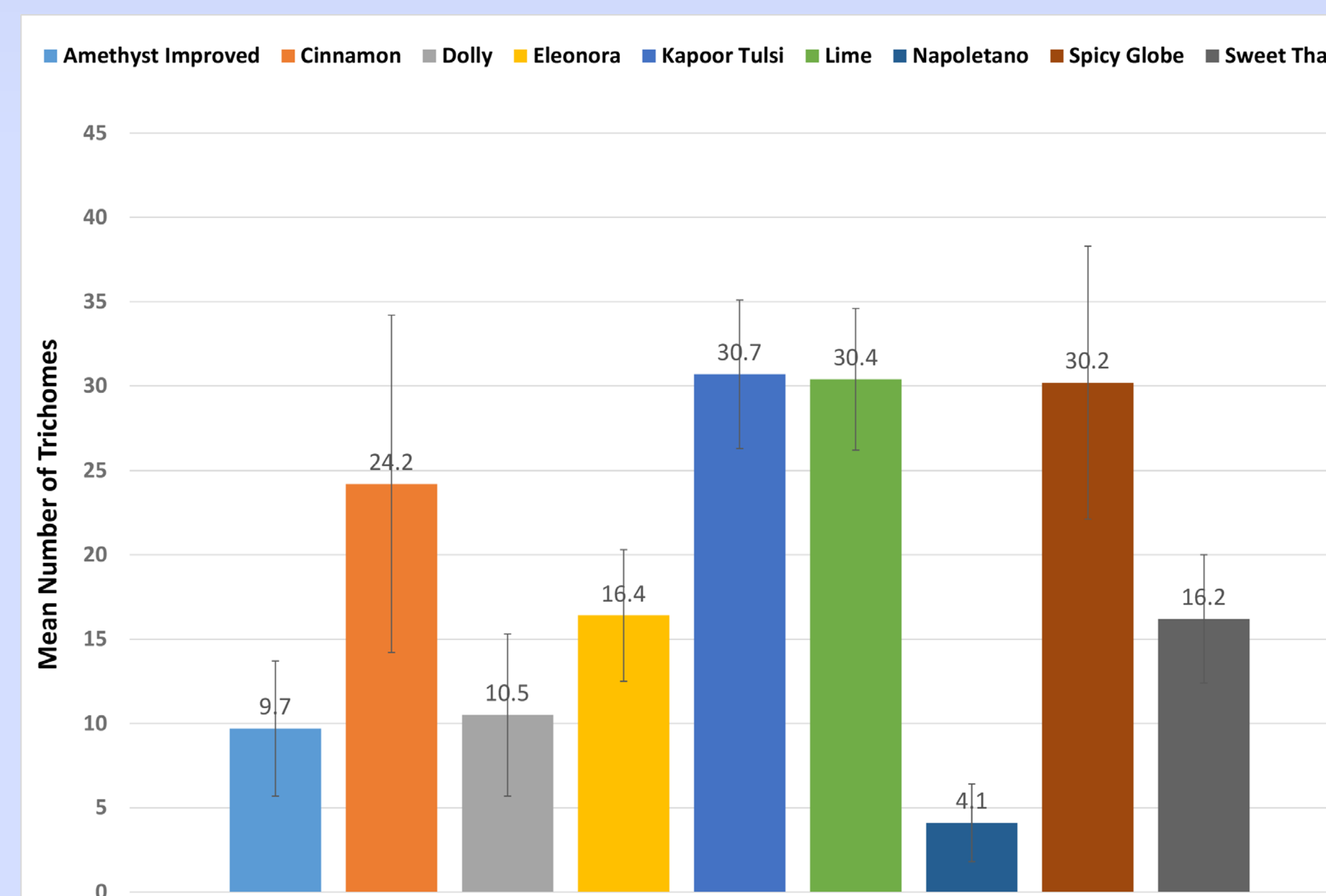


Figure 7. Average number of trichomes observed on the abaxial surface of basil leaves.

Results

For all cultivars tested, oil trichomes were found on both the adaxial and abaxial with more trichomes on the abaxial. In some instances the adaxial trichomes were harder to see and fewer in number than those on the abaxial.

Using confocal microscopy it was determined that there was more than one type of oil trichome present (Figures 5, 6). Why that is we are not certain!

In general, the mean number of trichomes on the abaxial side varied greatly from sample to sample as evidenced by the standard deviation bars (Figure 7). This variation may be associated with general basil type as the specialty basils ('Cinnamon', 'Kapoor Tulsi', 'Lime' and 'Spicy Globe') all had trichomes mean counts that fell between 24 and 31 as compared to the trichome variation for the pesto basils 'Amethyst Improved', 'Dolly', 'Eleonora' and 'Napolitano' which fell between 9 and 17.

In terms of oil production, our preliminary measurements indicate that leaves of 'Spicy Globe', 'Cinnamon', 'Dolly', 'Lime' and 'Sweet Thai' produced the most oil (Table 1). However only 'Spicy Globe' leaves produced more than 1 ml.

| Cultivar | Basil Type | Oil Produced, mL |
|-------------------|--------------|------------------|
| Amethyst Improved | Purple pesto | In process |
| Cinnamon | Asian | 0.8 - 0.5 |
| Dolly | Pesto | 0.45 - <0.1 |
| Eleonora | Pesto | 0.2 - <0.1 |
| Kapoor Tulsi | Asian | <0.1 |
| Lime | Citrus | 0.4 - 0.3 |
| Napoleitano | Pesto | < 0.1 |
| Spicy Globe | Fine leaf | 1.9 - <0.1 |
| Sweet Thai | Asian | 0.35 |

Table 1. Range of oil volume produced by basil cultivars used in the anatomy study.

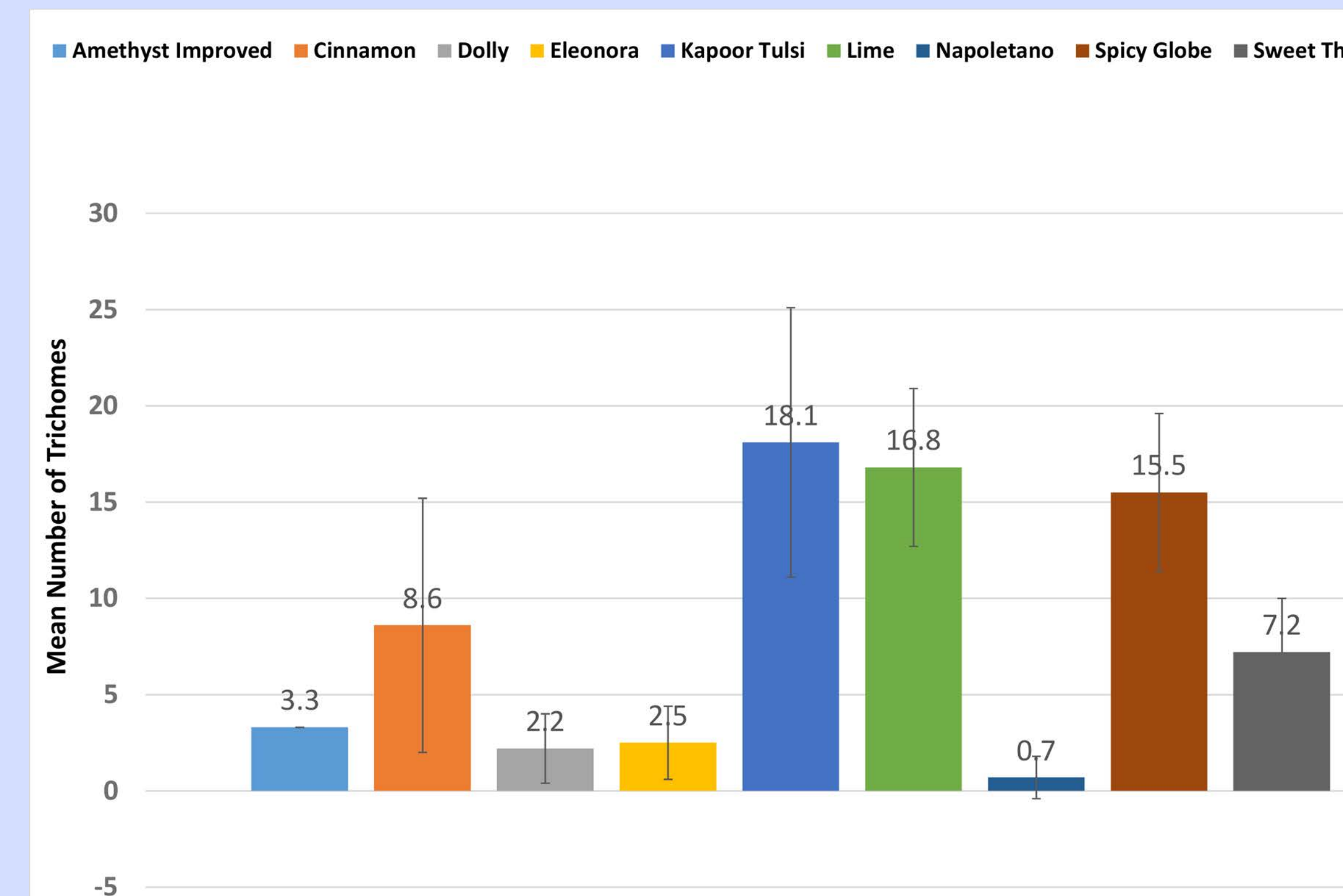


Figure 8. Average number of trichomes observed on the adaxial surface of basil leaves.

The mean number of trichomes on the adaxial side again varied greatly from sample to sample as evidenced by the standard deviation bars (Figure 8). Leaves from 'Kapoor Tulsi', 'Lime' and 'Spicy Globe' had mean trichome counts between 15 and 18 as compared to all other cultivars which had less than 9.