

# **MONITORING FUMIGATION EFFICACY IN STRAWBERRY PRODUCTION USING REMOTE SENSING**

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## **SUMMARY**

The efficacy of alternative soil fumigation treatments on strawberry production was evaluated using ground based spectral and image analysis and remote sensing. Digital images of production beds collected in the visible and near infrared spectrum were useful for determining the amount of canopy coverage on the bed top. Subsequent analysis revealed a good correlation between the extent of this canopy coverage and leaf area for three cultivars differing in plant architecture. Field trials evaluating the effect of fumigation treatments with either Methyl Bromide + Chloropicrin (MB + Pic) or Telone + Chloropicrin (T + Pic) compared to nonfumigated controls were established. In this trial, yield was the greatest for the MB + Pic fumigation treatment and less for the T + Pic and nonfumigated control. Little difference in % Canopy Coverage (which is correlated to leaf area) was observed between the fumigation treatments, but both were significantly larger than the nonfumigated control. Spectral reflectance of the canopy taken shortly after harvest started was similar among treatments, however, two months later differences in reflectance among treatments were apparent. Some of these differences corresponded to changes in fruit production in the treatments. Analysis of aerial images and calculation of a normalized distribution vegetation index (NDVI) revealed that the T + Pic treatment block had a higher NDVI than the MB + Pic treatment block three weeks before harvest started (3/14/02). However, 3 ½ months later the MB + Pic treatment block had higher NDVI values even though at this time the plants in the T + Pic treatment were slightly larger, suggesting lower plant vigor in the T + Pic treatment. A larger scale comparison between fumigation treatments was done by selecting specific production blocks 1-3 acres in size for collection of yield data (commercial trays/block) and analysis of NDVI data from aerial images.

## **INTRODUCTION**

Soil fumigation with methyl bromide and chloropicrin is widely used by the strawberry industry for controlling soilborne diseases that can dramatically reduce yields. Historically, the reason for soil fumigation was the control of the lethal diseases *Verticillium* wilt and *Phytophthora* root and crown rot. However, there is another group of broad host range, nonspecific pathogens that can also cause significant reductions in yield and are frequently associated with a general root disease of strawberry (referred to as Black Root Rot). While generally not responsible for killing the plant, this disease can cause reductions in plant growth with a corresponding effect on yield. Aside from stunting plants, there are no foliar symptoms diagnostic of black root rot. With the phase out of MB in 2005

the industry is faced with the need for developing alternative production practices for control of soilborne diseases. Techniques that will quantify plant growth parameters and allow for evaluation of plant vigor will facilitate this research effort. Collection of reflectance data from plants (on the ground and with aerial images) and calculation of vegetation indexes is one approach that can be useful.

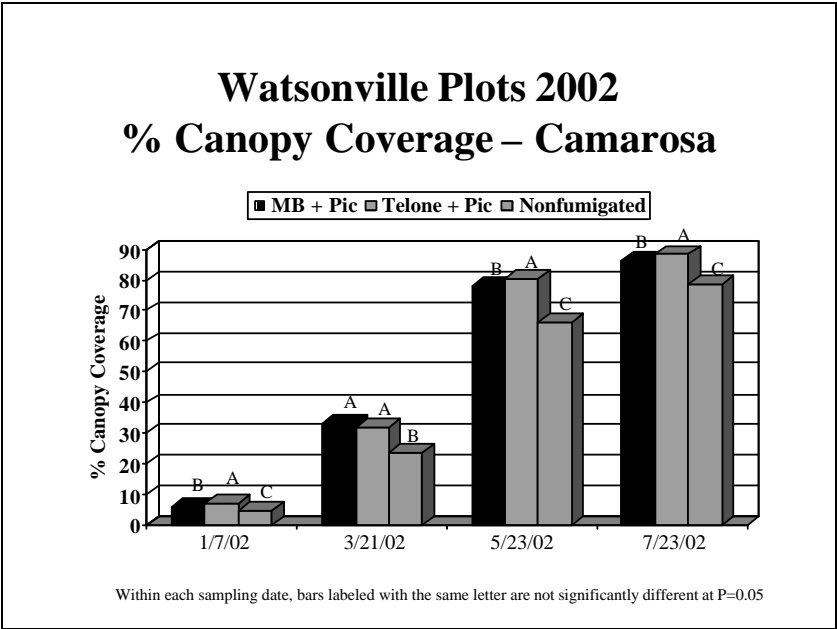
### **Estimation of Plant Leaf Area**

The ability to accurately determine leaf area and plant biomass without the need for destructive plant sampling would facilitate quantitative assessments of the effect of specific soilborne pathogens or alternative soil fumigation treatments on plant growth. Furthermore, it would allow for yield data to be collected from the same plants from which growth determinations were made. A Dycam ADC was used to collect digital images of the plants. This camera collects images in the visible as well as the near infrared spectrum, thereby eliminating problems with leaf shadowing in the image. The camera was attached to a PVC pipe frame and placed on top of the bed so all images would be the same size. The percentage of the image that was represented by plant canopy (% canopy coverage) was determined. Plants were harvested and leaf area for individual plants determined in the lab. There was a good correlation ( $r^2 = 0.90-0.95$ ) between % canopy coverage and actual leaf area for the cultivars Aromas, Camarosa and Diamante.

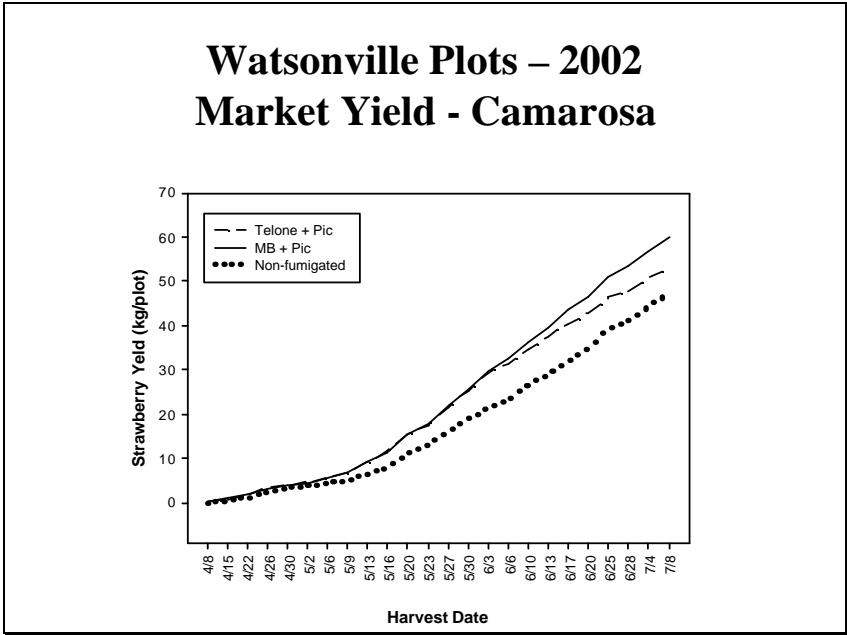
### **2002 Fumigation Trial**

Trials were conducted in a commercial production field in Watsonville, CA with a previous history of MB + Pic broadcast fumigation and strawberry cultivation. A standard broadcast fumigation with MB + Pic (57:43 @ 350 lbs/A) was compared to T + Pic (42:58 @ 142 + 200 lbs/A). Due to buffer zone requirements no fumigants were applied at one edge of the field, allowing for data collection in a nonfumigated area. Market and cull yield was collected from 6 subplots of 40 plants twice/week in single blocks of the three treatment areas. Canopy coverage and reflectance data were collected in 24 other areas of the treatment blocks (6 for the nonfumigated treatment). The exact position of these subplots was determined by GPS and placed on georeferenced aerial images for further analysis. Aerial images of the 46-acre field were collected with a 2-meter resolution. A 56% reflectance tarp was deployed on the day that images were collected to allow for calibration of images so comparisons could be made between different collection dates. Marketable yield (commercial trays/block) was collected for 3 larger blocks (1-3.2 acres each) in each fumigation treatment and image analysis of entire blocks was used to compare fumigation treatments.

Difference in canopy coverage for the fumigation treatments were small (although T + Pic was significantly larger than MB + Pic for 5/23/02 and 7/23/02) while both fumigation treatments had significantly larger canopy coverage than the nonfumigated control (Fig.1). As of 7/8/02, the T + Pic treatment had a 13% reduction in market yield relative to MB + Pic while the nonfumigated plots had a 21.5% reduction in market yield (Fig. 2). The yield reduction with T + Pic was unusual as other trials with T + Pic had similar yields as MB + Pic.



**Figure 1.**



**Figure 2.**