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Effect of Plastic Mulch Color on Fresh Weight of Leaf Lettuce (*Lactuca sativa* L.) and Soil Carbon Dioxide

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Abstract:

Lettuce was grown with five different colors of plastic mulch to evaluate its effect on fresh weight of leaf lettuce and soil carbon dioxide. The plastic mulches were silver, red, orange, yellow and green. A Split plot following the Randomized Complete Block design was used in the experiment. The obtained result showed that Looseleaf variety had better response in terms of the plant fresh weight compared with the Romaine variety and different color of the mulch significantly affected the fresh weight of leaf lettuce. Lettuce when grown with red plastic mulch had better result or heavier compared with the other colored plastic mulch. The mulch color showed no significant variation on the soil carbon dioxide produced from the different colored plastic mulch

Keywords: Colored plastic mulch, lettuce, soil carbon dioxide, Looseleaf, Romaine, light

1. Introduction

Lettuce (*Lactuca sativa* L.) is considered to be one of the most important salads. It is also serves as an ornament to the prepared dishes. Several varieties of lettuce thrive in different soil and climatic conditions. Polyethylene mulches are used in vegetable production as well as fruit productions. Plastic mulch offers several benefits in the production of vegetables such as retention of soil moisture, minimizes soil evaporation, and prevents weed growth. Soil is a major source of carbon dioxide (Raich and Potter, 1995). Crops like potato and eggplant according to Baron and Gorski (1986) can absorb carbon dioxide through their roots, thus this may affect the productivity of the plant. The amount of soil carbon dioxide within the different color of the mulch may affect the growth and development of plants. The carbon dioxide that was released from the soil cannot escape from the soil since it was blocked by the plastic mulch thus the carbon dioxide produced were accumulated within the hole and this may affect the amount of carbon dioxide which further may affect the growth of plants by raising the level of carbon dioxide within the area. However, according to some research, the raise level of carbon dioxide from the soil did not affect the yield of certain crops like eggplant and tomato. Research has been done using different colors of plastic mulch that affects plant growth (Franquera, 2011). However, its effect on the amount of soil carbon dioxide in relation to the productivity is limited. Thus, this study was conducted to determine the effect of mulch color on the soil carbon dioxide and fresh weight of leaf lettuce.

2. Methodology

2.1. Place of Study

The research was conducted at the vegetable experimental station of the University of the Philippines Los Baños (UPLB).

2.2. Establishment of Crops

Two lettuce varieties Looseleaf and Romaine were sown in seedling trays with a pre mixed media composed of one part garden soil, one part carbonized rice hull and one part compost. One week after the emergence of lettuce seeds, the newly emerged seedlings were pricked to ensure individual seedlings in each hole of the plastic seedling trays to ensure uniform growth of the seedlings. The seedlings were established in the plastic house for four weeks before they were transplanted in the field.

2.3. Experimental Design and Layout

A Split plot design following the Randomized Complete Block Design was used. The main treatments were the two lettuce varieties, the Looseleaf and Romaine. The sub treatments are the different colors such as silver, red, orange, yellow and green. The plastic mulch was sprayed with a latex paint using an electric pressurized sprayer with the corresponding colors to make a uniform paint on the plastic mulch.

2.4. Care and Maintenance of the Experimental Set Up

Four weeks old lettuce seedlings were transplanted in the field with 45cmx20 cm spacing. Each treatment has an area of five square meters. The treatments were replicated three times. Transplanting of seedlings was done late in the afternoon to avoid the transplanting shock. The complete fertilizer (14-14-14) was applied before transplanting at the rate of 10 grams per hill. Two weeks after transplanting, the lettuce was applied with 5 grams of urea per hill to ensure the proper nutrition of the plant.

2.5. Data Gathered and Methods of Gathering

2.5.1. Soil Carbon Dioxide and Plant Fresh Weight

For the soil carbon dioxide parameter, plastic bottles of equal sizes were used as chambers where samples of soil carbon dioxide were collected. The opening of the bottle was tightly sealed. Gas syringes were used to obtain samples from the plastic bottles and successive sampling was done. The collected gas samples from the sealed syringe were analysed for soil carbon dioxide using a gas chromatograph. For the plant fresh weight, representative plants from one square meter were collected and determined the fresh weight using an electronic weighing device to ensure proper data.

2.5.2. Statistical Analysis

The data analysis was done and the comparison of the data by Least Significant Differences was done using the SAS software (9.1).

3. Results and Discussions

3.1. Soil Carbon Dioxide (%)

The carbon dioxide released by the roots and or the decomposition of organic matter in the soil accumulates beneath the plastic mulch. This is one of the reported advantage of plastic film which favors vegetative growth (Sheldrake, 1963; Baron and Gorske, 1981). Carbon dioxide accumulated beneath the plastic mulch was not able to penetrate within the plastic mulch since it was nearly impervious. This results in the escaping of the accumulated gas (carbon dioxide) through the punched holes of the plastic film, creating a chimney effect resulting in higher levels of carbon dioxide for the actively growing leaves near the transplant hole (Hopen, 1965; Lament, 1993). Furthermore, this might affect the growth of the plant since a small increase of carbon dioxide level around the stomata of foliage promotes growth by enhancing photosynthesis. However, results of the study show no significant variation in terms of the soil carbon dioxide observed within the different colored plastic mulch (Figure 1).

The result indicates that the soil carbon dioxide was not affected by the color of the mulch. The soil carbon dioxide fluctuates from 8 am to 4 pm however, the results also revealed no significant variations in soil carbon dioxide thru different time of the day.

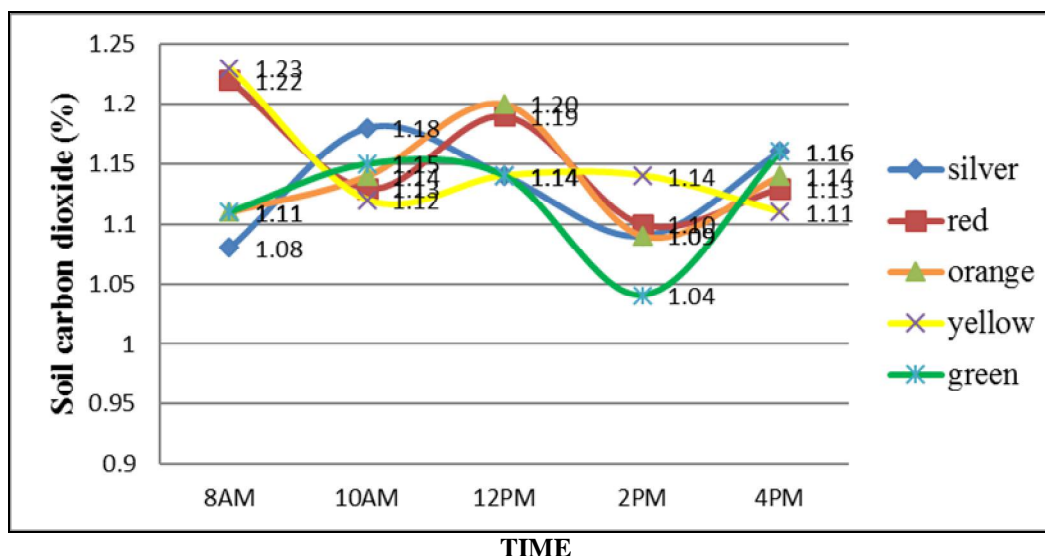


Figure 1: Soil carbon dioxide obtained under the different colored plastic mulch at different time of the day

3.2. Plant Fresh Weight

Data on the plant fresh weight (Table 1) between the two varieties showed highly significant differences. Apparently, Looseleaf (145.81 g) had higher fresh weight compared with Romaine lettuce (75.30g).

MULCH COLOR	VARIETY		MEAN
	Looseleaf Lettuce	Romaine Lettuce	
Silver	155.27 ^b	65.10 ^c	110.18 ^c
Red	196.73 ^a	103.30 ^a	150.01 ^a
Orange	161.93 ^b	78.67 ^b	120.3 ^b
Yellow	71.20 ^d	64.80 ^c	68.0 ^e
Green	143.93 ^c	64.67 ^c	104.3 ^d
Mean	145.81 ^a	75.30 ^b	

Table 1: Plant fresh weight (g) of leaf lettuce grown with different colored plastic mulch in Vegetable Crop Division experimental station

Means in the same column or row followed by a common letter (s) are not significantly different at 5% level by LSD

Heavier lettuce was obtained from those grown within the red plastic mulch compared with the other colored plastic mulch (150.01g). Those grown with orange, silver and green plastic mulch succeeded (120.30g, 110.18g and 104.30g, respectively). The least value was noted within those grown with yellow plastic mulch (68.00g). The result suggested that the mulch color had an impact on the fresh weight of lettuce.

The differences on the plant fresh weight could be contributed by the differences in the spectral distribution of light which was reflected from the surface of the colored mulch. Due to reflections of different wavelengths of light, different colors of mulch create a specific environment that could have a considerable effect on plant growth and development (Posada, 2011) which also affects the plants biomass. According to Franquera (2015) lettuce when grown with red plastic mulch is heavier and has a longer leaves compared with lettuce grown with other colored plastic mulch. Plant biomass in pepper increases with increasing FR:R ratio (Decoteau *et al.*, 1989). Antonious *et al.*, (1996) concluded that the spectrum of light reflected from the mulch on the soil surface can influence the shoot and root biomass. The color of light reflected from the colored mulch to the growing leaves can act to the natural growth regulatory within the plants system which influences the growth of shoots and roots (Kasperbauer, 2002). Lettuce grown within the red plastic mulch was heavier because this could also be linked with longer roots which was observed to be within the red plastic mulch since the uptake of nutrients could also be affected by the length of roots and root architecture (Bar-Tal *et al.*, 1995). Root length strongly influences nutrient absorption and this could be the reason for heavier plant weight observed within the red plastic mulch, since more nutrients could be absorbed by the plants thus better growth and development.

The interaction effect of varieties and the color of the mulch was highly significant which indicates that the response of the two varieties varies with the color of the mulch. Both varieties (Looseleaf and Romaine) respond better when grown with red plastic mulch as compared to the other colored plastic mulch. The lowest value was found to be within those grown in yellow plastic mulch for Looseleaf. However, in Romaine lettuce the lowest value was observed within the green plastic mulch, but did not differ significantly with the other colored plastic mulch such as yellow and silver (control).

4. Conclusion

The result of the research has a very important implication in lettuce production since the color of plastic mulch significantly affected the fresh weight of lettuce. Using red plastic mulch significantly enhanced the fresh weight of leaf lettuce compared with the other colors of plastic mulch. However, the mulch color has no effect on the soil carbon dioxide.

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