

Influence of Different Colored Plastic Mulch on the Growth of Lettuce (*Lactuca sativa*)

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Received: 4 April 2011

Accepted: 7 June 2011

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Mulches bring several benefits to lettuce cultivation. A study on the lettuce 'Red Rapids' has been conducted to determine the influence of the different colored plastic mulch on its growth. The experiment consisted of five color treatments as follows; treatment 1- metallic silver (control), treatment 2- red, treatment 3- orange, treatment 4- yellow and treatment 5- green. Results showed that the colored mulch treatments had significant influence on the different parameters including: root length at harvest, average leaf length, leaf diameter, plant height, plant weight, number of leaves at harvest and percentage survival. Lettuce grown in red mulch had significantly outperformed the other colored treatments.

Abstract

Keywords: Colored plastic mulch, *Lactuca sativa*, Lettuce.

INTRODUCTION

Lettuce (*Lactuca sativa*) comes from the family Asteraceae. Lettuce 'Red Rapids' has ideal leaves for salads. This variety can be grown in cold-frames, greenhouses or in the garden. This cultivar has crisp, tender and tasty leaves and approximately its growth period is 55 days to maturity. An excellent variety for forcing, or outdoor planting, being quick of growth, and little liable to rot.

Plastic mulches directly impact the microclimate around the plant by modifying the radiation budget (absorptivity vs. reflectivity) of the surface and decreasing the soil water loss. The color of a mulch largely determines its energy-radiating behavior and its influence on the microclimate around a vegetable plant. Color affects the surface temperature of the mulch and the underlying soil temperature. The degree of contact between the mulch and soil, often quantified as a thermal contact resistance, can affect greatly the performance of a mulch. If an air space is created between the plastic mulch and the soil by a rough soil surface, soil warming can be less effective than would be expected from a particular mulch. Extensive research utilizing certain photosensitive mulch has been reported to increase yields of various horticultural crops (Lamont, 2004). The purpose of assorted colors is to reflect FR:R ratios that result in phytochrome regulation that may enhance plant growth and yield. In a tomato production study, Orzolek *et al.*, (2000) found silver and red plastic mulches to have the greatest reflected FR:R ratios. This study reported an increase in marketable fruit yields occurred with tomatoes growing on silver or red mulch compared to the use of traditional black plastic.

Originally, plastic mulches were primarily black, clear, and white. Clear produces the most heat, but weeds grow like crazy. White keeps the soil cool. Black warms the soil and blocks weed growth. Additional colors have now been introduced such as red, blue, yellow, gray, orange, brown, green, and silver or silver-black. In recent years, it has been shown that selecting a plastic mulch of the right color is very important in vegetable production. The objective of this study was to determine the influence of different colored plastic mulch on the growth of lettuce.

MATERIALS AND METHODS

Crop Establishment

Seeds of the lettuce variety Red Rapids (Known You), were sown in a seedling tray. At 5 days after germination the seedlings were pricked to ensure individual seedlings per hole in the tray. The seedlings were maintained at the plastic house for 2 weeks after pricking before they were transplanted in the field.

Plot Preparation and Plastic Mulch Coloring and Treatments

Five treatments (10 m² plot) laid with plastic mulch were used for this study. The plots were subdivided following the treatments and replicated four times. The plastic mulch were sprayed with different colors using a spray paint with the following color treatments:

treatment 1-metallic silver (control)

treatment 2-red

treatment 3-orange

treatment 4- yellow

treatment 5- green

Seedlings of 5 cm leaves were transplanted in the field spaced with 35 cm x 30 cm. Replanting were done 1 day after transplanting to cope for the missing hills and dead plants. Watering was done as often as necessary to ensure the growth of the lettuce. Fertilizer application was done one week after transplanting with 10 grams of urea (46-0-0) diluted in galloon of water drenched within the individual plant with a volume of 150 ml per plant. Spraying was not done since occurrence of insects were not prevalent.

Harvesting and Data Gathering

Lettuce were harvested four weeks after transplanting. Random sampling were done to measure the different parameters per plot.

Parameters Measured

1. Percentage survival: The total number of lettuce plants survived divided by the total number of lettuce plants transplanted in a plot.

2. Weight of plant: The weight of the representative plants were weighted individually at harvest

3. Leaf diameter: The leaf diameter of the representative plants were taken at harvest with the average of ten leaf samples per plant.

4. Number of leaves: This was taken at harvest time the total number of leaves per plant were counted and recorded.

5. Leaf length: This was taken from the ten leaf of the representative which was measured using a ruler.

6. Root length: This was taken during the harvest and the root length were measured using a ruler.

7. Plant height at harvest: This was taken at harvest time and was measured from the basal to the tip of the leaves.

The data gathered were statistically analysed using the SAS computer software program.

RESULTS AND DISCUSSION

Percentage Survival Plants

The percentage of survival plants (Fig. 1a,b) showed significant differences on the colored mulch treatments. No significant differences were noted in red, orange, green and metallic silver mulch. However, the four colored mulch was significantly different with yellow colored mulch. It was observed that yellow colored mulch has the least percentage of survival. It has been stated that yellow color is the most fatigue color which could be related with this observation. As observed and shown in figure 1b yellow color has least percentage survival in the field as compared with the other colored mulch treatments. Kaspabeauer and Wilkinson (1995) stated that even a small differences in FR to R ratio over the various colored mulch surfaces could have a significant effect on plant development and since as they found out that red surfaces had higher FR to R ratio that would signal the plants to develop characteristics that would favor survival among relatively competition from other plants.

Weight of the Plant

Fig. 2 presents the weight of the lettuce grown in different colored mulch. Results showed that the weight of the lettuce plant at harvest collected from treatment 2-red was the heaviest on all the treatments. Red plastic mulch causes plants to put more of their energy into upper growth improving yields which could affect the weight of the plant. Yellow colored plastic mulch has the lightest plant weight. This implies that the different color of mulch had a significant influence on the weight of the lettuce plant. Research conducted by Decotaeu (2008) mentioned that the lighter color mulches reflected more light; but a lower ratio of FR/R. Increasing in light intensity can affect plant development and yield through greater photosynthetic rates, and the ratio of FR/R is important in phytochrome regulation of plant physiological processes and can affect internode lengths and stem elongation, chloroplast ultrastructure, photosynthetic efficiency, and photosynthate partitioning among leaves, stems and roots. Red plastic mulch has been reported to increase tomato yields and quality by various scientists, while others have reported a reduced severity of early blight in tomatoes. It also has been shown to

increase yields of strawberry, honeydews, muskmelons and zucchini. In addition, it has been shown to significantly increase soil temperatures.

Leaf Diameter

Data pertaining to the effect of different colored plastic mulches on leaf diameter of lettuce revealed significant differences on the different colored mulch treatments. Lettuce grown in red, orange and silver colored plastic mulch had greater leaf diameter as compared to green and yellow mulch. These colors were statistically different from green and yellow colored plastic mulch. Smallest leaf diameter was observed under the yellow colored plastic mulch. Use of colored plastic mulches offers the possibility of using basic principles of photomorphogenesis to enhance plant productivity. In this system, plants will grow in sunlight and in appropriate surface color will reflect light of predetermined spectral balance up to the plant where it will be absorbed by photoreceptors and result in a desired plant response (Kaul and Kasperbauer, 1992). Some authors concluded that the FR/R ratio in the upwardly reflected light over the various soil surface colors acted through the phytochrome system and played a major role in plant development.

Leaf Length

Fig. 4 indicates the result of lettuce leaf length. Significant differences were noted on the different treatments. It was observed that lettuce obtained from red colored plastic mulch had the longest length of leaves as compared with the other color treatments. Plant metabolism processes rely on the wavelengths inside red and blue light to regulate stages of photosynthesis, according to plant physiology. Red wavelengths stimulate carbon dioxide absorption, which is needed to manufacture glucose materials which could be attributed for the longer leaves of lettuce grown in red colored mulch. This was followed by orange mulch. Green colored mulch had comparable means with the silver colored mulch. The shortest leaves were obtained from lettuce grown in yellow mulch.

Number of Leaves

In terms of the number of leaves at harvest, it was shown that significant differences on the color treatments (Fig. 5). Lettuce grown in red mulch had most number of leaves as compared with the other colored treatments. Followed by orange, green and silver. The least number of leaves was observed in lettuce obtained from yellow colored plastic mulch. The color that has the highest influence on photosynthesis is blue, which is why many plant growers use blue lights to grow indoor plants. Red light is next best for photosynthesis and yellow light creates the lowest amount of light absorption. Thus, yellow plastic mulch resulted to the least number of leaves produced.

Root Length

The data (Fig.6) shows the average length of roots in lettuce with the different colored plastic mulch treatments. Significant differences were noted on the different treatments. Lettuce grown in red plastic mulch had the longest roots and was significantly different from the other treatments. Followed by orange, green and silver, although they were not significantly different. Lettuce grown in yellow colored mulch had the shortest roots. The results was in accordance with the study conducted by Kasperbauer (2010) that leaves of basil developing over red mulch, had greater area, succulent and heavier leaves than those grown in black. He also mentioned that colored-mulch technology relies greatly on "fooling" plants into behaving as if they face stiffer competition for sunlight than they actually do. This is achieved when they receive high amounts of FR light. Plants reflect FR and sense reflected FR to gauge how close and dense other vegetation around them is.

Plant Height

The final height of the lettuce plants were determined at harvest. It was observed that lettuce grown from red mulch were the tallest. Orange, green and silver colored mulch were not statistically different which followed. The yellow colored mulch was the smallest. The color of the mulch also influenced the plant light environment. The lighter color mulches reflected more total light; but a lower ratio of far-red relative to red light. Increases in light intensity can affect plant development and yield through greater photosynthetic rates, and the ratio of FR/R is important in phytochrome regulation of plant physiological processes and can affect internode lengths and stem elongation, chloroplast ultrastructure, photosynthetic efficiency, and photosynthate partitioning among leaves, stems and roots. According to Decoteau (2008) in red bell pepper, plants grown in red mulch were taller compared to the other colored mulch treatments. Kasperbauer (2010) stated that the reflected FR from the red mulch tricked the plants to believe there was more competition thus development was stimulated and thus this could be a reason why the lettuce grown in red mulch were the tallest.

CONCLUSIONS

Lettuce 'Red Rapids' was grown under plastic mulch subjected to five different colors metallic silver, red, orange, yellow and green. Harvesting was done four weeks after transplanting. Results showed that on the percentage survival of the plants it was found to be significantly different with yellow colored mulch as the lowest percentage of survival under field conditions. Other parameters tested namely; leaf length, leaf diameter, number of leaves, root length, plant weight, and plant height were also statistically tested and had shown to be statistically different. The results on all the parameters showed that red mulch had the best performance compared with the other colored mulchs and lettuce grown in yellow colored mulch has the least performance showing the shortest and lightest plants.

RECOMMENDATIONS

Based on the results, there were significant differences on the different colored mulchs employed as statistically analysed. It was observed that lettuce grown in red mulch performed the best among the other colors used for mulch which was noted on all the parameters used on the root length, leaf diameter, leaf length, plant height, number of leaves and plant height. Although in terms of percentage survival. Red colored mulch was not statistically different from orange and green but significantly different from yellow colored mulch. Dry weight of the samples should also be determined in order to find out if there was differences in the assimilates. Black and clear plastic mulch could also be included in order to compare its differences with the other colors. Therefore, based on the results of this study, using of red mulch for better lettuce growth and since it are recommended.

ACKNOWLEDGEMENTS

The assistance of the staff and field workers at the Vegetable Production Division, Department of Horticulture, ASC-CA, UPLB, College, Laguna is greatly appreciated.

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Figures

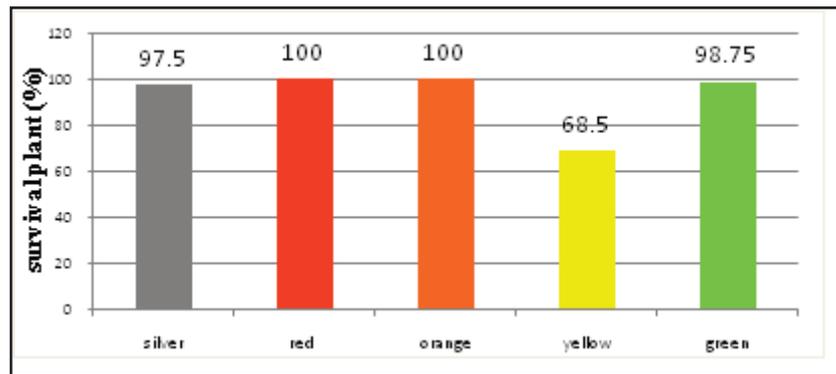


Fig. 1a. Percentage of survival plants as affected by the different colored mulchs.



Fig. 1b. Percentage of survival plants in the field.

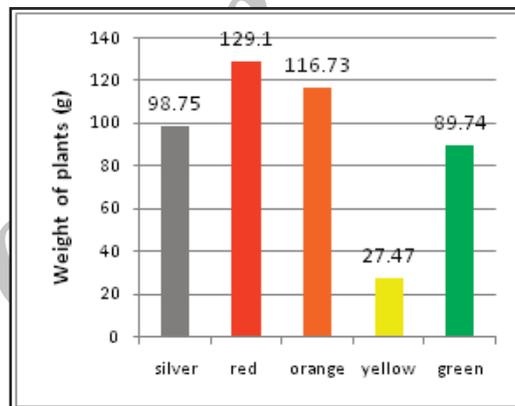


Fig. 2. Weight of plants as affected by colored plastic mulch.

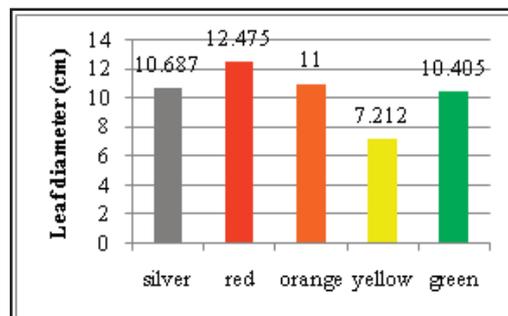


Fig. 3. Leaf diameter of plants as affected by different colored plastic mulchs.

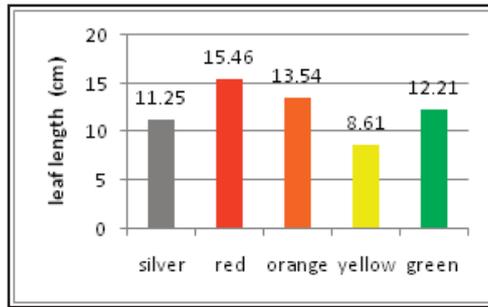


Fig. 4. Effect of colored mulchs on leaf length.

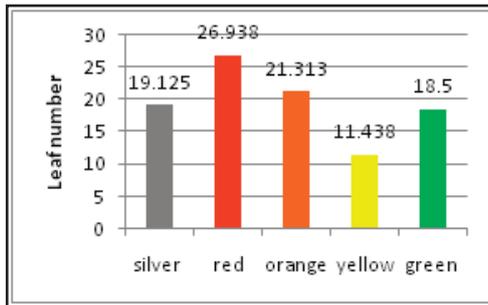


Fig. 5. Effects of different colored plastic mulchs on the number of leaves.

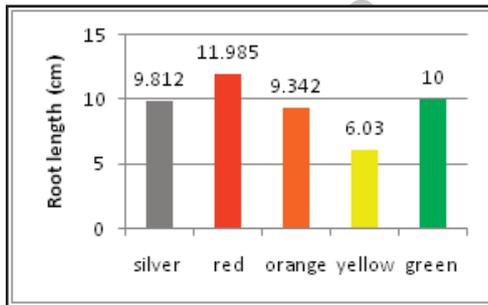


Fig. 6. Roots length as affected by colored plastic mulchs.