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Effect of Plastic Mulch on Sweet Potato Yield and Quality

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Abstract
Sweet potato, Ipomoea batatas, is a warmseason vegetable predominantly grown in the southern part of the United States. In recent years, its production region has expanded quite rapidly to various Midwestern and Eastern states.

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Introduction

Sweet potato, *Ipomoea batatas,* is a warm-season vegetable predominantly grown in the southern part of the United States. In recent years, its production region has expanded quite rapidly to various Midwestern and Eastern states.

Growing sweet potatoes in Iowa could be challenging especially due to the short growing season. The crop requires a long frost-free period and high soil and air temperatures to produce quality roots. Growing this crop on raised beds with plastic mulch could be an alternative technique as plastic mulch warms the soil and accelerates crop growth. When it comes to plastic mulch, growers primarily use black plastic; however, there are other colors available. A few of the commonly available mulch colors are red, olive, green, and white. This study investigated the effect of six mulch treatments: bare ground, black, green, olive, red, and white plastic mulches on yield and root quality of two sweet potato cultivars. Cultivars tested were Beauregard and Evangeline.

Materials and Methods

On May 23, 2014, sweet potato slips were planted on raised beds with six different mulch treatments. Each treatment had 22-ft-long beds/replication. Beds were spaced 6 ft center-to-center. Spacing between plants was 12 in. Experimental design was a split plot design arranged in a randomized complete block design with four replications. Cultivar (Beauregard or Evangeline) was the whole plot factor and mulch treatment was the split plot factor. Sweet potato slips were purchased from Jones Family Farms, Bailey, North Carolina. Soil type was Clarion loam, moderately eroded, with 5 to 9 percent slope. Weed control was achieved by hand hoeing two times before plants started vining. Crop was drip irrigated and irrigation frequencies were determined using Watermark® soil moisture sensors. Plots were harvested on September 15, 2014, by mowing off tops and lifting roots with a tractor-pulled under cutter. Roots were graded according to USDA grade standards and data was collected on yield and quality (average root length and diameter). Two roots were randomly picked from grade 1 and taken to the lab to analyze for sugar content. Remaining roots were cured at 80°F and a relative humidity of 80-90 percent for 14 days.

Results and Discussion

The 2014 growing season was not very conducive for sweet potato production. A wet spring with cool temperatures slowed sweet potato growth and the season came to an end early with cooler temperatures in the fall. Plants started vining out mid-July and produced healthy shoots. There was no interaction between cultivar and mulch treatments that enabled us to individually focus on the whole plot (cultivar) and subplot (mulch) treatments. There were no statistically significant differences in yield of jumbo grade roots between cultivars or mulch treatments (Table 1). Beauregard produced higher amounts of grade 1 roots than Evangeline. Beauregard is the most widely grown sweet potato cultivar. Evangeline is a relatively new cultivar with characteristics similar to Beauregard but with southern root-knot nematode resistance and higher sugar content.

Yield of grade 1 roots ranged from 3,919 to 8,989 lb/acre in mulch treatments. Bare ground produced the lowest amount of grade 1 roots. White plastic mulch treatment was the second lowest but it was statistically similar to bare ground and green plastic mulch treatments. There were no statistically significant differences in grade 1 yields between black, olive, or red plastic mulch treatments, yields of which were higher than white or bare ground treatments. Grade 2 root yield was higher for Evangeline than Beauregard. Red and white mulch treatments produced higher yields than black or green mulch treatments. There were no statistically significant differences in yield for grade 2 roots among mulch treatments. Non-marketable or culls were higher for Beauregard than Evangeline There were no statistically significant differences in culls among mulch treatments. Culls ranged from 1,936 lb/acre to 3,348 lb/acre.

There were no statistically significant differences in average root length or diameter between cultivars. However, Evangeline roots had higher sugar content than Beauregard (Table 2). Average root length was measured for grade 1 roots. Mulch treatments significantly affected average root length. White plastic mulch produced longer roots when compared with bare ground, green, olive, or red plastic mulch treatments. Average root length ranged from 18.0 to 25.3 cm. There were no statistically significant differences in average root diameter or sugar content among mulch treatments.

Mulch treatments significantly affected soil temperature, which impacts crop growth and yield (Figure 1). In the month of June, higher temperatures were recorded under green and olive than bare, red, or white mulch treatments. Temperatures ranged from 71.6 (white plastic) to 77°F (green plastic). Black plastic had statistically similar temperature when compared with green or olive mulch treatments. In the month of July, green, olive, and red mulch treatments had higher soil temperatures than white plastic mulch. There were no treatment differences in the month of August. In September, lowest soil temperature was recorded under the bare ground treatment, indicating a faster cool down that can potentially lower sweet potato yields.

There is a general trend of lower soil temperatures under white plastic or bare ground treatment. This correlates to lower grade 1 root yields in those treatments. Results from this study suggest the use of plastic mulch for sweet potato production as it directly affects root zone temperature and ultimately yield. Black, green, olive, or red mulches responded similarly indicating no differences among them. Use of white plastic mulch is not recommended as it maintains lower root zone temperatures leading to lower yields.

Table 1. Sweet potato yield in Jumbo, Grade 1, Grade 2, and Non-marketable (odd shaped, mice damaged, pest damage) categories in pounds per acre.

Treatment	Jumbo[w]	Grade 1[x]	Grade 2[y]	Non-marketable[z]
Cultivar				
Beauregard	583[NS]	9,227 A[†]	5,970 B	3,027 A
Evangeline	390	5,789 B	7,088 A	2,130 B
Mulch				
Bare ground	396 [NS]	3,919 c	5,928 ab	1,936[NS]
Black	701	8,802 a	5,828 b	2,993
Green	692	8,157 ab	4,969 b	2,343
Olive	412	8,989 a	6,677 ab	2,677
Red	261	8,962 a	6,999 a	2,172
White	460	6,219 bc	8,774 a	3,348

[w]Jumbo = roots 3 to 9 in. long and more than 3.5 in. in diameter.
[x]Grade 1 = roots 3 to 9 in. long and between 2.25 to 3.5 in. diameter.
[y]Grade 2 = roots 3 to 7 in. long and 1.5 to 2.25 in. diameter.
[z]Non-marketable = root less than 1.5 in. diameter, Malformed or abnormally shaped roots, and mice damage.
[†]Mean separation within columns for cultivar (uppercase) and mulch (lowercase); means followed by same letter(s) are not significantly different ($P \leq 0.05$).
[NS] Non-significant at $P \leq 0.05$.

Table 2. Root quality attributes of sweet potatoes as affected by cultivar and mulch treatments.

Treatment	Avg. root length (cm)	Avg. root width (cm)	Sugar content (Brix)
Cultivar			
Beauregard	20.2[NS]	7.6[NS]	7.9 B[*]
Evangeline	19.9	7.4	8.8 A
Mulch			
Bare ground	18.0 b	6.8[NS]	8.1[NS]
Black	21.8 ab	8.3	8.4
Green	17.3 b	7.0	8.6
Olive	18.9 b	7.3	8.2
Red	18.9 b	7.3	8.4
White	25.3 a	8.7	8.4

[NS]Non-significant at $P \leq 0.05$.
*Mean separation within columns for cultivar (uppercase) and plastic mulch (lowercase); means followed by same letter(s) are not significantly different ($P \leq 0.05$).

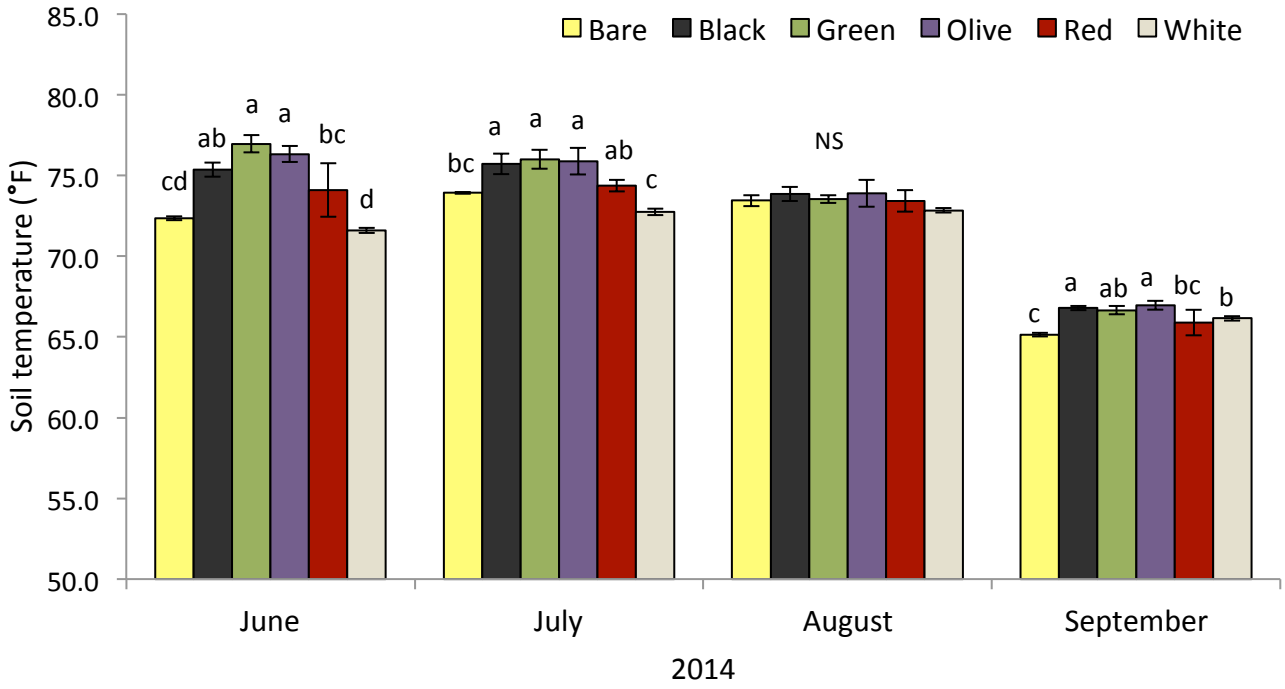

Figure 1. Effect of mulch treatment on soil temperature 6 in. under the soil. Mean separation between treatments within a month at P ≤ 0.05. Means followed by same letter(s) are not significantly different.