# Effect of Soil Mulching and Cultivar for Improved Winter Squash Production

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Kabocha squash is a winter squash derived from local Japanese squashes of the species *Cucurbita maxima* of the Cucurbitaceae family and is known commonly as Japanese pumpkin. The aim of this project was to evaluate the effect of soil mulch (±) on two types of cultivars (open-pollinated and hybrid) in two different soil types in Iowa. Results from this study will determine effects on soil moisture and temperature levels, plant yield, and relative sugar content of squash fruit at harvest and after curing and storage.

## Materials and Methods

Field experiments established in May 2021 included two different soil types at the Iowa State University Horticulture Research Station that best matched the soil of field plots in the Kamuli district in Uganda, where similar field studies were conducted. The experimental design was a randomized complete block with a split-plot arrangement of treatments. Soil mulching served as main plots and cultivars as subplots; four replications were used in each of two separate field locations that differed by soil types and were classified as Nicollet clay loam or Storden loam. The treatments consisted of two soil mulch (±) treatments, covering the soil surface with dried switchgrass *(Panicum virgatum)* applied at a 6-in. depth (+ mulch) or bare soil (– mulch), and two cultivars, open-pollinated, Squash Sweet Meat, (Harris Seeds Company) and hybrid, Winter Sweet (Johnny's Selected Seeds). Finished compost (University Compost Facility) at a rate of 3.0 tons per acre and synthetic fertilizers were applied to manage soil fertility levels to the recommended amounts of N, P, and K for squash production based on the soil test analyses. Trickle irrigation using a drip tape of 0.34 gallons per minute per100 ft. at 8 PSI was installed in each squash row at the start of the growing season and supplemental watering of all plots typically included four hours a week from May through September.

Two direct-seeded plants were thinned to one seedling, spaced at 4 ft. within and 8 ft. between rows. Plots were 18 ft. wide and 24 ft. long and included three rows and three plants per row for a total of nine plants per plot. One additional guard row was included per plot. Hand-hoeing was used to control weeds. Above-ground weed density was collected by counting and classifying the number of weeds per square foot, selected at random within each treatment plot. Soil thermometers were used to measure soil temperature weekly, while soil moisture levels were determined weekly using the gravimetric method. Fresh soil samples were collected, weighed, and oven-dried for 24 hours at 106°C to obtain moisture content on a dry weight basis of soil. Cucumber beetles (spotted and striped) and powdery mildew were controlled using recommended fungicides and insecticides.

Squash fruits were harvested on September 23 and included all fruits from three of the four rows in each subplot and evaluated as marketable or non-marketable in the field. Squashes were considered non-marketable based on visual evaluation of whether they had sun scald, damage from disease, insect, rodent, or mechanical injury, misshapen appearance, small size while mature, rough epidermis, or were immature. Percent soluble solid levels of two squashes randomly selected from each plot were measured using a digital hand refractometer. Squashes were cured for three weeks at 85°F and stored for an additional five weeks at 55°F.

Data for the variables soil moisture, soil temperature, weed growth, yield factors, and percent soluble solids were analyzed using SAS (PROC GLM). Mean separation within treatments was completed using Tukey HSD ($P \leq 0.05$).

## Results and Discussion

There were no significant interactions among main effects for number of weeds, number of total and marketable squashes, and percent soluble solids (Table 1). Significant interactions occurred within soil type and mulch for total and marketable weight and cultivar for marketable weight. Therefore, means for yield weight variables are presented separately by soil type (Table 2). Data and analysis presented include one growing season and are considered preliminary.

Soil moisture levels showed an average moisture content of 20.5% in mulched plots and 17.8 % in non-mulched plots. Soil moisture content at 6-in. and 12-in. soil depth had a mean moisture content of 21.8% and 18.2% in mulched plots and 17.5% and 18.2% in non-mulched plots, respectively.

Nicollet clay loam's moisture content (21.3%) was higher than that of the Storden loam (17.1%). A lower soil temperature occurred for mulched treatment plots versus non-mulched plots (Table 1).

**Table 1. Effects of soil mulch and cultivar treatments in two soil types on soil temperature, weed number, total and marketable number of squashes at harvest, and percent soluble solids of squashes at harvest and after eight weeks, preliminary analysis.**

| Treatment | Soil temp | Weed number (per sq ft)[zy] | Total squash (number÷ per sq f)t[zy] | Marketable squash (number÷ plot)[y] | Soluble solids at harvest (%)[x] | Soluble solids after 8 weeks (%)[x] |
|---|---|---|---|---|---|---|
| **Soil Mulch (±)** | | | | | | |
| Non-mulched | 78.6 a[w] | 9.33 a | 55 a | 31 a | 12.3 a | 14.5 a |
| Mulched | 71.1 b | 0.64 b | 58 a | 37 a | 11.7 a | 13.6 a |
| **Cultivar** | | | | | | |
| Squash Sweet Meat | 74.7 a | 5.03 a | 47 b | 27 b | 12.3 a | 14.5 a |
| Winter Sweet | 75.0 a | 4.94 a | 66 a | 41 a | 11.7 a | 13.6 a |
| **Soil Type** | | | | | | |
| Nicollet clay loam | 74.8 a | 5.6 a | 57 a | 41 a | 11.8 a | 13.8 a |
| Storden loam | 74.8 a | 4.4 b | 56 a | 27 b | 12.2 a | 14.3 a |

[z] Number of weeds per square ft. selected at random within a plot.
[y] Plot dimensions included three rows and nine plants; each row was 18 ft. wide and 24 ft. long with three plants per row.
[x] Measurement after eight weeks, which included curing for three weeks and storage for five weeks.
[w] Mean separation within treatments by Tukey HSD. LS Means followed with the same letter within the column and treatment are not significantly different from one another, $P \leq 0.05$.

Number of weeds per square foot was lower in mulched plots, with less than one weed, compared with non-mulched plots (Table 1). Monocotyledonous weed numbers were lower (4.3) than dicotyledonous weeds (5.6), and Nicollet clay loam plots had higher weed numbers than Storden loam plots.

Total number and marketable number of squashes were higher in plots with Winter Sweet (Table 1).

Squash Sweet Meat grown in Nicollet clay loam soil without a soil mulch had higher total and marketable weights at harvest than Winter Sweet grown with and without soil mulch (Table 2). No differences occurred for yield weights among treatments when squash was grown in Storden loam soil (Table 2). Losses of marketable yield across all experimental plots at harvest mostly were due to small sized fruits (37.8%), rough epidermis (18.1%), misshaped fruits (14.6%), and rodent damage (9.5%).

Treatments did not affect percent soluble solids of squash at harvest or after storage (Table 1).

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**Table 2. Effects of soil mulch and cultivar treatments on total and marketable weight of fruit at harvest of Kabocha winter squash grown in two soil types, preliminary analysis.**

| Cultivar and soil mulching treatment combinations within a soil type | Total squash weight (kg per plot)[z] | Marketable squash weight (kg per plot) |
|---|---|---|
| **Nicollet clay loam** | | |
| Squash Sweet Meat; non-mulched | 293.7 a[y] | 229.5 a |
| Squash Sweet Meat; mulched | 221.4 ab | 176.4 ab |
| Winter Sweet; non-mulched | 145.2 b | 106.0 b |
| Winter Sweet; mulched | 130.9 b | 111.3 b |
| **Storden loam** | | |
| Squash Sweet Meat; non-mulched | 177.8 b | 86.3 b |
| Squash Sweet Meat; mulched | 242.1 ab | 158.3 ab |
| Winter Sweet; non-mulched | 129.6 b | 63.1 b |
| Winter Sweet; mulched | 139.5 b | 86.4 b |

[z] Plot dimensions included three rows and nine plants; each row was 18 ft. wide and 24 ft. long with three plants per row.
[y] Mean separation within soil types and treatments by Tukey HSD. LS Means followed with the same letter within the column and soil type are not significantly different from one another, $P \leq 0.05$.