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Evaluation of Two Sakurab (*Allium Chinense* G. Don) Varieties under Various Mulching Materials

Adley L. Masnar[1*]

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ABSTRACT

This study focuses on the evaluation of two varieties of Sakurab (*Allium chinense* G. Don) under various mulching materials. Sakurab, also known as Chinese onion, holds cultural significance for the Meranao tribe in the Philippines and is traditionally processed into "palapa," a key ingredient in their recipes. Despite its cultural importance, there is a lack of scientific understanding of Sakurab's growth and development, especially regarding the influence of mulching. The research is conducted in Saguiaran, Lanao del Sur, Philippines, and employs a randomized complete block design with two varieties (Rikit and Urder) and four mulching materials (No Mulch, Corn Stalk, Rice Straw, Plastic Mulch). The study aims to assess the growth and development of Sakurab varieties and determine the effects of different mulching materials on crop growth and yield. Results indicate significant differences in plant height between varieties, with Urder being taller. Mulching materials, especially corn stalk, significantly impact plant height, emphasizing the importance of mulching in crop management. The number of leaves per hill is influenced by both variety and mulching material, with Rikit displaying greater leaf counts. Crop stand at harvest is significantly affected by variety, mulching material, and their interactions, with corn stalk mulch contributing to higher stand counts. Vegetative yield per hectare is influenced by the interaction of variety and mulching material, with corn stalk mulch enhancing yields. Similarly, vegetative yield per hill is significantly affected by variety and mulching material, emphasizing the importance of these factors in determining crop productivity. Bulb yield per hill varies significantly between varieties and is positively influenced by corn stalk mulch. The number of bulbs per hill is significantly higher in Rikit, indicating a faster rate of bulb division. The length of bulbs is significantly longer in Urder, with corn stalk mulch contributing to increased bulb length. Moreover, understanding the morphological growth and development of Sakurab varieties and the influence of mulching materials is crucial for optimizing crop production. The study provides valuable insights into the cultural and agricultural significance of Sakurab, offering a foundation for further research and development in the Sakurab industry.

INTRODUCTION

Sakurab (*Allium chinense* G. Don) is a perennial plant and a member of Alliaceae family, which includes herbaceous perennial flowering plants distributed throughout the world in most of the temperate regions. Plant height is up to 0.5 m and producing evergreen bulbs. It has hollow bright green leaves, grows in clumps and forms many well developed bulbs (Fritsch & Friesen, 2002). In Philippines, this Allium species (sakurab) is considered by Meranao tribe as a native or indigenous crop which is usually planted at the hilly and sloppy areas of Lanao del sur. They used this, by simple processing, producing a product known as "palapa", a primary ingredient for every cooked recipes. The art of making "palapa" is a way of preserving Meranao culture which the recipe are being handed down from ancestors through the generation to generation of the Meranao tribe.

Meranao literally means people of the lake or the dweller of the lake. Their civilization and culture is associated with the lake. Apparently Lake Lanao is vital in the life of the Meranao. However, it has been shown that sakurab is more important to the Meranao than the lake. Nowadays, the Meranaos are scattered all over the Philippines and even some parts of the world as a result of the 1972 Martial Law and the 2017 Marawi Siege. The existence of Meranaos outside their homeland proves that they can live without a lake but not without sakurab. Wherever Meranao goes, sakurab is with them.

Most of the Meranaos know sakurab only as a spice crop or a condiment but not its cultural requirements, and its added values. The production of sakurab can be a potential source of farmer's income in particular and national economy in general. Hence, any activity leading to the sakurab industry development will benefit both the farmers and the country. Understanding sakurab, its nature or characteristics and its behaviour in response to various production and management practices should be the first step in developing its production. Up to now, there is no study undertaken about this crop.

For instance, the morphological growth and development of the existing sakurab varieties is not clearly understood or known. These particular characteristics have bearings on the productivity of any crop. Consequently, growth regulation had been used to improve the productivity and adaptability of many horticultural crops. Same might be done to sakurab if its growth and development is fully understood.

[1] College of Agriculture, Mindanao State University, Main Campus, Marawi City, Philippines
[*] Corresponding author's email: adley.masnar@msumain.edu.ph

Another aspect is the influence of mulching. Can mulching enhance the growth and yield of sakurab? What about the different mulching materials? The influence of mulching on the growth and yield of sakurab is a crucial aspect that requires thorough investigation.

The current studies deal on the characterization of sakurab and evaluating whether different mulching materials can enhance the overall growth and yield of the crop. These studies are expected to generate basic information about the crop particularly its morphological characters and its basic production practices

Objectives

1. Characterize the morphological growth and development of two varieties of sakurab in Lanao del Sur; and
2. Determine the effects of different types of mulching materials on the growth and yield of sakurab

MATERIALS AND METHODS

Site Description

The field experiments were conducted at Saguiaran, Lanao del Sur, Philippines (8°00'38" N and 124°16'06" E, 625.5 Masl), from March 5, 2020 to July 5, 2020. The experimental area falls under Type IV climate, characterized by evenly distributed rainfall throughout the year, with soil classification of adtuyon clay. The field is slightly sloping but takes 1-2 days to drain during heavy rains.

Experimental Design

This study was laid out in 2 x 4 split plot in Randomized Complete Block Design (RCBD). There were three replications with a total area of 5.5 x 8.5 m (46.75 sqm) which was divided into three equal blocks. of 13.75 sqm. Each block represented as replication having a 0.5 meter distance in between. These were divided into two equal parts to represent main plot: Variety [V1 – Rikit (Small Variety) and V2 – Urder (Large Variety)] measuring 6.5 sqm and having 0.5 m distance in between. Each main plot was divided into four equal parts to represent sub plot: Mulching Materials (M1 – No Mulch, M2 – Corn Stalk, M3 – Rice Straw and M4 – Plastic Mulch. Each sub plot had 1 sqm and the distance between sub plot was also 0.5 m. Plots were framed to keep the soil intact within plot. Each plot was planted with 100 hills.

The following treatments were evaluated in this study:

Main Plot: – Variety

V_1 – Rikit (small variety)
V_2 – Urder (large variety)

Sub-Plot: – Mulching

M_1 – No mulch
M_2 – Corn stalk
M_3 – Rice straw
M_4 – Plastic mulch

Cultural Management Practices

Preparation of the Plots

The area was prepared by alternate plowing and harrowing until good soil tilt was achieved. Afterwhich, the experimental plots were laid-out using spade and rake. Each plot measuring 1 x 1 m (1 sqm) was constructed with a wooden box within the perimeter in order to capture possible soil erosion and maintain raised bed. The beds were enclosed to prevent erosion during heavy rains. Moreover, the mulching materials were applied to the respective plots one week before planting. Organic mulches such as rice straw and corn stalk were applied at 5 cm thick while plastic sheet inorganic mulch was applied in single sheet.

Preparation of Planting Materials

Bunches of Rikit (small variety) and Urder (large variety) of sakurab from Piagapo, Lanao del Sur were used in this experiment. The leaves and roots of the plants were pruned to attain at least 15-20 cm length of planting materials (Figure 1). Each bulb was separated from the cluster to serve as one planting seed piece.

Figure 1: Bulblets of pruned sakurab planting materials

Planting Method

Single bulb was directly planted into a hole made by using Buso (A heavy solid sharpened metal) at a depth of 5 cm. The planting distance between rows was 10 cm and between hills was also 10 cm having 100 plants in every 1 sqm plot.

Fertilizer Application

Vermicast fertilizer produced from Hijra Organic Farm at Saguiaran, Lanao del Sur was used in the studies. Blanket application of organic and inorganic fertilizers was done to all plots. The rate of Inorganic fertilizer (14-14-14) was 600 kg per hectare while organic fertilizer (Vermicast) was 30 tons per hectare. In these rates, 14-14-14 was applied

at 60 grams per plot while vermicast was applied at 3 kg per plot. The recommended rate for bulb and green onions is 385-860 kg/ha of 14-14-14.

Water Management
Hand watering was employed using water sprinkler. First watering was done right after planting the bulbs. A total of four gallons of water was applied per plot every day for one week at 7:00 am. Succeeding watering was done at three days interval up to the end of the experiment. However, the area was not watered during rainy days.

Weed Management
To keep the experimental area clean, the pathway in between blocks and plots were maintained weed-free. Likewise, weeds that grew in the experimental plots were pulled or removed every two weeks by hand-pulling to prevent competition for nutrients, water, carbon dioxide, space and sunlight.

Harvesting
The crops were harvested at four (4) months after planting and this was done by gently loosening the surrounding soil using spade to carefully pull them up.

Data Gathered
Plant Height (cm)
This was taken by measuring the height of 10 sample plants randomly selected at the inner portion of the experimental plot every week. Measurement was done from the soil base up to the tip of the leaves.

Number of Leaves
This was taken by counting the number of leaves of 10 sample hills randomly selected at the inner portion of the experiment every week.

Crop Stand at Harvest (%/plot)
This was recorded by getting the proportion of plants that survived per plot multiplied by 100 (at harvest).

Vegetative Yield (ton/ha)
This was computed using the formula:

$$Vegetative\ Weight\ \left(\frac{\text{ton}}{\text{ha}}\right) = \frac{\text{Yield}}{\text{Plot}} kg\ x\ \frac{10000\ \text{sqm}}{1000\ ton}$$

Vegetative Yield (g/hill)
This was done by weighing the bunch of 10 sample hills randomly selected at the inner portion of the experimental plots.

Bulb Yield (g/hill)
This was recorded at harvest by weighing the bulbs of 10 sample hills randomly selected at the inner portion of the experimental plot. This was taken by removing the leaves from the bulbs, leaving only the edible parts.

Number of Bulbs Per Hill
This was recorded at harvest by counting the bulbs of 10 sample hills randomly selected at the inner portion of the experimental plot.

Length of Bulbs Per Hill (cm)
This was done at harvest by measuring the bulb length of 10 sample plants randomly selected at the inner portion of the experimental plot. Measurement was done from the base up to the neck of bulb.

Statistical Analysis
All data in these studies were tabulated and statistically analyzed using the Analysis of Variance (ANOVA) in RCBD with three replications to determine significant differences among treatment combinations. Comparison among means for significantly different parameters was done using Least Significant Difference (LSD) tests. The Statistical Tool for Agricultural Research (STAR) program was used for ANOVA and comparisons of treatment means.

RESULTS AND DISCUSSION

Plant Height
The difference in plant height between varieties was significant and the difference in plant height between mulching materials was highly significant but the interaction between variety and mulching materials in plant height showed no significant effect (Figures 2 and 3) As shown in Figure 2, variety Urder was significantly taller (31.45 cm) across mulching materials, while the other variety was significantly shorter (23.85 cm) across mulching materials. However, plant height of both varieties were relatively shorter, compared to the height of similar varieties in the farmer's fields, an indication of poor growth conditions. The experimental site has lower elevation against the highland sites of the farmers. In addition, there was an extended drought at the onset of the experiment, and frequent heavy rains towards crop maturity. Incidentally, the experimental site was relatively flat without efficient drainage, unlike the farmer's fields which are rolling lands that easily drain.
Plants mulched with corn stalk were the tallest (34.49 cm) as compared to those mulched with rice straw (27.21 cm) and plants mulched with plastic sheet (23.07 cm) Figure 3). However, plants without mulching materials had an average plant height of 25.83 cm, which were comparable to the plants with rice straw and plastic sheet mulches.
This is an indication that mulching is an important technology which decreases the loss of soil water through evaporation and conserve soil moisture thus reduces the irrigation requirements, increasing root development, promote faster crop development, reducing weed attack and induce earlier harvest of crops (Mahajan *et al.*, 2007). However, plastic mulches are sometimes undesirable in warmer conditions for increasing soil temperatures (Infonet Biovision, 2019). The higher rates of withering in plants provided with plastic mulch indicate that soil temperatures were raised during the warm and dry weather.

Number of Leaves Per Hill

There was a significant difference between Rikit and Urder varieties and highly significant difference between mulching materials in number of leaves/hill. However, there was no significant interaction between the variety and mulching material (Figures 4 and 5).

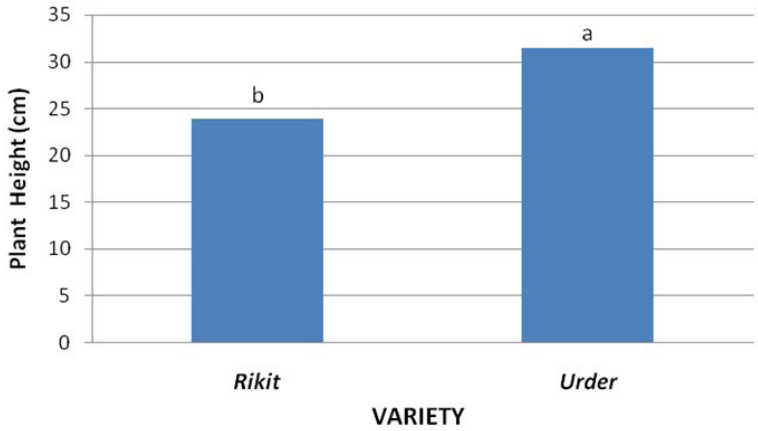

Figure 2: Plant height (cm) of two varieties of sakurab at harvest under different mulching materials. Saguiaran, Lanao del Sur. 2020

Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

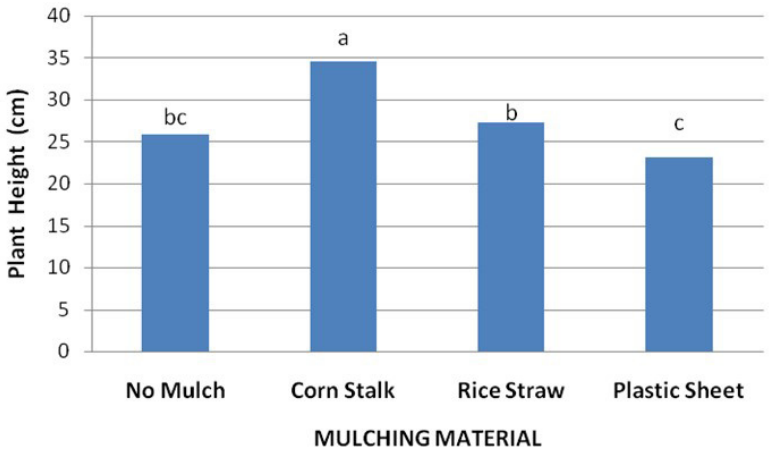

Figure 3: Plant height (cm) of sakurab at harvest as affected by different mulching materials. Saguiaran, Lanao del Sur. 2020

Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

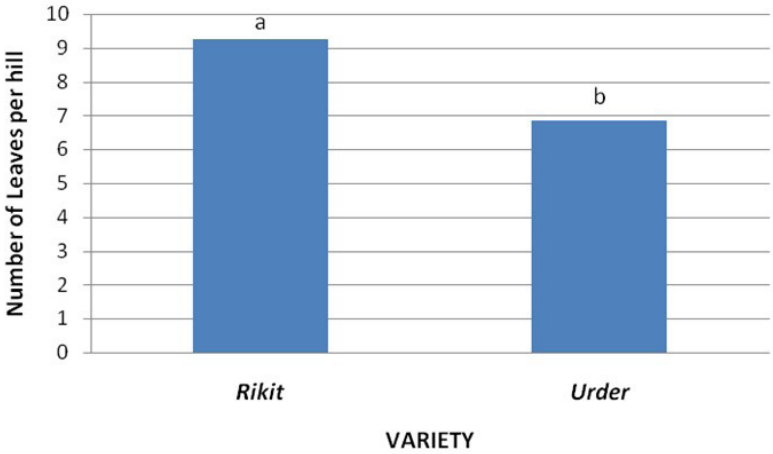

Figure 4: Number of leaves (leaves/hill) of two varieties of sakurab under different mulching materials. Saguiaran, Lanao del Sur. 2020

Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

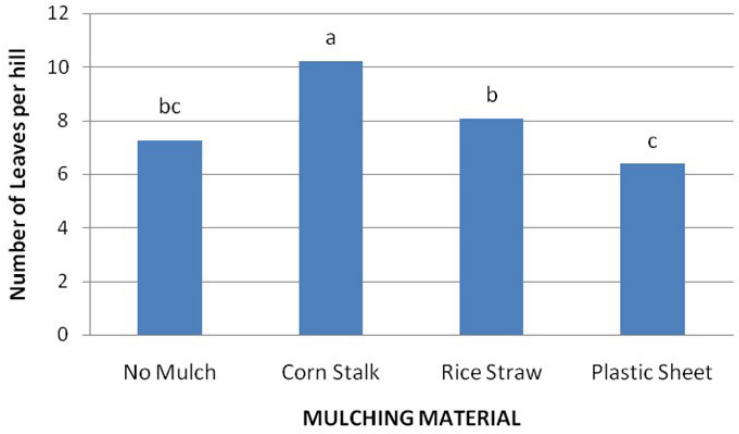

Figure 5: Number of leaves (leaves/hill) of sakurab as affected by different mulching materials. Saguiaran, Lanao del Sur. 2020

Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

Greater leaf counts of 9.26 leaves/hill were displayed by variety Rikit, and lesser number of leaves/hill was counted from variety Urder having 6.85 leaves/hill (Figure 4). The highest significant leaf counts of 10.22 leaves/hill were found in plants with corn stalk mulch (Figure 5). The lowest of 6.40 leaves/hill was counted from the plants with plastic mulch. Plants without and with rice straw mulch had comparable leaf counts of 7.25 and 8.08 leaves/hill, respectively. However, the effect of plastic mulch was similar to those without mulch in inducing withering and die back, and eventual lower leaf count.

Leaf number is a function of bulb counts or vice versa. Each bulb that splits from the mother plant, maintains a certain level of leaf area index that sustains the growth of the bulb, for eventual splitting again. The greater the number of bulbs in a cluster, the more leaf counts are there or vice versa. However, lavish leaves as in volcanic fertile soil are not desirable as it tends to pull plant nutrients to sustain the integrity of the foliage, rather than stimulate bulb growth for an increased marketable yield.

Crop Stand at Harvest

Differences between varieties, among mulching materials, and their interactions were both highly significant in crop stand (Table 1).

Variety Rikit incurred higher die back and missing hills with crop stand ranging from 41.30 to 78.00 percent/plot, in contrast to variety Urder which marked a range of 80.70 to 94.70 percent/plot (Table 1). This result implies that variety Rikit is more sensitive than variety Urder under warm and dry conditions.

Table 1: Crop stand (%/plot) of sakurab at harvest as affected by variety and mulching material. Saguiaran, Lanao del Sur. 2020

Mulching Material	Variety	
	Rikit	Urder
No Mulch	57.30^{b}	94.00^{a}
Corn Stalk	78.00^{a}	94.70^{a}
Rice Straw	41.30^{c}	86.70^{b}
Plastic Sheet	57.30^{b}	80.70^{b}

Means in column with uncommon letter superscripts are significantly different at 5% level, using LSD test of significance

Plants with corn stalk mulch consistently showed the highest stand counts in both varieties with a 78.00 and 94.70 percent/plot on Rikit and Urder, respectively.

However in variety Rikit, the lowest stand counts of 41.30 percent/plot was recorded from rice straw mulch. Similar crop stands were observed from plants without mulch and those with plastic sheet.

In variety Urder, lowest stand count of 80.70 percent/plot was noted from the plants with plastic mulch but did not differ from plants mulched with rice straw having a stand count of 86.70 percent/plot. Moreover, corn stalk and without mulch in variety Urder were similarly better in crop stand having 94.70 and 94.00 percent/plot, respectively.

Sakurab varieties do not respond to mulching under conditions of cooler environment as demonstrated in the cooler environments in northern Vietnam and Japan. In the Philippines where the crop is predominantly grown at medium elevations, such as in Lanao del Sur, mulching becomes a vital component in crop management without any particular choice of organic mulching materials in the highland of 1200 masl. In the current studies, which were undertaken at lower elevation, the kind of mulching materials was critical due to the temperature-based requirement of the crop for growth and development. Mulching material such as plastic sheet raises soil temperatures to levels that do not favour plant growth and development (Infonet Biovision, 2019). Absence of mulch similarly cause temperature increases in the surface of the soil due to direct exposure to solar and thermal radiations. Such conditions go beyond the threshold temperature levels that the crop can tolerate. Rice straw mulch is relatively faster in decomposition, which exposes the soil to warm temperatures before the crop reaches the desired crop maturity. Corn stalk mulch remains undecomposed until harvest, and is loose

enough to permit air circulation within the micro climate of the crop, thereby producing a cooling effect on the soil surface.

Mulching under Philippine conditions, where sakurab is grown mostly in Lanao, the elevations are rather low that do not completely simulate the conditions of the winter season in other major sakurab growing countries. The choice of mulching materials is critical for its effect on soil temperatures, so that crop stand is maintained within standard plant density. In the current study, the notable decrease in crop stand below 60% is a deviation from normal crop stand in sakurab production. Under elevations above 900 masl in Barangay Bualan, Balindong, Lanao del Sur, crop stand does not go below 95% regardless of organic mulching materials as claimed by farmers. The absence of mulching material is definitely non-negotiable, regardless of kind but not plastic sheet, or any material that can raise soil temperatures beyond critical level.

Vegetative Yield Per Hectare

Interactions of variety and mulching material had highly significant influence on vegetative yield/ha of "sakurab" (Table 2 and Figure 6).

Vegetative yield/ha of variety Rikit (4.20 ton/ha) and variety Urder (10.70 ton/ha) were both improved by corn stalk mulch (Table 2 and Figure 6). However, rice straw mulch did not increase the vegetative yield/ha of Rikit (1.20 ton/ha) and Urder (5.00 ton/ha). Moreover, plastic sheet mulch did not affect the vegetative yield/ha of Rikit (0.90 ton/ha) and Urder (2.90 ton/ha). The vegetative yield/ha of plants without mulching materials were 1.30 ton/ha in Rikit and 5.90 ton/ha in Urder.

Computation of vegetative yield/ha was based on actual plot yield which reflected the rate of plant survival. The two varieties which were treated with different production stimuli such as different mulching materials showed varied responses in terms of vegetative yield/ha. Apparently, the different mulching materials provided uncommon impacts on the soil conditions, more particularly on soil temperatures (Kader *et al.*, 2017; Jordan *et al.*, 2010; John *et al.*, 2005; Iriany *et al.*, 2017).

Survival rates of plants were expressed in crop stand which are shown in Table 1. Obviously, heavier vegetative weights were obtained from plots with greater crop stand. Mortality rates were primarily attributed to the unfavourable weather during the conduct of experiment. The weather was unusually dry and warm at early stages of plant growth and development and was characterized by heavy and frequent rainfalls towards crop maturity. Such unfavourable weather conditions induced plant withering and eventual die back. Plants subjected to longer dry and warm weather under a soil covered with a mulching material that inherently raise soil temperatures suffered heavier losses due to plant withering and die back.

Observations from farmer's field revealed that the same unfavourable weather conditions did not cause plant die back at higher elevations (> 1000 masl) where soil temperatures were not significantly increased but heavy mortality rates were also noted down hills in the same locality with altitude decrease of 50-100 m. Incidentally, only corn stalk mulching material was applied to the crop. Such observation suggests that mulching with corn stalk did not cause a rise in the soil temperature, high enough to induce plant die back.

Table 2: Vegetative yield (ton/ha) of sakurab as affected by variety and mulching material. Saguiaran, Lanao del Sur. 2020

Mulching Material	Variety	
	Rikit	**Urder**
No Mulch	1.30[b]	5.90[b]
Corn Stalk	4.20[a]	10.70[a]
Rice Straw	1.20[b]	5.00[b]
Plastic Sheet	0.90[b]	2.90[c]

Means in column with uncommon letter superscripts are significantly different at 5% level, using LSD test of significance

The superiority of corn stalk as mulching material of sakurab, particularly at lower elevations, with warmer temperatures, is due to its characteristic to insure air circulation into the soil surface. It is loosely packed above the soil that permits air movement to buffer possible soil temperature rise. The smooth stem can also reflect incoming heat, either solar or thermal. It provides a continuous soil cover throughout crop growth due to its slow decomposition process. On the other hand, rice straw is compactly packed above the soil that causes limited air movement into the soil surface. It can also partially or completely decompose prior to crop harvest which may render the soil naked to allow more heat movement into the soil. Plastic sheet is not a suitable mulching material for a cool temperature-loving plant such as sakurab. It traps heat within the soil surface that may cause a rise in soil temperature above critical level for bulb division and development. It can also cause a barrier for the emergence of newly dividing bulbs in view of closer spacing of the crop.

In the highlands where temperatures are relatively cool, far from being critical, the choice of organic mulches is not a problem, except for plastic sheet which has not been evaluated at higher elevations. Farmers select mulching materials on the basis of availability. Most growers are using corn stalk and rice straw. Others prefer cogon leaves in the absence of corn stalk and rice straw. Farmers in the highlands are growing sakurab for fresh market, who are concern with vegetative yield. Growers at lower elevation are backyard gardeners who do not care mulching their gardens.

Sakurab growing in China, Japan, Vietnam and others are undertaken in the temperate or sub-temperate zones and are done during winter season (Wang *et al.*, 2002). Survival rate of the crop is consistently high even if the crop is not provided with mulching material. In the Philippines where sakurab is grown in Lanao with temperatures not too cool for the crop, mulching is a vital component in sakurab

market or commercial growing. Although mulching does not cause soil temperature rises above critical levels at higher elevations, it offers so much benefits particularly weed control, soil moisture preservation, improving soil water-holding capacity, provision of mineral nutrients and improving soil conditions (Hatch *et al.*, 2007; Singh *et al.*, 2011). Consequently, farmers do not leave their crops without mulching.

Variety Rikit was adversely affected than variety Urder in terms of vegetative yield/ha. Apparently this variety has lesser tolerance to adverse conditions brought about by variety and mulching interactions. However, variety Urder suffered more losses with plastic mulching material, suggesting that this variety has narrower range of high temperature tolerance than variety Rikit. It was demonstrated that under similar production stimuli, the two varieties had comparable vegetative yield/ha. Variety Rikit having smaller bulbs produced more bulbs, while variety Urder having fewer bulbs are larger. Consequently, providing the crops with common production stimuli, the two varieties will demonstrate similar yield potentials for fresh market as long as those are harvested after 3-4 months of planting.

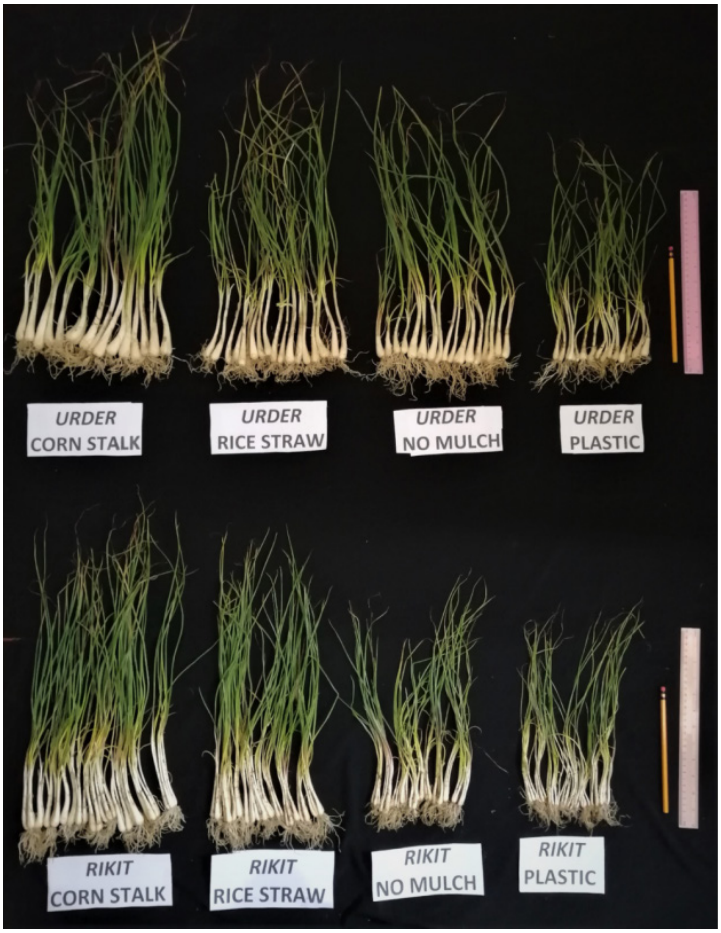

Figure 6: Harvested bunches of Rikit and Urder varieties of sakurab at different mulching materials (10 hills/plot)

Vegetative Yield Per Hill

Vegetative yield/hill was not significantly affected by the interactions of varieties and mulching materials (Figures 6, 7 and 8). Significant difference in vegetative yield/hill was noted between varieties with Urder, marking a higher yield of 9.60 g/hill and Rikit having only 6.40 g/hill (Figures 6 and 7). Highly significant variations were observed among mulching materials (Figures 6 and 8).

Plants without mulching materials produced 6.67 g/hill which were comparable to plants applied with rice straw mulch having 7.72 g/hill (Figure 8). Corn stalk mulch significantly raised the vegetative yields to 13.72 g/hill. On the other hand, plastic mulch significantly reduced the vegetative yields down to 3.77 g/hill. The impact of plastic mulch on soil temperature considering the long dry and warm periods during the early stage of plant growth and development may have caused an inhibitory action on bulb division and growth.

Differential vegetative yield/hill was caused by the additive influences of bulb size, bulb length and plant height which were greater in Urder and in plants with corn stalk mulching material. Number of bulbs and leaves were found greater in Rikit but the compounded influence of these parameters did not overcome the cumulative effect of the former parameters, maintaining variety Urder and corn stalk mulching materials consistently better than their counter parts. The obvious superiority of Urder as variety and of corn stalk as mulching material, as well as the observed antagonistic action of plastic sheet as mulching material on the vegetative yield/hill of sakurab

offer similar explanation as in vegetative yield/ha.

Vegetative yield/hill was based on the weight of 10 randomly selected hills from experimental plots. Hence, the estimated potential vegetative yields of Urder and Rikit, at lower elevation (625 masl), provided with corn stalk mulching materials, shall be 15.50 and 11.90 ton/ha, respectively. Given a conservative farm gate price of fresh market sakurab at Php 200.00/kg, the prospective income/ha shall be 3.1-4.546M and 2.3-4.020M pesos, respectively for Urder and Rikit varieties. The crops attain harvestable age at 3-4 months of planting.

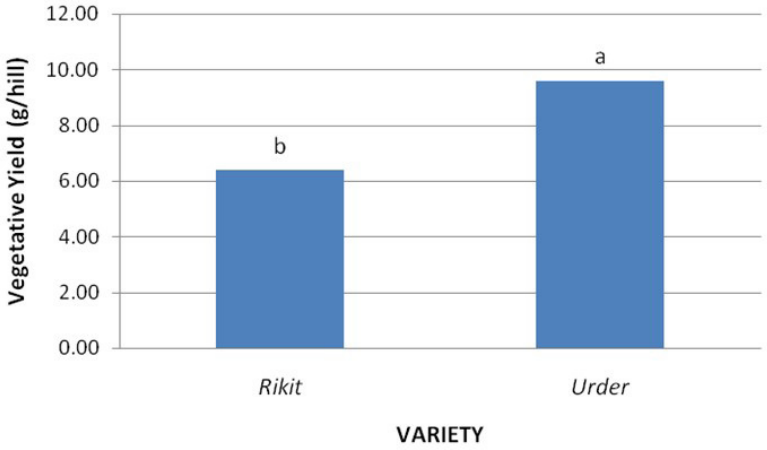

Figure 7: Vegetative yield (g/hill) of two varieties of sakurab under different mulching materials. Saguiaran, Lanao del Sur. 2020

Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

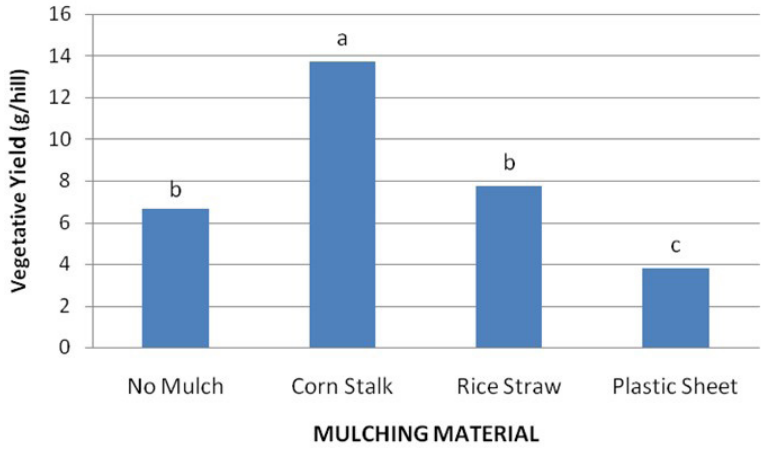

Figure 8: Vegetative yield (g/hill) of sakurab as affected by different mulching materials. Saguiaran, Lanao del Sur. 2020

Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

Bulb Yield Per Hill

Interactions of varieties and mulching materials on bulb yield per hill were highly significant. While the difference between varieties and mulching material was significant (Table 3).

Bulb yield of variety Rikit was significantly enhanced by the application of corn stalk mulch having 7.10 g/hill (Table 3). The application of rice straw mulch and those without mulch showed no influence on bulb yield per hill in both varieties. Plants applied with rice straw mulch obtained 4.10 g/hill which was comparable to those without mulching materials having 3.10 g/hill. However, the response of Rikit without mulch was similar to those plants mulched with plastic sheet having 1.90 g/hill.

On the other hand, bulb yield of variety Urder was also significantly enhanced by the application of corn stalk mulch having 13.40 g/hill (Table 3). Plants without mulch and those with rice straw mulch produced similar bulb yields of 6.70 and 7.60 g/hill, respectively. Plastic sheet mulch had significantly reduced the bulb yield into 3.60 g/hill.

Measurement of bulb yield is of less importance in the current sakurab production system in the Philippines but it is the foremost concern of sakurab farmers abroad. Among the Meranaos, vegetative yield is of prime importance in determining the market value of the crop because it is grown for fresh market. Other nationals utilize the crop in the form of pickles where bulbs are preserved without the leaves. Filipinos utilize the crop in the form

of fresh or preserved "palapa" without incorporating the leaves, but consumers shy away from buying commodity without fresh-looking leaves. Future expansion of sakurab production beyond fresh market growing such as pickle making shall have to regard the importance of bulb yields, which proves the relevance of this information.

Table 3: Bulb yield (g/hill) of sakurab as affected by variety and mulching material. Saguiaran, Lanao del Sur. 2020

Mulching Material	Variety	
	Rikit	**Urder**
No Mulch	3.10^{bc}	6.70^{b}
Corn Stalk	7.10^{a}	13.40^{a}
Rice Straw	4.10^{b}	7.60^{b}
Plastic Sheet	1.90^{c}	3.60^{c}

Means in column with uncommon letter superscripts are significantly different at 5% level, using LSD test of significance

Number of Bulbs

The difference between varieties in number of bulbs/hill was highly significant. However, there was no significant difference among mulching materials, as well as the interactions between variety and mulching materials (Figure 9).

Variety Rikit had smaller bulbs with faster rate of bulb division, approximately 4.16 bulbs in a span of four months (Figure 9). The other variety was only capable of producing 1.73 bulbs in similar span of time. Bulbs in Rikit were smaller, in contrast to larger bulbs in Urder. Moreover, in spite of greater bulb counts in Rikit, bulb weight was still heavier in Urder. In such phenomenon, bulb number had lesser influence on the marketable yield of the crop, which is determined by weight.

The rapid rate of bulb division in Rikit suggests that the saturation point for biochemical loading of cells in smaller bulbs is earlier achieved but delayed in larger bulbs. The incoming biochemical inputs from photosynthesis and metabolisms can stimulate rapid bulb division, hence the greater number of bulbs in Rikit. Bulb division becomes apparent from the split of mother bulbs. It is suggested that the saturation of bulbs for biochemical components initiates vegetative bud growth. When the leaves emerged at the neck of the bulbs and become capable of photosynthesis, the two newly divided bulbs start to be independent in carbon synthesis, giving rise to the full development of new mother bulbs for another wave of bulb division. Splitting of bulbs tends to continue as long as growth stimuli are available until harvest, or until a shift to reproductive phase by virtue of cooler temperatures (Mengel & Kirkby, 2001; Smith & Rao, 2018; Khokhar, 2019 and 2017).

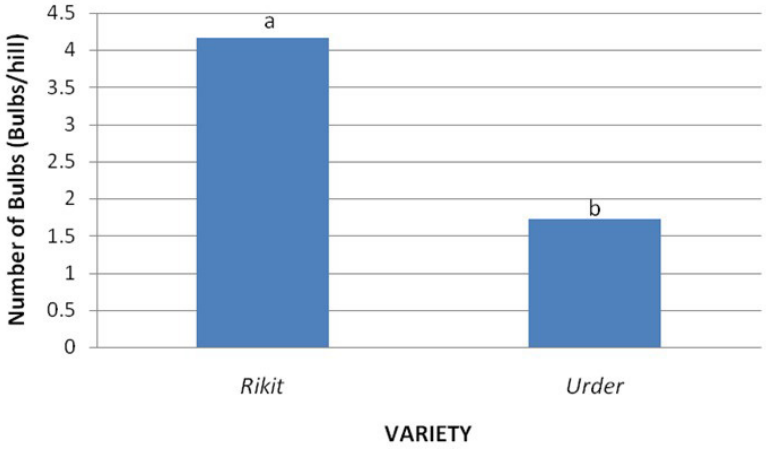

Figure 9: Number of bulbs (bulbs/hill) of two varieties of sakurab under different mulching materials. Saguiaran, Lanao del Sur. 2020

Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

Length of Bulbs

Differences between varieties and among mulching materials in length of bulbs were both highly significant (Figures 10 and 11). However the interaction between variety and mulching materials was not significant. Variety Urder had significantly longer tapered bulbs of 9.57 cm, while the other variety had only 6.99 cm (Figure 10).

The longest significant tapered bulbs of 9.34 cm were measured from the plants with corn stalk mulch, while the shortest of 7.08 cm was observed from plants with plastic sheet mulch (Figure 11). Plants without mulch and with rice straw mulch had similar length of bulbs.

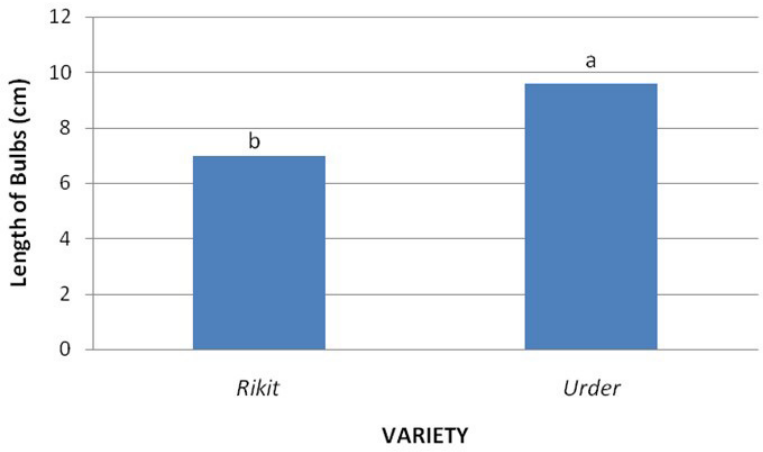

Figure 10: Length of bulbs (cm) of two varieties of sakurab under different mulching materials. Saguiaran, Lanao del Sur. 2020
Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

While plants with corn stalk mulch had also similar length of bulbs with rice straw mulch in both varieties. Corn stalk mulch produced 8.31 cm in Rikit and 10.37 cm bulb length in Urder. Plastic mulch supported 5.82 cm in Rikit and 8.34 cm length of bulbs in Urder. Although the length of bulbs is influenced by planting depth and soil compactness, larger bulbs tend to extend longer with corresponding weight increments.

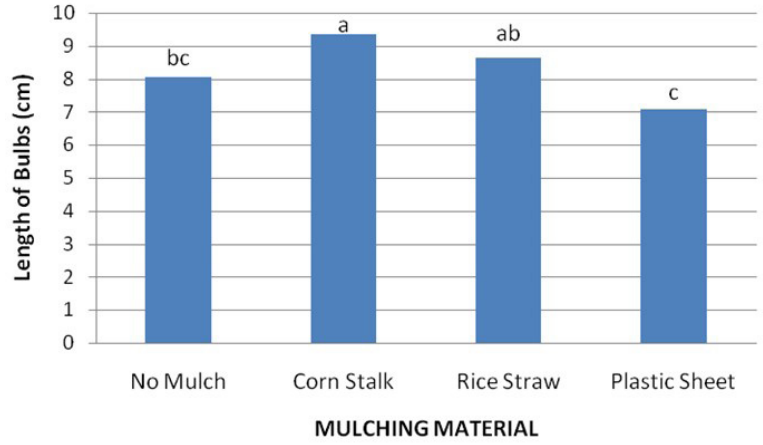

Figure 11: Length of bulbs (cm) of sakurab as affected by different mulching materials. Saguiaran, Lanao del Sur. 2020
Bar with uncommon letters are significantly different at 5% level, using LSD test of significance

CONCLUSION

The findings revealed that both variety and mulching materials significantly affected the growth parameters of Sakurab, such as plant height, number of leaves per hill, crop stand at harvest, and vegetative yield per hectare. Variety Urder demonstrated superior growth characteristics compared to Rikit, with taller plants, more leaves per hill, and higher crop stand. The mulching materials also played a crucial role, with corn stalk mulch proving to be the most effective in enhancing plant height, crop stand, and vegetative yield per hectare. Furthermore, the study highlighted the importance of mulching in Sakurab cultivation, especially in areas with lower elevation and warmer temperatures. The choice of mulching materials significantly influenced soil temperature, crop stand, and overall vegetative yield. Corn stalk mulch, with its loose composition allowing for air circulation, demonstrated positive effects on plant growth, while plastic mulch, by trapping heat, negatively impacted crop stand and yield. In terms of bulb yield, the study found that corn stalk mulch significantly increased bulb yield for both varieties, indicating its potential as a beneficial mulching material. The number of bulbs per hill and the length of bulbs were also influenced by variety and mulching materials, with Urder producing more and longer bulbs. Overall, this research emphasizes the importance of understanding the specific growth requirements of Sakurab, particularly in terms of variety and mulching practices. The findings contribute valuable knowledge for the development of the Sakurab industry, highlighting the potential for increased income for farmers and its significance in the Meranao culture. Further studies and attention to cultural practices, production stimuli, and environmental conditions will be essential for the sustainable development of Sakurab cultivation in the Philippines.

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