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Production Performance of Salad Tomato Varieties Under Conventional Cultivation and the Semi-Temperate Conditions of Benguet, Philippines

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Abstract

Tomato is an important vegetable and contributes to food security, income, and improved farmers' livelihoods worldwide. Tomatoes contain many health-promoting compounds and a nutritious part of a balanced diet. Over the last decade, consumers have become more aware of foods as a source of health benefits and their roles in preventing several chronic diseases. The study was conducted to evaluate, select and recommend specific varieties of salad-type tomato and to determine the economic benefits of growing salad tomato under a conventional production system at the HORTI Experimental Station of Benguet State University, La Trinidad, Benguet. The experiment consisted of 14 entries of salad tomato and laid out in a randomized complete block design with three replications. Variety 'Apollo' was used as the check variety. 'Athena' variety was the earliest to bear flower at 23 days after transplanting. 'Astig', 'Makapuno', and 'Apollo', the check variety, which were significantly comparable at 28-30 days to flowering. All the entries evaluated produced 5 to 6 flowers per cluster. 'Discovery' variety had the longest and widest fruit. 'Marvel' had the highest total number of marketable fruits at 193.70, while the 'Makapuno' variety significantly had the highest fruit yield with 8.68 kg/5m² plot. 'Victory' produced the highest total yield with 10.04 kg/plot and 'TM 03' variety recorded the highest sugar content with 12.86 ºBrix. Tomato cultivars evaluated were observed to be mild to moderately resistant to late blight infection. 'Victory' can be considered profitable due to high ROI under La Trinidad, Benguet condition as a strategy for food security.

Introduction

Tomato (*Solanum lycopersicum*) is the second most important horticultural product cultivated worldwide (Villanueva, 2018). Its importance could be attributed to the nutritional benefits it offers. Every 100g of fresh tomato fruit provides 735mg of Vitamin A, 266mg of potassium, and 29mg of ascorbic acid (Puwastein et al., 2000). Moreover, it is high in lycopene, known to have anticarcinogenic property (Kirankumar et al., 2008), and helps lower the risk of a heart attack. Tomatoes are also known sources of vitamins and pro-vitamins (vitamin C, pro-vitamin A, β carotene, folate), minerals such as potassium,

and secondary metabolites such as lycopene, flavonoids, phytosterols, and polyphenols (Luthria & Mukhopadhyay, 2006). Moreover, tomato is considered a model organism for research of the Solanaceae family and has therefore been and is still a major crop subject of studies both in the laboratory and under field conditions (Villanueva, 2018).

Globally, tomato is an important food component and the second-largest vegetable in terms of production and consumption (Food and Agriculture Organization [FAO], 2016). Reports from the United States show tomato as the second most consumed fresh vegetable with 6 kg/person in 2016 (United States Department of Agriculture [USDA], 2016). The trend in the Philippines is the same as tomato is also the second most important vegetable. In 2018, the production value of tomatoes in the Philippines was around Php3.9 billion, with a production volume of approximately 220.8 thousand metric tons (Statista, 2018). The demand for tomatoes is year-round, owing to its versatility in fresh and processed food preparation. However, the production of supply is limited, particularly during the off-season months, thus driving the high prices of tomatoes in the market. This case shows the big need to increase the production of tomatoes in the country.

Among the tomato varieties grown in the country, salad tomatoes are the most in-demand and command the highest price in the market due to their low supply. These varieties are known to prefer colder climates like the semi-temperate conditions of the Cordillera Administrative Region, particularly in the province of Benguet. This condition makes the improvement of salad tomato production more challenging but necessary.

Evaluating and introducing suitable cultivar or lines for a particular locality are important steps to consider to increase the yield of any crop. Many salad tomato varieties have been introduced in the Philippine market, and their seeds are reportedly expensive. Unfortunately, tomato growers use these newly introduced varieties without proper knowledge of their performances under field conditions. Thus, this study aimed to evaluate the growth and yield performance of salad tomato varieties' under field conditions.

The evaluation of the crop for conventional production is necessary to maintain quality and increase production. Newly introduced cultivar/ lines of tomato should first be evaluated to check if their performance is similar or better than the cultivars already grown by farmers. Chaerani (2006) stressed that the successful production of tomato depends on the choice of varieties for a particular location.

The study results would inform and guide the farmers in the locality on the most promising salad tomato variety. Moreover, the evaluation of the selected salad tomato varieties in this study is important evidence of their growth and yield performance under the semi-temperate conditions of Benguet, Philippines. This area is known for having a semi-temperate climate in a tropical country (Guron & Napaldet, 2020). This study could also apply to other semi-temperate regions of the globe that have similar conditions.

Materials and Methods

Salad Tomato Varieties Used

Fourteen entries of salad tomato cultivated under conventional production were from different seed companies were characterized, evaluated, and selected at the HORTI Experimental Station of Benguet State University (Table 1). Variety 'Apollo' was used as the check variety because farmers are commercially producing in the locality.

Open-pollinated tomatoes pollinate themselves and produce offspring just like themselves in looks and taste. Hybrid tomatoes are a cross between two varieties to create plants with specific attributes. The hybrid seed will not grow true (Albert, n.d.).

Production and Cultivation Practices Employed

Nursery Management in the Greenhouse

Prepared soil mixture of one part compost, one part carbonized rice hull (CRH), and one part garden soil. The seedling trays were irrigated before sowing the seeds. The seeds were sown per hole at a depth of 1.0cm in the seedlings trays. The seeds were covered with fine soil and water after sowing. The seedlings were thinned 3-5 days after emergence and developed the first 2-3 leaves. The

Table 1

Salad Tomato Varieties Used in the Study

Tomato Salad Variety	Supplier Company	Country of Origin	Genetic Type	Growth Habit
Kalpana	United Genetics	India	Hybrid	Semi-indeterminate
Discovery	Ramgo	Philippines		Semi-indeterminate
Astig F1	Haverson	Philippines	Hybrid	Semi-indeterminate
Marvel	Kaneko	Japan		Indeterminate
Victory New	Kaneko	Japan		Semi-determinate
Diamante Max	East West	Philippines	Hybrid	Indeterminate*
TM 03	Kaneko	Japan		Semi-indeterminate
Rocky 1	Kaneko	Japan	Hybrid	Semi-indeterminate
Marimax	East West	Philippines	Hybrid	Semi-indeterminate
Malakas	Kaneko	Japan		Semi-indeterminate
Victory	Kaneko	Japan	Hybrid	Semi-indeterminate
Athena	Condor	USA		Semi-determinate
Makapuno	George Seeds	USA		Semi-indeterminate
Apollo*	Kaneko	Japan	OP	Determinate**

* - check variety **-Determinate tomatoes are bush types ***-Indeterminate tomatoes are vining types

seedlings were hardened by reduced the water supply and gradually exposing them to sunlight one week before transplanting.

Experimental Plot Set-Up

The experiment was conducted at Benguet State University Experimental Farm in La Trinidad, Benguet, from December 2018-2019 dry season.

Plots measuring 1x5m^2 were prepared for conventional production. Compost and Triple 16 were applied as basal sources of nutrients at a rate of 3.3kg/5m^2 plot and 250g/5m^2, respectively, before planting and mixed with the soil following the standard practices set for the tomato production guide. The plants were transplanted at one seedling per hill with a distance of 30cm between hills and 30cm between rows. The field was irrigated immediately after transplanting. For pesticide management, Magnum insecticide was applied at three tbsp/16L of water, while Montana fungicide was applied at the rate of two tbsp and sprayed once a week to prevent insect and fungal diseases. The experiment was laid out following the Randomized Complete Block Design (RCBD) with three replications.

Cultural Management

Weeding was done two times a month to avoid competition and prevent the occurrence of pests and diseases. Hilling-up was done once, and irrigation was done two times a week to maintain the productivity of the plants. Trellis were made 20 days after transplanting using locally available materials like "rono" or bamboo stick.

Data Gathered

In the study, the data gathered were days from transplanting to flowering, days to first harvest of mature fruits, days to last harvest, fruit measurements (length, diameter), fruit shape, fruit color, weight of marketable and non-marketable fruit yield, total fruit yield, number of marketable and non-marketable fruits, total number, computed yield per hectare and return of investment (ROI).

The fruit sample was measured for length (polar) and width (equatorial) using a Vernier caliper. Fruit length (cm) was measured from the base to the tip, while fruit diameter (cm) at the center of the fruit part of ten randomly sampled fruits (Parajuli, 2019). The average fruit weight was determined by randomly selecting 10 fruits and weighing them right after harvesting. The computed fruit yield per hectare (kg) was determined using the formula:

$$\text{Yield (ton/ha)} = \frac{\text{Total Yield per Plot}}{\text{Plot Size}} \times 10{,}000\ m^2$$

$$\text{ROI} = \frac{\text{Gross Sales} - \text{Total Expenses}}{\text{Total Expenses}} \times 100\%$$

Additionally, the susceptibility of salad table-type tomato varieties to blight was rated after flowering and after pod formation. The build-up of tomato blight disease started during these stages, and blight ratings were gathered twice. The reaction of the different varieties to blight infection was rated based on the scale adopted from Tandang et al. 2000 (Table 2).

Table 2

Scale Used to Assess Blight Infection in Tomato Varieties

Scale	Description	Remarks
1	No infection	High resistance
2	11-25% of the total plant/ plot is infected	Mild resistance
3	25-50% of the total plant/ plot is infected	Moderate resistance
4	51-75% of the total plant/ plot is infected	Susceptible
5	76-100% of the total plant/ plot is infected	Very susceptible

Lastly, the sugar content of the tomato varieties were assessed using a refractomer.

Data gathered were statistically analyzed using the analysis of variance (ANOVA) for randomized complete block design (RCBD) with three replications. The significance of differences among treatment means was tested using the Least Significant Difference (LSD) at a 5% level of probability.

Results and Discussion

Flowering and Fruiting Characters

Highly significant differences in days to flowering and number of flowers per cluster were observed among the varieties. Among the 14 entries of salad tomato tested, 'Athena' variety was the earliest to bear flower at 23 days after transplanting. This variety is followed by 'Astig', 'Makapuno', and 'Apollo', the check variety, which was significantly comparable at 28-30 days to flowering. On the other hand, 'Diamante Max', 'Malakas', and 'Victory' were the last to flower at 38-40 days. All the entries evaluated produced 5 to 6 flowers per cluster. This finding was significantly earlier than Meseret et al. (2012) findings which put days to flowering of tomato varieties between 38 to 49 days. The formation of flowers of different cultivars has an effect on the genetic composition of the plants and important for the formation of fruits, and delays in flowering can lead to delays in fruit production. In 'indeterminate' cultivars of tomato, flower initiation once started continues through the plant's life. It is unlikely that the total yield of fruit will be limited by the number of flowers initiated.

The development of the cluster, flower, pollen viability, fruit shape, plant growth, and fruit set are affected by temperature and affect production (Hatfield & Prueger, 2015). Even moderately high temperatures inhibit several reproductive processes in tomato and other species, resulting in poor fertilization and fruit set (Snider & Oosterhuis, 2012; Zinn et al., 2010). Temperature constitutes a major environmental factor regulating flowering time. Flowering, pollination, and fruit set of tomatoes can be adversely affected by temperature.

Days to First Harvest and Last Harvest

'Victory New' has the significantly shortest days to first harvest at 51.67 days from flowering, followed by 'Diamante Max' at 54.33 days and 'Victory' with 56.34 days. These were 14-20 days earlier compared to the other varieties tested. On the other hand, the 'Marimax' variety had the longest days to last harvest at 114 days, while 'Astig F1' had the shortest days to last harvest at 103 days. Fruiting days, measured by

deducting the days from the last harvest with the first harvest ranged from 39 to 56 days. 'Athena' has the least fruiting days at 39, while 'Malakas' and 'Diamante Max' had the longest at 56 days.

Fruit Length, Diameter, Shape and Color

The length, diameter, and fruit shape of the 14 tomato varieties are also presented in Table 3. Among the entries of tomato characterized and evaluated, three fruit shapes were classified as round, rectangular, and ellipsoid. Fruit colors were observed red, orange, and red orange. Fruit length ranges from 3.13 to 7.18cm, while fruit width ranges from 3.41 to 5.17cm. Discovery recorded significantly longest and widest fruit while 'Apollo', the check variety, recorded the smallest fruit. The other varieties range from 4 to 5cm in fruit length and width.

The shapes of the fruits (Figure 1) are controlled by genetic and molecular mechanisms that contribute to the shape variation of cultivars. Dissimilarity in fruit shape results from differential growth processes that probably occur during the ovary formation or after anthesis during the fruit formation. Thus, uncovering the genes responsible for this phenotypic variation will provide insight into developmental pathways that control fruit formation (Brewer et al., 2006). Modern tomato varieties are morphologically and physiologically distinct from their wild ancestors in many ways, including enlarged fruit size, diverse fruit shapes and flavours, and improved plant architecture (Tieman et al., 2017; Bergougnoux, 2014).

Table 3

The Flowering and Fruiting Characters of the Salad Tomato Varieties

Tomato Salad Variety	Flowering Characters				Fruting Characters			
	Days from Transplanting to Flowering	Number of Flower per Cluster	Days from Flowering to First Harvest	Days from Flowering to Last Harvest	Fruit Length (Polar) (cm)	Fruit Diameter (Equatorial) (cm)	Fruit Shape	Fruit Color
Kalpana	31.33^{bc}	6.0^{b}	66.34^{b}	111.67^{b}	4.58^{bc}	4.11^{bc}	Round	Red
Discovery	35.33^{b}	5.0^{a}	61.34^{b}	111.67^{b}	7.18^{a}	5.17^{a}	Rectangular	Red
Astig F1	28.33^{c}	6.0^{b}	59.34^{bc}	103.00^{c}	5.33^{b}	3.41^{c}	Rectangular	Orange
Marvel	30.33^{bc}	6.0^{b}	64.67^{b}	111.00^{b}	3.70^{cd}	4.12^{bc}	Ellipsoid	Red
Victory New	38.33^{a}	6.0^{b}	51.67^{c}	106.00^{c}	4.64^{bc}	4.11^{bc}	Round	Orange
Diamante Max	39.67^{a}	6.0^{b}	54.33^{c}	110.00^{b}	3.71^{cd}	3.52^{c}	Round	Red
TM 03	32.33^{bc}	6.0^{b}	65.34^{b}	113.67^{a}	4.87^{bc}	4.18^{bc}	Round	Red
Rocky 1	36.33^{b}	6.0^{b}	60.67^{b}	113.00^{a}	4.23^{bcd}	4.72^{ab}	Round	Red Orange
Marimax	34.33^{b}	6.0^{b}	63.67^{b}	114.00^{a}	4.96^{bc}	3.42^{c}	Ellipsoid	Orange
Malakas	39.67^{a}	6.0^{b}	58.00^{bc}	113.67^{a}	4.33^{bcd}	3.62^{c}	Ellipsoid	Orange
Victory	38.33^{a}	6.0^{b}	56.34^{c}	110.67^{b}	4.11^{bcd}	5.05^{ab}	Round	Orange
Athena	23.00^{d}	6.0^{b}	74.67^{a}	113.67^{a}	3.27^{d}	3.63^{c}	Ellipsoid	Orange
Makapuno	28.33^{c}	6.0^{b}	59.67^{c}	104.00^{c}	3.86^{cd}	3.57^{c}	Ellipsoid	Red
Apollo*	29.67^{c}	6.0^{b}	65.33^{b}	111.00^{b}	3.13^{d}	3.37^{c}	Ellipsoid	Orange
LSD (5%)	1.68	0.65	1.68	2.50	0.64	1.77		
CV (%)	3.28	3.20	2.50	5.50	14.94	13.29		

Means with the same letter in a column are not significantly different at 5% LSD.

* - check variety

Figure 1

Different Varieties of Salad Type Tomato

Marketable, Non-Marketable Characteristics and Return of Investment (ROI)

Marketable and Non-Marketable Characteristics

The number of marketable, non-marketable and total number of fruits varied significant among the salad tomato varieties (Table 4). 'Marvel' variety produced the highest number of marketable fruits at 151.06, and the total number of fruits at 193.79, but these numbers did not differ significantly with 'Astig F1' and 'Athena'. 'Malakas' produced the lowest number of marketable fruits. On the other hand, 'Diamante Max' produced the highest number of non-marketable fruit while Discovery recorded the lowest number.

The high variety of fruit numbers among the tested tomato varieties were also noted in other studies. In Botswana, Baliyan and Rao (2013) also found significant variability in yield produced by six tomato varieties evaluated for pest and disease and productivity. Variety 'Miya' gave significantly higher marketable fruit yield (22.95 tons/ha-1) and higher average of single marketable fruit weight (85.84g) than other varieties. The least mean marketable fruit yield was obtained from the variety Fetan (11.61 tons/ha-1). The mean marketable fruit yield obtained (11.61 to 22.95 ton/ha) is comparable to other literature. Researchers on tomatoes (Palada & Allison, 2001; Znidarcic et al., 2003; Lemma, 2002) got a mean marketable fruit yield between 7.21 to 48.80 ton/ha. Other tomato researchers showed that total fruit yield ranged between 6.46 and 82.50

t/ha. 'Bishola' provided maximum fruit yield next to 'Melkashola' due to its maximum fruit weight because fruit weight, fruit clusters per plant, and number of fruits per plant are directly correlated to fruit yield. The varietals differences in growth and yield might be attributed to the differences in the ecological distribution of the tomato varieties. Besides the differences in varietal genetic make-up, the low marketable yield obtained for some tomato varieties might be due to the non-development of flowers into fruits as only about 50% of the flowers developed into fruits.

It is important to note that marketable tomato yields are governed by cultivar selection, cultural practices, and environmental constraints (Ortiz, 2007). Apart from proper cultivar selection and the use of well-established cultural practices for fresh tomato production, the environment encountered during plant development will strongly influence yield. Plant development is strongly linked to temperature (Reeves & Coupland, 2000).

The varieties 'Victory', 'TM 03', and 'Rocky 1' produced the significantly heaviest fruits at 656.66, 606.66, and 593.33g/10fruits. Marketable fruit yield is a major determinant variable for selecting a particular variety for its commercialization and income. Rangnamei et al. (2014) also reported that growth and yield attribute to different varieties. The trend observed in the results indicates that higher yield depends on the number of fruits and the weight of fruits per plant.

The marketable, non-marketable fruits and total yield also differed significantly among the salad tomato varieties. 'Victory' variety produced the significantly highest marketable fruit at

Table 4

Number of Marketable, Non-Marketable, and Total Number of Salad Tomato Evaluated during the Dry Season Under Conventional Production

Tomato Salad Variety	Number of Marketable Fruit	Number of Non-Marketable Fruit	Total Number of Fruit	Weight of 10 Fruits (g)	Marketable Fruit Yield (kg)	Non-Marketable Fruit Yield (kg)	Total Fruit Yield kg/plot	Total Fruit Yield t/ha	ROI (%)
Kalpana	138.80^{ab}	32.80^{bc}	171.60^{c}	463.33^{b}	6.43^{c}	2.43^{a}	8.86^{ab}	17.72^{ab}	**-13.84**
Discovery	140.73^{ab}	16.00^{e}	156.00^{d}	446.66^{b}	6.28^{c}	0.81^{d}	7.09^{c}	14.18^{c}	**-16.03**
Astig F1	148.60^{a}	42.33^{ab}	190.93^{a}	273.00^{de}	4.05^{e}	2.30^{b}	6.35^{cd}	12.70^{cd}	**-45.73**
Marvel	151.06^{a}	42.73^{ab}	193.79^{a}	350.00^{cd}	5.28^{d}	1.95^{d}	7.23^{c}	14.46^{c}	**-29.24**
Victory New	140.26^{ab}	33.80^{bc}	174.06^{c}	330.00^{cde}	4.62^{e}	2.63^{a}	7.25^{c}	14.50^{c}	**-38.09**
Diamante Max	79.73^{d}	45.00^{a}	124.73^{e}	386.66^{bc}	3.08^{ef}	2.38^{b}	5.46^{d}	10.92^{d}	**-58.73**
TM 03	126.33^{cd}	22.86^{de}	149.19^{de}	606.66^{a}	7.66^{b}	1.62^{c}	9.28^{b}	18.56^{b}	**2.63**
Rocky 1	122.91^{cd}	17.20^{e}	140.11^{de}	593.33^{ab}	7.29^{b}	1.56^{c}	8.85^{ab}	17.70^{ab}	**-99.67**
Marimax	131.20^{bc}	23.86^{de}	155.06^{d}	423.33^{b}c	5.55^{d}	1.47^{c}	7.02^{c}	14.04^{c}	**-25.63**
Malakas	70.49^{e}	26.80^{d}	97.29^{f}	270.00^{de}	2.90^{g}	1.24^{d}	4.14^{e}	8.28^{e}	**-61.14**
Victory	132.20^{bc}	28.80^{d}	161.00^{d}	656.66^{a}	8.68^{a}	1.36^{d}	10.04^{a}	20.16^{a}	**16.30**
Athena	145.06^{ab}	40.60^{ab}	185.66^{b}	330.00^{cde}	4.78^{e}	1.44^{c}	6.22^{cd}	13.10^{cd}	**-36.13**
Makapuno	131.80^{bc}	28.00^{d}	159.80^{d}	386.66^{bc}	5.09^{d}	1.23^{d}	5.32^{d}	10.64^{d}	**-31.79**
Apollo*	129.73^{bc}	27.26^{d}	156.99^{d}	250.00^{e}	3.24^{ef}	1.02^{d}	4.24^{e}	8.48^{e}	**-56.58**
LSD (5%)	2.85	0.57	3.67	0.85	6.24	0.87	21.45	7.05	
CV (%)	16.90	16.75	18.20	12.63	22.47	3.50	19.50	18.70	

Means with the same letter in a column are not significantly different at 5% LSD

* - check variety

8.68kg/plot, followed by 'TM 03' at 7.66kg/plot and 'Rocky 1' at 7.29kg/plot. 'Malakas' produced the lowest fruit yield at 2.90. On the other hand, 'Victory New' yielded the highest non-marketable fruit yield with 2.63kg, while Discovery had the lowest non-marketable fruit with 0.81kg because of the thicker and firmer flesh. Non-marketable fruit yield is one of the major variables for selecting a particular variety for its economic yield potential and varietal character. Lastly, in terms of total yield, 'Victory' has the highest total fruit yield at 20.16t/ha, followed by 'TM 03' at 18.56t/ha and 'Kalpana' at 17.72t/ha. 'Malakas' had the lowest total yield at 8.28t/ha.

Return of Investment (ROI)

Table 4 also presents the return of investment (ROI) for producing fresh fruits of 14 salad tomato varieties. 'Victory' yielded the highest ROI of 16.30% at a similar selling price of Php30.00 per kilogram. This figure connotes high profit from growing conventional salad tomato production in La Trinidad, Benguet during the dry season planting. Most of the entries had negative returns of investment because of the erratic weather conditions that affected the flowering and fruiting stage during the conduct of the study. The variation in the total yield of tomatoes might be due to the variation in the genetic make-up of different cultivars, even if they were grown under the same environmental conditions.

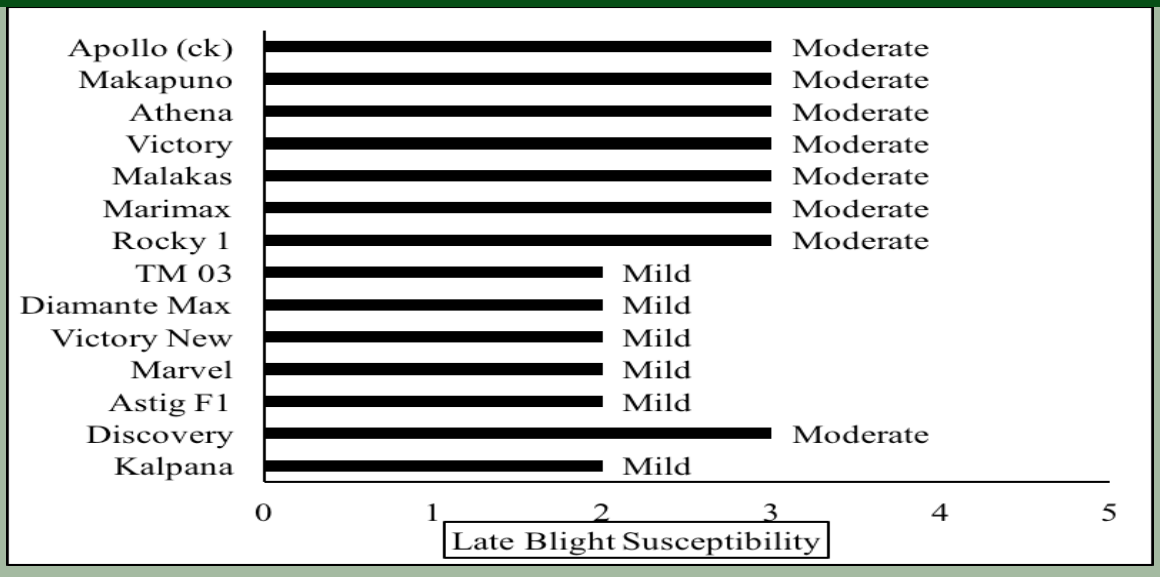
On the other hand, Zahedi and Ansari (2012) found significant variation in the yield of tomato genotypes due to differences in growing conditions. The varietal differences in growth and yield might be attributed to the differences in the ecological distribution of the tomato varieties (Olaniyi, 2007). Apart from their importance in yield, some events occurring during flower formation and set affect fruitlet development and final fruit size and quality, affecting returns. Varietal selection, yield potential, adaptability, and marketability determine the income of growers.

Resistance to Late Blight

Disease rating was done during trial implementation, and the results are as shown in Figure 2. 'Kalpana', 'Astig F1', 'Marvel', 'Victory New', 'Diamante Max', and 'TM 03' had mild resistance to late blight. The entries 'Discovery', 'Rocky 1','Marimax', 'Malakas', 'Victory', 'Athena', 'Makapuno', and 'Apollo' were moderately resistant to late blight infection. One of the key constraints in adapting tomato varieties is crop pests and diseases, requiring integrated pest and disease management options (Raini et al., 2005).

Figure 2

Reaction to Late Blight of Salad Tomato Varieties Evaluated during the Dry Season Under Conventional Production, BSU, La Trinidad, Benguet Conditions



Sugar Content

Sugar level is measured with a refractometer. Rainfall affects sugar measurements, especially if it happens close to the date of fruit harvesting. After a heavy rainfall, tomato fruits absorb water, their volume increases, and sugars get diluted. The average monthly temperatures in the dry season are favorable for the growth of tomato plants. In the dry season, these temperatures ranged from 15-25ºC in summer and rainy season from 16.3-25.8ºC during most of the fruit development period (Max, 2009). ºBrix values are important because these values can be measured objectively, and they relate to a subjective criterion that buyers and eaters use to assess quality, flavor, or sweetness. ºBrix values can aid in variety selection, harvest scheduling, and other aspects of crop production, including irrigation, fertility, and post-harvest management (Kleinhenz & Bumgarner, 2013).

Fruit sugar content is a complex, multi-genic trait highly affected by the environment (Beckles, 2011). Some cultivars have the genetic background to realize potential high total soluble solids (TSS), but pre- and post-harvest factors severely influence the extent to which this high TSS is achieved. The pre-harvest environment, including solar radiation, temperature, day length, water availability, soil mineral content, irrigation, fertilization regime, and pruning techniques, can influence fruit sugar levels (Dorais & Papadopoulos, 2001).

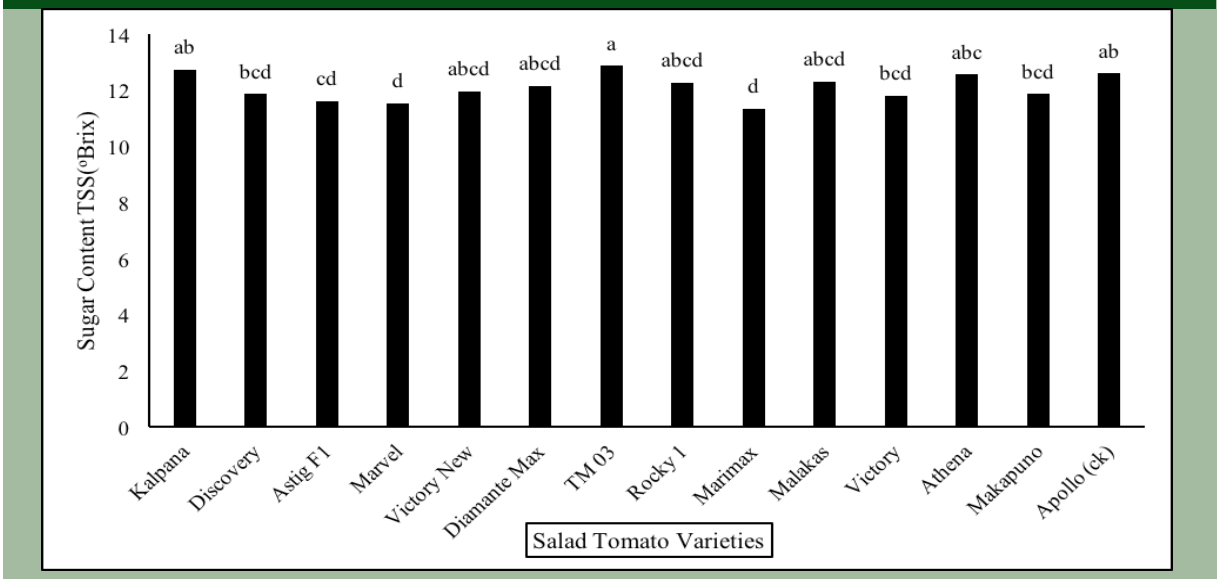
As mentioned above, the environment influences the sugar level of sweetness of fourteen entries of tomato tested. 'TM 03' variety recorded the highest sugar content with a mean ºBrix reading of 12.86. One possible explanation is that 'TM 03' reached its maximum genetic potential to produce sugars in the dry season. 'Marimax' had the lowest sugar level content. Sugar content ranged from 11.53-12.73 ºBrix (Figure 3).

Conclusions

Tomato cultivars cultivated in the dry season showed significant variations in the different growth and yield attributes. The best cultivar that produced maximum yield with potential growth and yield contributing characters was 'Marvel', 'Makapuno', and 'Victory'. The cultivar 'Victory' was found superior in economic yield (marketable yield) and other parameters. This study also suggests that Victory cultivar may be considered as a candidate variety for future commercial cultivation.

Figure 3

Sugar Content of Salad Tomatoes Evaluated during the Dry Season Under Conventional Production, BSU La Trinidad, Benguet Conditions



(Means with the same letter are not significantly different at 5% LSD)

Recommendation

'Marvel', 'Makapuno', and 'Victory' cultivars may be recommended for tomato production under conventional production and the semi-temperate conditions of Benguet, Philippines. Selection, yield potential, adaptability, and marketability determine the income of growers. Select varieties that are high-yielding, resistant to pests and diseases, and with market preference. For policy recommendation, seed companies should register their own varieties/entries in the National Seed Industry (NSIC) before commercialization to the public/stakeholders. In this way, the seeds would pass the NSIC requirements before they are utilized by stakeholders, especially before the farmers can produce their own seeds.

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