Open Science and Technology
Vol. 03 No. 02, 2023 (62-73)
ISSN (Print) :2776-169X
ISSN (Online) :2776--1681

Study on Agronomical Characteristics of Several Introduced Cucumber (*Cucumis sativus* L.) Genotypes

Studi Karakteristik Agronomis Beberapa Genotipe Tanaman Mentimun (Cucumis sativus L.) Hasil Introduksi

Ade Sumiahadi[*1], Adiwijaya Adiwijaya[1]
[1] Agrotechnology Study Program, Faculty of Agriculture, Universitas Muhammadiyah Jakarta, Indonesia
*email: ade.sumiahadi@umj.ac.id

Submitted:10 October 2023 Accepted: 16 January *2024 Published: 18 January 2024*

ABSTRAK

Mentimun merupakan salah satu sayuran buah yang banyak digemari oleh masyarakat Indonesia. Prospek pengembangan budidaya mentimun secara komersial dan pengelolaannya dalam skala agribisnis semakin cerah, karena peluang pemasaran tidak hanya dilakukan di dalam negeri, tetapi juga mancanegara. Introduksi tanaman merupakan suatu proses memperkenalkan tanaman dari tempat asal tumbuhnya ke suatu daerah (negara) baru. Penelitian ini bertujuan mempelajari karakteristik agronomis beberapa genotipe mentimun hasil introduksi. Penelitian ini dilaksanakan dari bulan Oktober sampai Desember 2022 di lahan percobaan Fakultas Pertanian Universitas Muhammadiyah Jakarta. Rancangan penelitian yang digunakan yaitu Rancangan Kelompok Lengkap Teracak (RKLT) dengan lima taraf genotipe mentimun, yaitu tiga genotipe introduksi (MIT001, MIT002, dan MIT003) dan dua varietas nasional sebagai pembanding (Ronaldo dan Merkuri). Hasil penelitian menunjukkan bahwa setiap genotipe introduksi yang diujikan secara umum memiliki karakter pertumbuhan vegetatif yang sama dengan varietas pembandingnya, namun memiliki beberapa karakter komponen produksi yang lebih rendah dari varietas nasional pembandingnya. Genotipe introduksi MIT001 dan MIT003 memiliki panjang buah yang lebih pendek dari varietas nasional pembandingnya (Ronaldo), sedangkan MIT002 menghasilkan bobot kering tanaman dan bobot buah per tanaman yang lebih rendah dari varietas nasional pembandingnya (Merkuri). Genotipe MIT003 adalah genotipe introduksi yang mampu menghasilkan produksi yang paling mendekati varietas pembandingnya.

Kata kunci: Mentimun, Varietas Domestik, Genotipe, Pertumbuhan Vegetatif, Hasil Produksi.

ABSTRACT

Cucumber is one of the fruit vegetables favored by the Indonesian people. Its development prospect of commercial cultivation and agribusiness management has been very promising, because the marketing opportunities are not only available domestically, but also abroad. Plant introduction is a process of introducing plants from their place of origin into a new region. This study aims to examine the agronomic characteristics of several introduced cucumber genotypes, and was conducted from October to December 2022 at the experimental field of the Faculty of Agriculture, Jakarta Muhammadiyah University. Randomized Complete Group Design (RCGD) was used with five cucumber genotypes: three introduced genotypes (MIT001, MIT002, and MIT003) and two comparator domestic varieties (Ronaldo and Mercury). The results show that the introduced genotypes produced similar vegetative growth characters to those of their comparator varieties. However, several yield components produced are lower than those of their comparator varieties, as seen from several significantly different parameters. MIT001 and MIT003 produced shorter fruit length than that of their comparator variety (Ronaldo), while MIT002 produced lower plant dry weight and fruit weight per plant than those of its comparator variety (Mercury). MIT003 was able to produce the yield components closest to those of its comparator variety.

Keywords: *Cucumber, Domestic variety, Genotype, Vegetative growth, Yield.*

Open Science and Technology
Vol. 03 No. 02, 2023 (62-73)
ISSN (Print) :2776-169X
ISSN (Online) :2776--1681

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the fruit vegetables that is widely consumed fresh by Indonesians. Although not native to Indonesia, cucumber is well known by the Indonesian people. This type of vegetable is easily found in almost all corners of Indonesia. Cucumber is also known in the health world for curing cough and lowering internal body heat (Tjibtaningrum & Erhadestria, 2016).

Cucumber in Indonesia is a very popular vegetable and is favored by many people. The average consumption of cucumber in Indonesia was 2,209 kg/capita/year in 2022 (The Ministry of Agriculture, 2022). The data shows that the increasing population leads to a higher demand for cucumbers. Therefore, the prospect of developing cucumber cultivation commercially and cucumber management on an agribusiness scale has been getting brighter, because the marketing of the yields is not only carried out domestically, but also in foreign countries, such as Malaysia, Singapore, Taiwan, Hong Kong, Pakistan, France, England, Japan, the Netherlands, and Thailand. A potential target market for cucumber exports is Japan (Wijoyo, 2012).

On the other hand, based on the data by Central Bureau of Statistics (2023), there has been a decline in cucumber production from 2010 to 2022. In 2010, domestic cucumber production was 547,141 tons, while in 2022 it was 444,057 tons. This yield decrease can be caused by many factors, one of which is the technical cultivation conducted by farmers, including the use of inputs, such as seeds, fertilizers, lime, pesticides, and labor (Siagian & Sintawati, 2016). Cucumber production can also be affected by the type of variety used and the supply of nutrients provided (Dani *et al*., 2014; Simanullang *et al*., 2014). An imbalance of nutrients can cause overall plant growth to be disrupted or imperfect, thus decreasing its yield (Rahmasuri *et al*., 2014). Each variety has different productivity so that the use of varieties determines the amount of yield produced.

High genetic diversity is one of the important factors for assembling new superior varieties. In order to multiply alternative high-yielding cucumber varieties that can be favored by the farmers, it is necessary to conduct a plant introduction process on superior cucumber varieties, with the aim to see the adaptability of the variety to the growing environment through the appearance of growth and yield phenotypes. The ability of a variety to adapt to a particular growing environment can be seen from the growth characters and yield components achieved (Karim *et al*., 2020).

Plant introduction is a process of introducing plants from their place of origin into a new region. Particularly, the intention of this process is to bring or enter plant varieties from abroad into a country (Mangoendidjojo, 2007). Plant introduction is carried out with the aim to obtain or assemble new cultivars. Introduced plants that have gone through the process of adaptation and selection can be used as new cultivars directly or as crossing material with existing cultivars. A variety is considered superior if it exhibit high yield potential, good production quality, resistant to pests and diseases, long-lived, and able to adapt to the environment (Syahri & Somantri, 2016). Therefore, considering the current situation, plant introduction is needed to increase the abundance of domestic cucumber genetic resources and to create superior cucumber varieties in Indonesia. This study aims to investigate the agronomic characteristics of several introduced cucumber genotypes.

Open Science and Technology
Vol. 03 No. 02, 2023 (62-73)
ISSN (Print) :2776-169X
ISSN (Online) :2776--1681

MATERIALS AND METHODS

Time and Location

This study was conducted from October to December 2022 at the experimental field of the Faculty of Agriculture, Jakarta Muhammadiyah University, South Tangerang City, which is located at the coordinate of 6º17'58" south latitude (SL) and 106º46'02" east longitude (EL) with an altitude of about 15 m above sea level (masl) (Central Bureau of Statistics of South Tangerang City, 2019). The climatic condition during the study is presented in Table 1.

Table 1. Climatic condition from October to December 2022 (BMKG, 2023).

Month	Average Temperature (ºC)	Average Humidity (%)	Total Rainfall (mm)	Max. Sunshine Duration (hour)
October	27.47	86.10	281.20	8.80
November	27.49	85.80	347.60	7.70
December	27.06	87.19	337.60	8.10

Tools and Materials

The tools and materials used were measuring instruments, cultivation equipment, firewood, goat manure, NPK fertilizer, 40 cm x 40 cm of polybags, introduced cucumber seeds (MIT001, MIT002, and MIT003) and domestic variety cucumber seeds (Ronaldo and Mercury).

Research Design

The research design used was Randomized Complete Group Design (RCGD) with five cucumber genotypes, namely three introduced genotypes (introduced genotype MIT001, introduced genotype MIT002, and introduced genotype MIT003) and two domestic varieties as comparator (domestic variety Ronaldo and domestic variety Mercury). Each treatment was repeated five times so that there were 25 experimental units. Each experimental unit consisted of three plants so that there were total amount of 75 plants.

The results of the data obtained were analyzed using ANOVA (variance analysis), then was proceeded to Honestly Significant Difference (HSD) test at a significance level of 5%, if the results of ANOVA reveal any significance. The parameters observed included growth parameters (plant height, number of leaves, leaf length, leaf width) and yield components (number of male and female flowers, number of fruits per plant, fruit length, fruit diameter, fruit color and shape, weight per fruit, fruit weight per plant, and plant dry weight).

Seeds Preparation

Two types of cucumber were used in this study, namely fresh (raw) cucumber and Japanese cucumber. The introduced genotypes MIT001 and MIT003 are fresh cucumber with the domestic variety Ronaldo as the comparator, while the introduced genotype MIT002 is a Japanese cucumber with the domestic variety Mercury as the comparator. The introduced genotypes used were imported from Turkey.

Planting and Stakes Installation

The planting medium used was a mixture of soil, goat manure, and husk charcoal in a ratio of 1:1:1. The media was stirred until homogeneous, then was put into polybags. Planting was conducted by planting two cucumber seeds in each polybag. When the plants reached the age of 2 weeks after planting (WAP), thinning was conducted by leaving one plant that exhibit the best condition. Stakes were installed after the plants reached a height of 20–30 cm. The stakes were made from bamboo slats that functioned to propagate the tendrils of cucumber plants so that they could grow upright following the direction of the stakes.

Fertilization and Maintenance

Fertilization was conducted at planting using NPK 16-16-16 compound fertilizer at a dose of 20 gr/polybag (Kurniawati et al., 2015). Fertilizer application was conducted twice by sprinkling it around the plant root area at a dose of 10 gr/polybag. The first fertilization was conducted at planting, while the second fertilization was conducted at the plant age of 4 WAP. Plant maintenance included watering, weeding, and pest and disease control based on the field conditions.

Harvesting

The harvesting process was carried out four times for all cucumber fruits produced. The first harvest began at the plant age of 7 WAP. The suitable criteria for the cucumber fruits to be harvested were the ones that have reached their maximum size and there are still fine thorns attached to the fruits. The cucumbers were harvested in the morning using a sharp knife (Siswadi, 2007).

RESULTS AND DISCUSSION

Plant Growth

Cucumber plant growth parameters, including plant height, number of leaves, leaf length, and leaf width, were observed at plant age of 4 WAP. ANOVA results show that plant genotypes had no significant effect on all growth parameters (Table 2). These results indicate that the introduced genotypes are able to adapt well so that they are able to grow optimally and do not differ from the comparator domestic varieties. The introduced genotypes MIT001 and MIT003 produced growth that is not significantly different from that of their comparator variety (Ronaldo). Similarly, the growth of the introduced genotype MIT002 is not significantly different from that of its comparator variety (Mercury).

These results indicate that the adaptation process of the introduced genotypes has gone well so that the photosynthesis process occurred optimally and resulted in optimal growth. All introduced cucumber genotypes can grow well in the new environment so that they can produce good plant height, number of leaves, leaf length, and leaf width. Good adaptability supports the ability of plants to be able to absorb nutrients well so that the growth occurs optimally.

Table 2. Growth of the introduced genotypes and domestic varieties of cucumber plants.

Genotype of Cucumber Plants	Plant Height (cm)	Number of Leaves (strand)	Leaf Length (cm)	Leaf Width (cm)
Introduced Genotype 1 (MIT001)	15.97	6.93	8.80	10.90
Introduced Genotype 2 (MIT002)	18.97	7.20	9.39	12.17
Introduced Genotype 3 (MIT003)	16.30	7.33	9.30	12.42
Domestic Variety (Ronaldo)	18.93	6.47	9.90	11.90
Domestic Variety (Mercury)	20.83	6.60	8.65	11.93

Growth characters in plants are influenced by two factors, namely genetic and environmental. According to Syahputri et al. (2018), good plant growth is highly dependent on genetic factors, the growing environment, and the cultivation measures taken. According to Oktaviani et al. (2020), each plant variety has genetic differences that can affect its growth, yield, and adaptability.

Good plant growth can be achieved if the environmental factors are in a balanced and favorable condition, apart from genetic factors. These environmental factors include moisture content, climate, and soil nutrients (Hardiatmi et al., 2015). Climatic conditions are a very influential factor in the introduction process, especially in the process of introducing plants from subtropical into tropical regions. Cucumber plants require almost the same climatic conditions, either in the tropics or subtropics. In subtropical regions, such as Turkey, cucumber plants require temperature in the range of 18–30^{o}C, humidity of 60–80%, and sunshine duration of 8–12 hours with sufficient irrigation of about 2.5–4 liters of water per m^2 (Samsun Provincial Directorate of Agriculture and Forestry, 2018). Meanwhile, in the tropics, the optimal climatic conditions required by cucumber plants are temperature in the range of 18–30^{o}C, humidity of 50–85%, sunshine duration of 8–12 hours, and rainfall of 200–400 mm/month (Sumpena, 2001; Sudarma, 2013).

In this study, the climatic conditions that occurred in general were in accordance with the conditions that are required by cucumber plants (Table 1), except for humidity, which was relatively higher than the normal requirement, especially for introduced genotypes. Nonetheless, the results show that all introduced genotypes were able to produce vegetative growth that is not significantly different from that of their comparison varieties, indicating that all introduced genotypes used were able to adapt to the lowland tropical environmental conditions at the research location.

The ability of plants to adapt optimally to their environment will result in optimal genetic expression. Each plant, and even each variety, exhibit different adaptability to its surrounding environment so that it can produce different phenotype expressions. A study by Wasonowati et al. (2013) showed that each different variety of lettuce produced different growth due to different adaptability and ability to grow and develop. Likewise, Khumaero et al. (2014) conducted their study on four genotypes of melon plants (*Cucumis melo* L.), namely IPB Meta 3, IPB Meta 4, IPB Meta 6, IPB Meta 8H, and two comparator varieties, namely Action 434 and Sky Sweet, with the results that the IPB Meta 4 genotype produced a larger stem diameter and leaf size than those of the two comparator varieties.

Open Science and Technology
Vol. 03 No. 02, 2023 (62-73)
ISSN (Print) :2776-169X
ISSN (Online) :2776--1681

Yield Components

Yield components were measured from flowering to harvesting, including the number of male and female flowers, number of fruits per plant, fruit length, fruit diameter, fruit color and shape, weight per fruit, fruit weight per plant, and plant dry weight. ANOVA results show that the introduced genotypes significantly influenced the number of male and female flowers, number of fruits, fruit length, fruit diameter, fruit weight per plant, and plant dry weight, but did not significantly influence the weight per fruit parameter.

As seen in Table 3, the introduced genotypes MIT001 and MIT003 produced more male flowers than that of their comparator variety (Ronaldo), although the result from MIT003 is not significantly different. The introduced genotype MIT002 produced male flowers that are not different at all from that of its comparator variety (Mercury). In the parameter of the number of female flowers, the introduced genotypes MIT001 and MIT003 also produced fewer female flowers than that of their comparator variety (Ronaldo), although the result from MIT003 is not significantly different. The introduced genotype MIT002 produced female flowers that are not significantly different from that of its comparator variety (Mercury).

Table 3. Flower number and plant dry weight of the introduced genotypes and domestic varieties of cucumber plants.

Genotypes of Cucumber Plants	Number of Flowers		Plant Dry Weight (gr)
	Male	Female	
Introduced Genotype 1 (MIT001)	25.87 b	6.33 a	108.73 a
Introduced Genotype 2 (MIT002)	19.00 ab	8.13 ab	94.07 a
Introduced Genotype 3 (MIT003)	12.60 ab	8.87 abc	94.47 a
Domestic Variety (Ronaldo)	6.33 a	13.67 c	138.73 ab
Domestic Variety (Mercury)	19.53 ab	11.00 bc	197.53 b

Description: Numbers followed by the same letter in the same column indicate no significant difference based on the results of HSD test at the 5% level.

These results also show that under the existing climatic conditions, all introduced genotypes and domestic varieties produced more male flowers than female flowers, except for the domestic variety Ronaldo, which produced more female flowers than male flowers. According to Sakri (2014), the process of flowering and fruit formation is influenced by external factors, such as temperature, day length, and altitude.

The genotypes tested had different responses to environmental conditions in the plantation, resulting in differences in the timing of flower emergence in each genotype. Saragih et al. (2018) reported that each plant genotype has different growth characteristics due to differences in plant genetic traits and plant genetic responses to the environment.

Table 3 also shows that the introduced genotypes MIT001 and MIT003 produced plant dry weight that is not significantly different from that of their comparator variety (Ronaldo). Meanwhile, the introduced genotype MIT002 produced significantly lower plant dry weight than that of its comparator variety (Mercury). These results indicate that only the introduced genotype MIT002 produced lower plant dry weight than that of its comparator variety.

Plant dry weight is associated to the accumulation of photosynthetic products in plant organs. Plant dry weight indicates the ability of plants to capture sunlight as a raw material for the photosynthesis process. This means the more optimal photosynthesis that occurs, the more photosynthate produced by plants that can be translocated to other plant organs, such as leaves, stems, and branches. Each plant with different genetic traits will produce different plant weight, either fresh or dry. This is in line with a study by Widiastuti and Latifah (2016), which stated that plant dry weight is more influenced by the variety and genetic traits of each plant.

Table 4. Number of fruits, fruit length, fruit diameter, weight per fruit, and fruit weight per plant of the introduced genotypes and domestic varieties of cucumber plants.

Genotype of Cucumber Plants	Number of Fruit	Fruit Length (cm)	Fruit Diameter (cm)	Weight per Fruit (gr)	Fruit Weight per Plant (gr)
Introduced Genotype 1 (MIT001)	0.73 a	6.86 a	1.28 a	135.03 a	152.27 a
Introduced Genotype 2 (MIT002)	1.40 ab	6.40 a	2.86 b	157.64 a	219.96 a
Introduced Genotype 3 (MIT003)	1.47 ab	10.76 a	1.88 ab	223.98 a	396.07 ab
Domestic Variety (Ronaldo)	1.47 ab	15.90 b	1.76 ab	245.89 a	409.17 ab
Domestic Variety (Mercury)	2.07 b	10.79 ab	2.21 ab	248.30 a	602.66 b

Description: Numbers followed by the same letter in the same column indicate no significant difference based on the results of HSD test at the 5% level.

Table 4 shows that the introduced genotypes MIT001 and MIT003 produced number of fruit that is not significantly different from that of their comparator variety (Ronaldo). Likewise, the introduced genotype MIT002 also produced number of fruit that is not significantly different from that of its comparator variety (Mercury). These results indicate that the existing genetic and environmental factors have not been able to produce variations in the number of fruit of cucumber plants. Hakim et al. (2019) stated that genetic traits carried by plants and plant adaptation to the environment determine yield, both in terms of quality and quantity. According to Wicaksana and Sulistiyo (2017), the number of fruits produced from cucumber plants depends on the environmental conditions and the varieties planted. A study by Nazirwan et al. (2014) showed that eight different tomato varieties produced a different number of fruits with various shapes. Dani et al. (2014) also reported that different cucumber cultivars produced different numbers of fruits.

The results of fruit length in Table 4 show that the introduced genotypes MIT001 and MIT003 produced significantly shorter fruits than that of their comparator variety (Ronaldo). Meanwhile, the introduced genotype MIT002 produced fruits with length that are not significantly different from that of its comparator variety (Mercury). These results indicate that the introduced genotypes MIT001 and MIT003 produced shorter fruit than that of their comparator variety, while the introduced genotype MIT002 produced the same fruit length as that of its comparator variety. In the parameter of fruit

diameter, the introduced genotypes MIT001, MIT003, and MIT002 produced relatively the same size of fruit diameter as that of their respective comparator varieties.

According to Suherman (2014), fruit size depends on the fruit produced by the plant, which is greatly influenced by the environment and genetic traits of the plant. Each plant has a variety of different fruit shapes due to the genetic traits inherited by each parent. A study by Khumaero et al. (2014) on the horticultural characteristics of four genotypes of melon plants (*Cucumis melo* L.), namely IPB Meta 3, IPB Meta 4, IPB Meta 6, IPB Meta 8H, and two comparison varieties, namely Action 434 and Sky Sweet, revealed that the fruit size of IPB melon was relatively smaller than the comparison varieties with various sizes.

The adaptability of plants to the environment will greatly affect the quality of the fruit produced. Good adaptability causes metabolism to run optimally so that it can support plants to produce fruit with optimal size. Good adaptability can ensure that the photosynthesis process runs optimally so that plants are able to produce yield optimally and consistently (Jusuf *et al*., 2012). In addition, Waskito et.al. (2018) stated that the amount of photosynthate formed will help increase fruit diameter and fruit length.

Based on results in Table 4, the introduced genotypes MIT001, MIT002, and MIT003 produced weights per fruit that tended to be the same as that of their respective comparator varieties. Table 4 also shows that the introduced genotypes MIT001 and MIT003 produced fruit weight per plant that is not significantly different from that of their comparator variety (Ronaldo), while the introduced genotype MIT002 produced fruit weight per plant that is significantly smaller than that of its comparator variety (Mercury).

The results in Table 4 also show that only the introduced genotype MIT002 that produced lower fruit weight per plant than that of its comparator variety, which means MIT002 has not been able to adapt well to the environment so that the environment affects the plant's ability to express its genetic potential (Akbar *et al*., 2014). An environment that is not in accordance with the conditions needed by plants can inhibit plant growth and yield production. The ability of plants to adapt to conditions that are less favorable to the growth requirements also affects their phenotypic expression (Cahyaningrum *et al*., 2014).

In this study, climatic conditions, especially humidity, were higher than the conditions that are normally required by cucumber plants, which is thought to affect the generative growth, thus affecting the yield components of cucumber plants. Humidity is needed in the photosynthesis process and plants only need a limited amount of moisture so that it is very important to maintain the optimal humidity state around the plant (Chia & Lim, 2022). Humidity that is too high can cause a decrease in the transpiration process, which can reduce the formation and translocation of assimilates and nutrients in the plant body (Jolliet, 1993). When the process of formation and translocation of assimilates are inhibited, the process of fertilization is also inhibited, which causes lower yield production.

Observation on the color and shape of cucumber fruits was only conducted once, namely at the harvesting. When harvested, cucumber fruits exhibit different colors and shapes depending on the type of cucumber planted. This is due to different genetic factors of the cucumber plants. As seen in Figure 1, the introduced genotypes MIT001 and MIT003 produced fruit characteristic that is similar to that of their comparator variety (Ronaldo), namely dark green color and longer oval shape. However, at closer

inspection, the fruit color of MIT001 and MIT003 is apparently lighter and shinier than that of Ronaldo. Next, the introduced genotype MIT002 produced fruit characteristic that is similar to that of its comparator variety (Mercury), namely rounded oval-shaped and a white-green color. However, the fruit shape of MIT002 is apparently shorter and more rounded than that of Mercury.

These results indicate a diversity in the shape and color of cucumber fruit from the genotypes and varieties used. A study by Nazirwan et al. (2014) also showed that the eight tomato varieties tested produced diverse fruit shapes and colors. Merpaung et al. (2019) also reported that three local red chillies and two comparison varieties produced different visual characters.

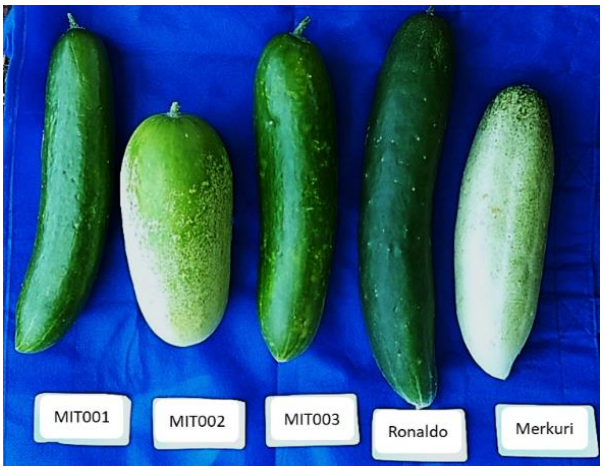

Figure 1. Cucumber fruit yields of the introduced genotypes and domestic varieties

CONCLUSIONS

Based on the results of this study, it can be concluded that the introduced genotypes produced vegetative growth characters that are not significantly different from those of their comparator domestic varieties. However, they produced yield components that tend to be lower than those of their comparator domestic varieties, as seen from several parameters that are significantly different. The introduced genotypes MIT001 and MIT003 produced shorter fruit length than that of their comparator variety (Ronaldo), while MIT002 produced lower plant dry weight and fruit weight per plant than those of its comparator variety (Mercury). As a suggestion for future studies, observations using more detailed parameters must be performed to clearly see the morphological and physiological performance of plants. In addition, molecular genetic observation is also necessary to examine how close the genetic relationship of the genotypes tested.

REFERENCES

Akbar, R. A. M., Sudiarso, & Nugroho, A. (2014). Pengaruh mulsa organik pada gulma dan tanaman kedelai (*Glycine max* L.) var. Gema. *Jurnal Produksi Tanaman, 1*(6), 478–485.

Central Bureau of Statistics of South Tangerang City. (2019). *South Tangerang City in Number 2019*. Central Bureau of Statistics of South Tangerang City.

Central Bureau of Statistics. (2023). *Production of vegetable crops 2022*. https://www.bps.go.id/indicator/55/61/1/produksi-tanaman-sayuran.html

Cahyaningrum, D. G., Yulianah, I., & Kuswanto. (2014). Interaksi genotipe lingkungan galur-galur harapan kacang panjang (*Vigna sesquipedalis* L. Fruwirth) berpolong ungu di dua lokasi. *Jurnal Protan, 2*(5), 304–411.

Central Bureau of Statistics of South Tangerang City. (2019). *South Tangerang City in Number: 2019*. Central Bureau of Statistics of South Tangerang City.

Central Bureau of Statistics. (2023). *Production of vegetable crops 2022*. https://www.bps.go.id/indicator/55/61/1/produksi-tanaman-sayuran.html

Chia, S. Y. & Lim, W. M. (2022). A critical review on the influence of humidity for plant growth forecasting. *IOP Conf. Series: Materials Science and Engineering, 1257*: 012001. https://doi.org/10.1088/1757-899X/1257/1/012001.

Dani, U., Harti, A. O. R., Nugraha, D. R., & Rusta. (2014). Pertumbuhan dan hasil tanaman mentimun (*Cucumis sativus* L.) kultivar Sabana F1 dan Vanesa pada berbagai dosis pemberian bio-fosfat. *Jurnal Ilmu Pertanian dan Peternakan, 2*(2), 1–8.

Hakim, M. A. R., Sumarsono, & Sutarno. (2019). Pertumbuhan dan produksi dua varietas selada (*Lactuca sativa* L.) pada berbagai tingkat naungan dengan metode hidroponik. *Jurnal Agro Complex, 3*(1), 15-23.

Hardiatmi, S., Santosa, S. J. & Suryanegara, S. S. (2015). Pengaruh konsentrasi ekstrak teh dan dosis pupuk NPK terhadap pertumbuhan dan hasil tanaman mentimun (*Cucumis sativus* L.). *Jurnal Inovasi Pertanian*, *14*(1), 78–87.

Jolliet, D. O. (1993). Modelling of water uptake, transpiration, and humidity in greenhouse, and of their effects on crops. *Acta Horticulture, 328*, 69–78

Jusuf, M., Wahyuni, T. S. & Rahajeng, W. (2012, November). Kajian adaptasi dan stabilitas hasil varietas unggul ubi jalar di sepuluh likasi di Indonesia. *Prosiding Seminar Nasional Sumber Daya Genetik dan Pemuliaan Tanaman "Peran Sumber Daya dan Pemuliaan dalam Rangka Mewujudkan Kemandirian Perbenihan Nasional".* Bogor, Indonesia.

Karim, H. A., Yasin H. G. M., Kandatong, H., Hasan, H., & Fitrianti. (2020). Uji produktivitas berbagai varietas jagung (*Zea mays* L.) hibrida dan non-hibrida yang sesuai pada agroekosistem Kabupaten Polewali Mandar. *Agrovital: Jurnal Ilmu Pertanian*, *5*(1), 25–29.

Khumaero, W. W., Efendi, D., Suwarno, W.B., & Sobir. (2014). Evaluasi karakteristik hortikultura empat genotipe melon (*Cucumis melo* L.) Pusat Kajian Hortikultura Tropika IPB. *Jurnal Hortikultura Indonesia*, *5*(1), 56–63.

Kurniawati, H. Y., Karyanto, A., & Rugayah. (2015). Pengaruh pemberian pupuk organik cair dan dosis pupuk NPK (15:15:15) terhadap pertumbuhan dan produksi tanaman mentimun (*Cucumis sativus* L.). *Jurnal Agrotek Tropika, 3*(1), 30–35.

Mangoendidjojo, W. (2007). *Dasar-dasar pemuliaan tanaman*. Kanisius Publisher.

Merpaung, A. E., Barus, S., & Musaddad, D. (2019). Karakterisasi dan keragaan pertumbuhan tiga klon cabai merah (*Capsicum annuum* L.) lokal. *Jurnal Hortikultura, 29*(1), 33–44.

Meteorology, Climatology, and Geophysics Agency (BMKG). (2023). *Climatic data of Tangerang City on October to December 2022*. https://dataonline.bmkg.go.id/home

Ministry of Agriculture. (2022). *Food consumption statistics in 2022*. Center of Agriculture Data and Information System, General Secretary of the Ministry of Agriculture of the Republik of Indonesia.

Nazirwan, Wahyudi, A., & Dulbari. (2014). Karakterisasi koleksi plasma nutfah tomat lokal dan introduksi. *Jurnal Penelitian Pertanian Terapan*, *14*(1), 70–75.

Oktaviani, W., Khairani, L., & Indriani, N. P. (2020). Pengaruh berbagai varietas jagung manis *(Zea mays* L.) terhadap tinggi tanaman, jumlah daun, dan kandungan lignin tanaman jagung. *Jurnal Nutrisi Ternak Tropis dan Ilmu Pakan*, *2*(2), 60–70.

Rahmasuri, A., Ginting, Y. C., & Bakrie, A. H. (2014). Pengaruh konsentrasi boron terhadap pertumbuhan dan produksi dua varietas mentimun (*Cucumis sativus* L.) yang ditanam secara hidroponik. *Jurnal Agrotek Tropika*, *2*(3), 363–367.

Sakri, R. M. (2014). *Meraup untung jutaan rupiah dari budidaya terung putih*. Penebar Swadaya Publisher.

Samsun Provincial Directorate of Agriculture and Forestry. (2018). *Hıyar Yetiştiriciliği (Cucumber Cultivation)*. Samsun Provincial Directorate of Agriculture and Forestry.

Saragih, R., Saptadi, D., Zanetta, C. U., & Waluyo, B. (2018). Keanekaragaman genotipe-genotipe potensial dan penentuan keragaman karakter agro-morfologi ercis (*Pisum sativum* L.). *Jurnal Agro*, *5*(2), 127–139. https://doi.org/10.15575/3230

Siagian, V., & Sintawati, R. (2016, September). *Faktor-faktor yang memengaruhi produksi mentimun di Kabupaten Lebak, Provinsi Banten*. Prosiding Seminar Nasional Pengembangan Teknologi Pertanian. Bandar Lampung (p. 308–314). Politeknik Negeri Lampung.

Simanullang, V., Bangun, M. K., & Setiado, H. (2014). Respons pertumbuhan beberapa varietas mentimun (*Cucumis sativus* L.) terhadap pemberian pupuk organik. *Jurnal Online Agroekoteknologi*, *2*(2), 680–690.

Siswadi. (2007). Penanganan pascapanen buah-buahan dan sayuran. *Jurnal Inovasi Pertanian*, *6*(1), 68–71.

Sudarma, H. J. (2013). *Pembibitan palawija dan hortikultura*. Bola Bintang Publisher.

Suherman. (2014). Pengaruh dosis pupuk kandang sapi dan konsentrasi Gandasil B terhadap pertumbuhan dan produksi tanaman mentimun (*Cucumis sativus* L.). Faculty of Agriculture. Padang Tamansiswa University.

Sumpena, U. (2001). *Budidaya mentimun intensif dengan mulsa secara tumpang gilir*. Penebar Swadaya Publisher.

Syahputri, W. W., Setiado, H., & Lubis, K. (2018). Studi karakteristik jagung introduksi dan beberapa varietas jagung lokal. *Jurnal Agroekoteknologi*, *6*(2), 209–214.

Syahri, & Somantri, R. U. (2016). Penggunaan varietas unggul tahan hama dan penyakit mendukung peningkatan produksi padi nasional. *Jurnal Penelitian dan Perkembangan Pertanian*, *35*(1), 25–36.

Tjibtaningrum, A., & Erhadestria, S. (2016). Manfaat jus mentimun (*Cucumis sativus* L.) sebagai terapi hipertensi. *Jurnal Majority*, *5*(1), 112–116.

Waskito, H., Nuraini, A., & Rostini, N. (2018). Respons pertumbuhan dan hasil cabai keriting (*Capsicum annuum* L.) CK5 akibat perlakuan pupuk NPK dan pupuk hayati. *Jurnal Kultivar, 17*(2), 676–681.

Wasonowati, C., Sinar, S., & Ade, R. (2013). Respons dua varietas tanaman selada (*Lactuca sativa* L.) terhadap macam nutrisi pada sistem hidroponik. *Agrovigor, 6*(1), 50-56.

Wicaksana, P. C., & Sulistiyo, N. B. E. (2017). Aplikasi pupuk kandang ayam dan mikroorganisme lokal (MOL) daun gamal terhadap produksi dan mutu benih mentimun (*Cucumis sativus* L.*). Journal of Applied Agricultural Sciences*, *1*(1), 72–85.

Widiastuti, E., & Latifah, E. (2016). Keragaan pertumbuhan dan biomassa varietas kedelai (*Glycine max* L.) di lahan sawah dengan aplikasi pupuk organik cair. *Jurnal Ilmu Pertanian Indonesia*, *21*(2), 90–97.

Wijoyo, P. M. (2012). *Budidaya mentimun yang lebih menguntungkan*. Pustaka Agro Indonesia Publisher.