Growth And Yield Of Six Newly Developed Chili Pepper Hybrids At Medium Elevation In Wet Season

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Abstract

Chili pepper is a very important and high economic value horticultural crop. One effort to increase productivity of chili pepper is the use of hybrid cultivar. However, newly developed cultivars have to pass multi-location evaluation before being released to farmers. This study was a part of a multi-location test and aimed to evaluate the growth and yield of six hybrid genotypes at medium elevation during wet season. The research was carried out during the peak of rainy season (November 2014 to February 2015) at Padang Lekat village, Kepahiang, Bengkulu Province. The experiment was arranged in a randomized completely block design (RCBD) with 3 replications. Six newly developed hybrids, H5, H14, H17, H20, H23, and H39, and a commercial cultivar, Dimas, were used as treatments. The results showed that hybrid H39 was the highest vegetative growth among hybrids. Hybrid H20 show the highest yield components. Other hybrids were about similar to Dimas in vegetative growth and yield components. Yield per plant and per plot of hybrid H20 and H23 were similar to that of Dimas. Further evaluation is needed to have enough information on the performance of those new hybrids in different location and season.

Key words: chili pepper, hybrid, growth, production

INTRODUCTION

Chili pepper or hot pepper is the most important spice and specific ingredient of oriental cooking recipes. Most Indonesians and other Asian people like hot sensation on their food. In Indonesia, chili pepper fruit is consumed in the form of fresh or dried form as seasoning and also can be used as industrial raw materials (Kusmana *et al.*, 2009) and has a very high economic value due to high demand. Based on data from the BPS (2014), chili pepper production of Indonesia during the year of 2011-2013 had amounted to 1.5, 1.66, and 1.7 million tons, respectively. However, that was still lower compared to other countries, such as China (15.52 million tons), Mexico (2.14 million tons), and Turkey (2 million tons) (Rubatzky and Yamaguchi, 1998). The average chili pepper productivity is about 7.93 tons per hectare (BPS, 2013) which was far below its potential productivity which can reach 20 tons per hectare (Agustin *et al*. 2010).

Efforts to elevate the production of chili pepper are necessary to fulfill the increasing demand for chili pepper due to the increase population. Besides increasing chili pepper planting area, one promising alternative solution is developing local and most adaptive hybrid cultivar is to increase the productivity. The yield of chili pepper hybrid variety is higher compared to open pollinated variety, as higher as 61% (Kalloo, 1986).

University of Bengkulu through a series of studies has made various efforts to develop high yielding chili pepper hybrid varieties and come up with six elite hybrids, namely H5, H14, H17, H20, H23 and H39. In Indonesia, and other tropical countries, based on agroecosystem characteristics, there are commonly three group of vegetable producing areas, they are low elevation (0 - 350 m above sea level, asl), medium elevation (350-700 m asl), and high elevation (> 700 m asl). The grouping is actually associated with the average temperature which significantly different at different elevation (Djaenudin *et al*., 2002). Therefore, prior to being released as new varieties, those novel hybrids must pass field trial on various locations or seasons (Direktorat Jendral Hortikultura, 2011) in order to determine their adaptability properties. The objective of this study was to evaluate the growth and yield of six chili pepper hybrid genotypes on medium elevation in wet season.

MATERIALS AND METHODS

This study was conducted in November 2014 to March 2015 at Padang Lekat village, Kepahiang, Bengkulu Province, a medium elevation of 615 m asl. The experiment was arranged in a randomized completely block design (RCBD) with 3 replications. The treatments were six new developed hybrids, namely H5, H14, H17, H20, H23, H39 and a commercial hybrid, Dimas (DMS). The experimental unit was a pair-row plot consisted of 50 plants.

Seedlings were grown in 72 celled trays with top soil and manure mix of 1:1 (w/w) ratio. Before sown on the tray, the seed were germinated on a damp tissue paper for 3 days until the radicle emerge from the seeds. The seedlings were watered and pest and diseases controlled preventively to maintenance the seedling during in the nursery.

Commercially accepted field growing techniques and pest management practices were adopted. The land was cleared from weeds or other vegetation, and tilled manually by hoe. The crumbled soil was, then, made into soil beds, 1 m wide and 10 m long, with 50 cm space between beds. After the application of 20 ton per hectare cow manure, black-silver plastic mulch was installed on every soil beds. A pair-row planting distance with 50 cm apart was made in each soil bed, with 40 cm spacing within each row. Therefore, there were 50 plants each plot. Six-week old seedlings were transplanted into transplanting hole. A mix fertilizer of urea, KCL and TSP of 100, 300, and 100 kg per hectare, respectively, was applied prior to transplanting. At 4 weeks after transplanting, other application of urea at 100 kg per hectare was done encircle the stem with radius of 5 cm. In order to avoid lodging, the plants were supported by 75 cm long bamboo sticks and loosely bound to it with raffia. Side branches below the first dichotomous branch were hand pruned anytime they emerged. Weeds growing enclose to the stem were controlled manually by hand, and ones growing in the furrow between the beds were sprayed by herbicide. Pest and diseases were controlled weekly with a combination of insecticide, fungicide and surfactant. Fruits were harvested when 75% part of the fruits turn red.

Variables measured were plant height, stem diameter, dichotomous branch height, canopy width, number of fruit per plant, and yield per plot. The data collected were analyzed by analysis of variance (ANOVA) and the mean comparison by Duncan's Multiple Range Test (DMRT) at the 5% level.

RESULTS AND DISCUSSION

The research was conducted in November to February and the average rainfall was ranging from 279 – 383 mm per month, considered to be very high intensity. The average humidity during the study was 85.75%. This humid condition was suitable for disease to grow. However, with the preventive control measure done with fungicide weekly, there was little percentage of disease occurrences in the field. Only about 5 and 4 plants out of 1050 plants were identified being infected fusarium wilt and yellow mosaic complex, respectively.

The results of analysis of variance indicated that the genotype significantly affected plant height, canopy width, the number of fruit, and yield per plot. The highest plant height and stem diameter were obtained on genotype H39, with the average of 99.99 cm and 1.43 cm, respectively, and the lowest was on H14, with the average of 76.12 cm and 1.21 cm, respectively. The habitus of H39 was significantly higher than that of DMS, H5, H14, H17, H20, or H23, while among other genotypes was relatively of the same height. Dichotomous branch height of genotype H39 was also the highest, with the average of 31.87 cm, and the lowest was that of genotype H17, averaging of 26.91 cm (Table 1). The widest plant canopy was found in genotype H39, 6211.93 cm^2, and significantly wider than that of other genotypes. The narrowest one was found in genotype H14, 2874.79 cm^2 although it was not significantly different from that of other hybrid genotypes (Table 2).

The highest number of fruit per plant was obtained on hybrid H39 with an average of 81.66 total fruit which was significantly higher than that of other hybrids. The second highest number of fruit was the commercial hybrid, 'Dimas'. The other novel hybrids, except H5, possessed number of fruit similarly to 'Dimas'. Hybrid H5, produced the least number of fruit per plant, 44.13 fruits. The hybrid H20 showed the highest yield per 10 m^2 plot, although similarly to 'Dimas' and H23. It was 18.85 kg per 10m^2 plot or, in estimation, about 15 ton per hectares. That of 'Dimas' and H23 was 18.81 and 17.43 kg per 10m^2 plot, respectively. The yield of other hybrids were in a range of 12.42 to 13.23 kg per plot and they were not significantly different each other (Table 2).

Tabel 1. Vegetative growth performance of six newly developed hybrids and a commercial hybrid cultivar, 'Dimas' at medium elevation in wet season

Hybrid	Plant height (cm)	Stem diameter (cm)	Dichotomous branch height (cm)
Dimas	83.31 b	1.26 ab	29.36 a
H5	83.45 b	1.29 ab	27.21 a
H14	76.12 b	1.21 b	28.40 a
H17	76.81 b	1.34 ab	26.91 a
H20	81.96 b	1.30 ab	27.07 a
H23	80.87 b	1.30 ab	27.11 a
H39	99.99 a	1.43 a	31.87 a

The numbers followed by different letters in the same column were significantly different based on DMRT 5%.

Tabel 2. Canopy width, number of fruit and yield of six newly developed hybrids and a commercial hybrid cultivar, 'Dimas' at medium elevation in wet season

Hybrid	Canopy width (cm^2)	Number of fruit per plant	yield per 10 m^2 plot (kg)
Dimas	4175.15 b	61.80 b	18.81 a
H5	4132.00 b	44.13 c	12.42 b
H14	2874.79 b	47.33 bc	12.59 b
H17	3250.88 b	53.76 bc	13.23 b
H20	3893.69 b	51.53 bc	**18.85 a**
H23	4205.64 b	54.83 bc	17.43 ab
H39	**6211.93 a**	**81.66 a**	12.64 b

The numbers followed by different letters in the same column were significantly different based on DMRT 5%.

This study was focused on obtaining information on growth and yield performance of six novel hybrids, developed for high yielding and tolerance to cucumber mosaic virus, in the field. The information will be combined with other experiments conducted on different season and elevation in order to support a conclusion which hybrid will be the most prospectively to be released to farmers. Theoretically, there is a correlation between vegetative growth performance and the yield of plant, as vigorous growth will provide strong sources supporting high yield. However, it seems that there is a great variation among genotypes. In this study, variation on plant height, dichotomous branch height, canopy width, number of fruit and yield was due to genetic factors. The genetic background of parental used to develop the hybrids under study is likely responsible to this variations. Broad genetic diversity was found on many vegetative and generative characters of chili pepper genotypes (Syukur and Sujiprihati, 2011). Among genotypes showed different response even in the same environmental condition. Some hybrids showing not significantly different in many characteristics indicated that they were developed from genetically closely related parents.

Plant height and canopy width are the most representative character to describe vegetative performance of plants. In this study, hybrid H39 showed vegetative growth more vigorously than other hybrids. Vigorous habitus, also supported by higher number of branches, contributes to higher number of fruits per plant. Although it was not significantly different from other hybrids, H39 also showed the largest stem diameter. The larger the stem diameter, the more sturdy the stems, and this characteristic is of great value to support high number of fruits or from potentially lodging due to strong wind. The perspective of chili pepper breeding on high dichotomous character is preferably to develop variety with higher dichotomous branches (Saputra *et al.*, 2012). The higher the dichotomous then the higher the distance between fruit and ground, the lesser the soil born fungal infection due to dirt splash on fruits (Kirana and Sofiari, 2007).

In some study, there are positive correlations between vegetative plant growth and yield components of chili pepper (Pranita, 2007; Muniarti *et al*., 2013). Higher number of branches increases the chance of plants to produce higher number of flowers and then elevates the possibility to produce more fruits (Maryani dan Yunianti, 2010). Crop productivity is the main goal of plant

breeding besides other valuable traits (Syukur *et al*., 2012). Yield of chili pepper is a resultant of many yield components, such as number per fruit, fruit length, fruit diameter, seed weight or number, fruit flesh thickness etc. The number of fruits and weight per fruit were positively correlated with plant yield (Ganefianti, 2006; Syukur *et al*., 2010; Muniarti *et al*., 2013). Fruit length, fruit diameter, thick fruit flesh and seed weight affect the weight per fruit. Fruit length is influenced by genetic and environmental factors (Syukur *et al*., 2012). Fruit length and diameter are the characters that determine the quality of chili pepper Kirana *et al*. (2014). The thicker the fruit flesh, the longer the fruit, the larger the diameter, the more weight per fruit and consequently, the higher fruit yield per plant (Deviona *et al.* 2011; Muniarti *et al*., 2013). Therefore, crop yield can be elevated by increasing the number of fruits per plant (Kirana and Sofiari, 2007). However, result of this study is not fully in agreement to the last study. H39 showed the highest number of fruits but yielded less then 'Dimas', H20, or H23. Fruit size (length and diameter) is other determining variable to the yield of chili pepper.

Hybrid H39 showed the biggest habitus, indicated by the highest plant height, stem diameter and plant canopy. On the other hand, habitus of H14 was the smallest. This will imply to the plant management in the field in order to maximize crop productivity. The large habitus genotype will be suitable to wider plant spacing, optimizing the performance of individual plants. Conversely, the small habitus type hybrid will be suitable for high plant population. Both of which will end up with high yield per area unit (Mastaufan, 2011).

CONCLUSIONS

Hybrid H39 was the most vigorous vegetative growth among hybrids. H20 and H23 showed higher fruit yield compared to other novel hybrids. Further test is needed to have additional information on the performance of growth and yield at different location and season.

ACKNOWLEDGEMENT

This research was supported by the National Strategic Research (STRANAS) the year of 2014, Directorate General on Higher Education, The Ministry of Education and Culture, The Republic of Indonesia. The authors thank to Mr. Zahibul, a farmer at Padang Lekat village, for support and help on the field work.

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