INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 14, No. 3, p. 1-6, 2019

RESEARCH PAPER OPEN ACCESS

Advantage of resistance genetic parameters from several pepaya F1 results (*Carica papaya* L.) to mealybug pest (*Paracoccus marginatus*) using choice test method

Siti Hafsah[1*], Firdaus[2]

[1]*Agrotechnology Department, Faculty of Agriculture, University of Syiah Kuala, Darussalam 23111, Indonesia*

[2]*Assesment Institute of Agricultural Technology (Aceh AIAT), Indonesia*

Key words: Papaya, Genotype, Endurance, Mealybug pests, Genetic parameters.

http://dx.doi.org/10.12692/ijb/14.3.1-6 Article published on March 15, 2019

Abstract

Papaya is a popular and economically important fruit tree of tropical and subtropical country. This study aims to obtain information on the genetic parameters and the best level of resistance of papaya plants to mealybug pests (*Paracoccus marginatus*) using the choice test method.This study used a Completely Randomized Design with eleven genotypes as a treatment and repeated three times. Observations carried out included variables (plant height, leaf number, petiol length, stem diameter, leaf area index and dry weight), and resistance variables (intensity of attack, number of ovisaks).The results showed that: The intensity of the fourth week of attack after infestation of mealybug pests on choice test found that the genotypes were resistant to testing were USK7, USK1, and USK1xUSK7; heritability values with high category on choice test were found in the character of plant height, petiol length, dry weight and leaf area index; there is a significant correlation on all the characters of plant growth on the intensity of the attack with the highest value of the character of dry weight with the intensity of the attack on the test with a value of -0.58.

* **Corresponding Author:** Siti Hafsah ✉ sitihafsah@unsyiah.ac.id

Introduction

Papaya (*Carica papaya* L.) is a plant originating from Central America. papaya is one of the most important fruit commoditiesin Indonesia, papaya fruit is favored by all levels of society because has sweet taste and contains many nutrients and vitamins, especially vitamins A and C, papaya is also used as a raw material for the food, medicine, cosmetics and pesticides industries (Sujiprihati, 2009).

Aceh Province is one of the highest papaya producing regions in Indonesia. Based on the Central Statistics Agency (2016), papaya production in Aceh Province amounted to 725,260 quintals, North Aceh District was the highest papaya producing district in Aceh with a production of 33,271 quintals. The many obstacles encountered in the cultivation of papaya cause the domestic market demand is often not maximally fulfilled.

One of the obstacles in the papaya cultivation is the high attack of pests. As for the new pests that attack papaya plants, namely mealybug pest, *Paracoccus marginatus*. These pests are very influential on the production of papaya plants. *P. marginatus* is one of the most difficult to control insect species, its control strategy is very limited because mealybug pest have a thick waxy layer on the surface of their bodies that is able to avoid synthetic contact (Krishnan *et al*., 2016).

The solution to this problem is to conduct a series of papaya plant breeding activities. First of all by forming a population so genetic diversity is available. One way to get resistant genotype is to make a selection based on genetic parameter analysis of mealybug pest resistance on papaya plants. The resistant genotype is the solution to overcome the mealybug pests and environmental friendly by pest infestation. Budiyanti and Sunyoto (2014), mentioned that knowledge of genetic parameters in papaya plant breeding is key in choosing procedures that will provide maximum selection progress. Solutions for solving the above problems can be carried out by a series of papaya plant breeding activities, namely by forming populations so that genetic diversity is available and analyzing the genetic parameters of papaya plants against white flea pestsFrom this selection the breeder can get resistance genotype of papaya.

Materials and methods

Materials

This research was carried out in the village of Cot Cut, Aceh Besar District, from September 2017 to January 2018. The seeds of papaya plants used amounted to 330 seeds from 11 genotypes, 7 of which were the results of previous crossline with 4 elders namely Dapina (USK4), Carisya (USK7), Calina (USK1) and Carmida (USK6), the results of F1 crossline from 4 of these elders are USK7 X USK4, USK1 X USK7, USK7 X USK6, USK6 X USK7, USK4 X USK7, USK4 X USK6, USK6 X USK4. As for the mealybug pest propagation host, seeds from one local genotype (saree genotype) were used as many as 15 seeds.

Methods

The seeds that have been prepared are directly planted into the nursery polybag with a planting hole size of 0.5 - 1 cm, at the age of 2 weeks after seedling, the seedlings are transferred to a large polybag growing medium with a volume of 10 kg of soil prepared. Fertilization is carried out in the nursery of papaya plants aged 30 HST fertilizer used is NPK 1 gram / plant. The source of the mealybug pest used comes from the papaya plant around the Great Aceh which is taken by several mealybugpest ovisaks, then bred in several prepared papaya seeds.

Previously, fifteen local papaya plants which were susceptible to mealybug pests, which will be used as host plants for the multiplication of mealybug pests to be placed at the center of the circle. Papaya plants which are 30 days after planting (HST) of each genotype tested, are placed in a circle in a gauze cage with a diameter of 150 cm and a height of 100 cm.

This study used an experimental method with a completely factorial randomized completely design with a plant genotype as a treatment. each genotype has three replications with five samples per replicate.

Observations made included plant growth variables (plant height, number of leaves, petiol length, stem diameter, leaf area and dry weight), and resistance variables (intensity of attacks and number of ovisaks).

Analysis of genetic parameters in each papaya character was observed using the formula is obtained using the Falconer formula (1989):

a) The value of heritability in the broadest sense can be calculated by the formula:

$$h^2_{bs} = \frac{\sigma^2 g}{\sigma^2 p} \times 100\%$$

b) The expectation genetic progress (KGH), namely: KGH = h^2bs (Sp). (i) (i=intensity selection).

c) Genetic correlation between properties is obtained by using exel data processing techniques. Correlation was carried out to see the relationship between the morphological characters of papaya plant growth on white aphid pest resistance.

Results and discussion

Resistance of papaya plants to mealybug pests (Paracoccus marginatus)

Based on the observations of the genotypes tested, it has a very significant effect on the intensity of the attack on the fourth week after investing in the *P. marginatus* pest.

The highest attack intensity was found in the USK4 genotype. Observation results showed that there were genotypes with a resistant category in this test with the lowest intensity of attacks, namely USK7, USK1 and USK1XUSK7 genotypes (Table 1).

Table 1. Intensity of Attack (%) and Category of Papaya Resistance Testing Choce Test 4 weeks After Pest Infestation Infestation *P. marginatus*.

Genotype	4 WAP (%)	Chategory
USK7	24.74ab	Resistance
USK2	22.95 a	Resistance
USK4	63.52 d	Rather Sensitive
USK6	35.84 abc	Rather Resistance
USK7XUSK4	29.38 ab	Rather Sensitive
USK1XUSK7	22.35 a	Resistance
USK7XUSK6	28.23 ab	Rather Sensitive
USK6XUSK7	39.33 bc	Rather Resistance
USK4XUSK7	47.17 c	Rather Resistance
USK4XUSK6	36.01 abc	Rather Resistance
USK6XUSK4	48.08 cd	Rather Resistance
$BNT_{0,05}$	16.01	

Description: The number followed by the same letter in the same column is not significant in the BNT0,05 test.

Genotypes with resistant categories are thought that has a genetic source of resistance to mealybug pests, so it can be selected for further testing. Crops that are resistant are plants that show little damage or are less able to be infected by a disrupting body compared to other plants in the same environmental conditions in the field (Nasir, 2013). An alternative pest control with plant breeding methods, namely using resistant varieties is the most practical, economical, and safe for the environment. The use of resistant varieties is intended to reduce pest populations in the initial phase and during plant growth and attacks from pests (Baliadi, 2008).

The highest average attack intensity at the fourth week was found in the USK4 genotype which was not significantly different from USK6XUSK4 but was significantly different from the other genotypes.

Lolong *et al.* (2014) stated that the population of *P. marginatus* was more in monoculture papaya plants when compared to the polyculture planting pattern. The high intensity of *P. Marginatus* mealybug pest infestation in monoculture cultivation due to lack of diversity of genotypes. The results of research conducted by A'yun (2015), also mention testing of soybean plants on pod sucking pests showed a higher level of pod damage compared to the choice test, because in the test without choice pests could not choose plants the soybean it likes but must attack only one plant.

Table 2. Heritability Value Genetic Progress and The Expectation Genetic Progress Some Characters in Pepaya Plant Choice test Age 60.

No	Character	GV	GPE (%)	Chriteria GPE	H^2bs (%)	Criteria H^2bs
1	Plant height	3.16	6.66	High Enough	50.40	high
2	Number of leaves	0.03	5.03	Ratherhigh	40.06	medium
3	Stem diameter	0.58	2.77	Low	34.54	medium
4	Length of petiol	0.92	5.62	Rather high	61.54	high
5	Dry weight	10.14	18.00	high	66.70	high
6	leaf area indexs	14.08	10.22	high	52.52	high

Description: GV = genetic variation, GPE = genetic progress expectations, H^2bs = heritability in the broadest sense.

According to Standfield (1991), expectations of genetic advancement criteria were: 0 <GPE <3.3% = low, 3.3% <GPE <6.6% = rather low, 6.6% <GPE <10% = quite high and GPE> 10% = high.

The attack of mealybug pests in Kadapa Regency Chttoor continued to decline from June 2013 to December 2013 due to a decrease in maximum and minimum temperatures, as well as high rainfall. Mealybug pest infestation in papaya plants increases gradually until April 2014, this is caused by dry weather which causes an increase in temperature which encourages population growth and further spread of papaya lice (Rasheed *et al.*, 2017).

Genetic Parameter Analysis

Heritability, Genetic Progress, Progress of GebetikHarapan and Inter-Character Correlation

The results choice test analysis showed the highest KG values on the character of dry weight and leaf area index with the values of each value 10.14 and 14.08. The highest KGH value was also found in the character of dry weight and leaf area index with a value of 18.00 and 10.22% with a high KGH category (Table 2).

This shows that the application of selection on the character of growth will have an effect on improving a plant genotype. Heritability values that have a high category are found in the character of plant height, crate length, dry weight and leaf area index with values of 50.40, 61.54, 66.70 and 52.52 respectively.

Kumar *et al.*, (2018) mentioned that high heritability showed that the selection program based on these characters would be more effective to improve the quality of papaya genotypes. High heritability followed by high expectations of genetic progress shows that these traits are largely governed by additive gene action and phenotypic selection, these traits can be more effective for desired genetic improvement.

The results of the choice test testing showed that there was a significant correlation on all the characters of plant growth on the intensity of the attack with the highest value found on the character of dry weight on the intensity of the attack with a value of -0.58. (Table 1).

Negative correlation indicates that an increase in a trait will decrease another trait, while a positive correlation occurs when an increase in a trait will

increase the other traits correlated. This shows that the character growth of plant growth such as plant height, leaf number, stem diameter, petiol length, leaf area index and plant dry weight will reduce the intensity of *P.marginatus* pest attack. Hapsari *et al.* (2010) states that genetic correlation between traits is an assessment of the closeness of the relationship between the two correlated traits.

Table 3. Correlation between Growth Characteristics and Endurance of Papaya Plants at Age 60 HST Choice Test.

Character	NL	SD	LP	LA	DW	IA	NO
PH	0.40*	0.68**	0.87**	0.71**	0.81**	-0.50*	-0.66**
NL		0.05^{tn}	0.48*	0.52**	0.44*	-0.18^{tn}	-0.28^{tn}
SD			0.55**	0.44*	0.57**	-0.35^{tn}	-0.36^{tn}
LP				0.68**	0.90**	-0.47*	-0.71**
LA					0.84**	-0.56**	-0.60**
DW						-0.58**	-0.79**
IA							0.86**

Description: PH = plant height, NL = number of leaves, SD = stem diameter, LP = length of petiol, LA = leaf area, DW = dry weight, IA = intensity of attack NO = number of ovisak.

The predictive value of positive correlations illustrates the relationship between the correlated characters. The results showed a positive correlation in the intensity of the attack on the number of ovisaks (Table 3).

This is in line with the results of the study of Tairas *et al.* (2014), which states that the population of *P. marginatus* has a positive correlation with the intensity of attacks on the fruit and leaves of papaya plants.

Conclusion

This research show that genotype USK7, USK1, and USK1XUSK7 are genotype with best resistance base on choice test method.

The character that has high correlation in choice test method are dry weigth and attack intensity (-0.58**). So can be concluded that genotype USK7 and USK1 are chosen candidate in the assembly of the next variety.

Acknowledgements

The authors appreciate and thank the University of Syiah Kuala who has provided financial support for this research.

References

Budiyanti T. dan Sunyoto. 2014. Pendugaanheritabilitasdari 15 genotipe papaya (Carica papaya L.) padaduaperiodemusimpanen. Jurnal Agroteknologi **2(4),** 11-14.

Badan Pusat Statistik Provinsi Aceh. 2016. Produksi tanaman buah-buahan menurut jenis dan kabupaten.

Falconer DS. 1989. Introduction to Quantitative Genetics. Third edition. English Language Book Society Longman. Hongkong. 438 hlm.

Nasir M. 2013. Pengantar Pemuliaan Tanaman. Penerbit CV Darmadana Multiguna. Banda Aceh. 354 hlm.

Tombing Y, Muhardi dan Ariembawa D. 2010. Pertumbuhan beberapa varietas pepaya (Carica papaya L.) pada berbagai jenis pupuk. Jurnal Agroland **17(2),** 149 – 153.

Tairas W, Tulung M, Pelealu dan Rondonuwu SJ. 2014. Study on Population Abundance of Papaya Mealybug (Paracoccus marginatus Williams & Granara de Willink) in the North Minahasa Regency

of North Sulawesi Province, Indonesia. International Journal of Scientific & Engineering Research. **(5) 3**.

Khan M, Biswas MJH, Ahmed KS, Sheheli S. 2017. Outbreak of Paracoccus marginatus in Bangladesh and its control strategies in the fields. Progressive Agriculture **(25),** 17-22, 2014.

Wahyuni F. 2016. Keragaan Beberapa Genotipe Pepaya (Carica papaya L.) dan Pendugaan Parameter Genetik Ketahanan Terhadap Hama Kutu Putih (Paracoccus marginatis) di pembibitan. Skripsi. Agroteknologi. Unsyiah. Banda Aceh.

Lolong R. 2014. Padat populasi dan persentase serangan Paracoccus marginatus William and Granara de willink (Hemiptera: Pseudococcidae) pada pertanaman pepaya monokultur dan polikultur di kecamatan dimembe kebupaten minahasa utara. Skripsi. Jurusan Hama Dan Penyakit Tumbuhan. Fakultas Pertanian. Universitas Sam Ratulangi Manado.

Ivak LM. 2010. Dampak Ekonomi Serangan Hama Asing Invansif Paracoccus marginatus(Hemimptera:Pseudococcidae) pada Usahatani. Nurhayati dan Anwar: Prevalensi Cendawan NeozygitesPapaya di Kabupaten Bogor. Thesis. Bogor: Institut Pertanian Bogor.

Krishnan JU, George M, Ajesh G, Jithine JR, Lekshmi NR, Deepasree ME. 2016. A review on paracoccus marginatus williams, papaya mealy bug (Hemiptera: Pseudococcidae). Journal of Entomology and Zoology Studies **4(1),** 528-533.

Stanfield WD. 1991. Genetics (Genetika, diterjemahkan oleh M. Apandi dan L. T. Hardi). Edisi kedua. Erlangga. Jakarta.

Kumar A, Prasad Y, Chaudhary P, Kumar N. 2018. studies on genetic variability, character association and path analysis among yield and yield contributing traits in papaya (carica papaya L.). Journal of Pharmacognosy and Phytochemistry. **SP(1),** 845-849.

A'yun Q. 2015. Seleksi ketahanan galur dan varietas kedelai (Glycine max L. Merrill) Berdasarkan karakter morfologi polong sebagai pengendali hama pengisap polong (Riptortus linearis F.). Jurnal Biology **1,** 1.

Rauf A. 2008. Hama Kutu Putih (Paracoccus marginatus). Pusat Penelitian Ilmu Hama Tanaman. Institut Pertanian Bogor.