AGRONOMIC EVALUATION OF 22 CASSAVA CLONES IN SOUTH LAMPUNG

Setyo Dwi Utomo[#], Dea Novia Natasya[#], Akari Edy[#], and Erwin Yuliadi[#]
[#]*Department of Agronomy and Horticulture, University of Lampung, Jl. S. Brodjonegoro 1, Bandar Lampung, 35145, Indonesia*
E-mail: setyo.dwiutomo@fp.unila.ac.id

***Abstract*— The objective of this research was to evaluate agronomic characters of22 cassava clones in Natar, South Lampung (. Experiment was arranged in randomized block design with two replications. Two selected clones (Gayor and Bendo 2) indicated starch rendement higher than UJ 3 and UJ 5. The fresh root weight per plant of 7 selected clones (Gayor, Bendo 2, CMM-25-27-271014-5, CMM-25-27-301, Duwet 1, SL 103, and TB 28)was higher than that of standard clones UJ 3 and UJ 5. The selected clones will be further evaluated in the next advanced yield trials**

***Keywords*— Clones, Manihot esculenta, starch content, yield trial**

I INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the most important agricultural commodities in Lampung Province. Lampung is the largest producer of cassava in Indonesia; the harvest area was 279 thousand hectars or 29% of total harvest area of Indonesia (BPS, 2016). The commodities can be used for food, feed, tapioca, bioplastics, and biofuel/bioethanol (Ceballos *etal*.,2012). Cassava as the source of bioethanol is becoming more important because the Indonesian Goverment plan to substitute 15% fossil fuel with biofuel in 2025. To anticipate the higher demand, the yield of cassava plants must be increased, i.e., by developing high-yielding cultivars and cultivars with high starch content.

The yield and qualitiy of cassava (*Manihot esculenta* Crantz) can be improved through breeding to develop superior cultivars. The status of cultivar development of cassava in Indonesia or worldwide was reported and reviewed by Poespodarsono (1992), Jennings dan Iglesias (2002), Ceballos *et al.* (2007), Lebot (2009), *Ceballos et al*. (2010), Ceballos *et al*. (2012), and Utomo *et al*.(2016). The steps of cassava breeding to develop new cultivars include development of genetically diversed population, selection, and yield trials. Genetically diversed population can be developed through sexual hybridization, genetic mutation, somaclonal variation, and genetic transformation. High genetic variation is required in order selection to be effective (Silva *et al*., 2016). Evaluation and election in cassava breeding can be conducted in F1 population (Poespodarsono, 1992: Ceballos *et al.*, 2007); homozigocity is not required because cassava is propagated through cutting. Selected clones will be included in yield trials by comparing with standard cultivars. Cultivars development of cassava at the University of Lampung is in progress (Utomo *et al*., 2016). This paper reported agronomic evaluation or yield trials of selected cassava clones.

II. MATERIALS AND METHODS

This experiment was conducted in Natar Integrated Field Laboratory of University of Lampung, at Muara Putih, Natar, South Lampung from January 2016 – January 2017. Twenty-two clones were evaluated, including three national cultivars (UJ 3, UJ 5, and Malang 4) (Table 1). Sixteen of them are F1 clones derived from a female parent. UJ 3 and UJ 5 where used as checks or standards. Experiment was arranged in randomized block design with two replications. One experimental unit consisted of 10 stem cuttings planted in one row. The planting distance was 50 cm within row and 100 cm among rows. Before planting, the land were ploughed, then ridges or mounds were prepared manually. NPK fertilizer (300 kg ha^{-1} was applied at two weeks after planting. Weeds were controlled manually and using herbicide.

Variables observed were number of fresh roots per plant, harvest index, fresh root weight per plant, and starch rendement. Fresh roots were harvested at 10 months after planting (Fukuda *et al*., 2010). The four variables were observed at the harvesting date. To count the number of fresh roots per plant, only fresh roots ≥ 1 cm in diameter were included.

II. RESULTS AND DISCUSSION

This experiment was a yield trial to evaluate agronomic character of 22 selected clones. Due to limited planting materials, this experiment was a small yield trial with two replications. Based on analysis of variances, some vegetative variables were significanty affected by clones. However, four important variables reported in this study were not significanty affected by clones (Table 2-5). The small number of replications contributed to the non-significance results. Therefore, evaluation to select the promising clones was based on quantitative data by comparing the promising clones to the performance of standard cultivars UJ 3 and UJ 5.

Although statistically not significant, quantitative data indicated that the harvest index of 8 clones (Mesa, Gayor, CMM-25-27-301, CMM-96-1-102, CMM-96-1-106) was higher than that of UJ 3 and UJ 5 (Table 2). Number of fresh roots per plant of of nine clones were higher than that of UJ 3 and UJ 5. The starch rendement and fresh root weight per plants of 3 and 8 clones were higher than those of UJ 3 and UJ 5 respectively. These results indicated that selection was effective to develop new high yielding clones (Ceballos *et al*., 2007; Utomo, 2012). The five best clones in number of fresh roots per plant, fresh root weight per plant, harvest index, and starch rendement were indicated in Table 3, 4, and 5.

CONCLUSION

Gayor and Bendo 2 showed starch rendement higher than UJ 3 and UJ 5. The fresh root weight per plant of 7 selected clones: Gayor, Bendo 2, CMM-25-27-271014-5, CMM-25-27-301, Duwet 1, SL 103, and TB 28, was higher than that of standard clones UJ 3 and UJ 5.The selected clones will be included in the next advanced yield trials.

ACKNOWLEDGMENT

This research was partially supported by national competitive grant "Hibah Strategis Nasional" Ministry of Research and Higher Education RI fiscal year 2016 and 2017. Letter of Appointment from the Head of LPPM Unila # 419/UN26/8/LPPM/2016 and 585/UN 26.21/KU/2017. The financial support was highly appreciated.

REFERENCES

Ceballos H. Fregene M. Perez JC. Morante N. Calle F. 2007. Cassava Genetic Improvement. *In*: Kang M.S. and P.M.Priyadarshan. Breeding Major Food Staples. Blackwell Publ. Oxford. UK. p: 365-391.

Badan Pusat Statistik. 2016. *Luas panenvUbi Kayu Menurut Provinsi (ton), 1993-2015*. https://www.bps.go.id/linkTableDinamis/view/id/880. Accessed 15 March 2017.

Ceballos H. Fregene M. Perez JC. Morante N. Calle F. 2007. Cassava Genetic Improvement. *In*: Kang M.S. and P.M.Priyadarshan. Breeding Major Food Staples. Blackwell Publ. Oxford. UK. p: 365-391

Ceballos H. Kulakow P. Hershey C. 2012. Cassava Breeding: Current Status. Bottlenecks and the Potential of Biotechnology Tools. *J. Tropical Plant Biol*. 5: 73-87.

Ceballos H. Okogbenin E. Pérez JC. Augusto B. López-Valle L. Debouck D. 2010. Chapter 2. Cassava. pp. 53 – 95. In J.E. Bradshaw (ed.). *Root and Tuber Crops*. Handbook of Plant Breeding. Springer Science+Business Media. LLC.

CeballosH. Perez JC. Calle F. Jaramillo G. Lenis JI. Morante N.Lopez J. 2007b. A New Evaluation Scheme For Cassava Breeding At CIAT. *In Proceedings 7th Regional Workshop held in Bangkok. Thailand.* www.ciat.cgiar.org. Accessed in June 2012. 125-135.

FukudaWMG. Guevara CL. Kawuki R. Ferguson ME. 2010. Selected Morphological and Agronomic Descriptors for The Characterization of Cassava. *International Institute of Tropical Agriculture (IITA). Ibadan. Nigeria. Nigeria*. *http://www.iita.org/c/document_library/get_file?uuid=4530a72e-917d-4801-9239-cb0ee3a4dd4e&groupId=25357*.

JenningsDL. IglesiasCA.2002. Breeding for crop improvement. In:Hillocks. R.J..Thresh.J.M.and Bellotti. A.C.(eds)*Cassava. Biology .Production and Utilization*. CAB International. Wallingford. UK.pp.149–166.

Lebot. V. 2009. Tropical root and tuber crops : cassava. sweet potato. yams. aroids / CABI International 875 Massachusetts Avenue 7th Floor 8DE Cambridge. MA 02139 USA.

Silva RS, Moura E. Neto JTF Sampaio JE. 2016. Genetic parameters and agronomic evaluation of cassava genotypes. Pesquisa Agropecuária Brasileira 51(7):834-841. DOI: 10.1590/S0100-204X2016000700006

Poespodarsono. S.1992. Pemuliaan Ubi Kayu. Dalam: Kasno A. Dahlan M. dan Hasnam (Eds.). *Prosiding Simposium Pemuliaan Tanaman I Perhimpunan Pemuliaan Tanaman Indonesia Komda Jawa Timur*. Malang. Jatim 27 – 28 Agustus. 1991. hlm 69 – 78.

Utomo. SD. Yuliadi E. Sunyoto. Edy A. Yafizham. Simatupang D. Suminar R. Hutapea A. 2016. Cultivar development of cassava at the university of Lampung Indonesia. *Converence ProsidingThe USR International Seminar On Food Security Improving Food Security: The Challenges for Enchancing Resilience to Climate Change.* Bandar Lampung 23–24 Augusts. 2016. p130–142.

Utomo, SD. 2012. Pemuliaan Menggunakan Rekayasa Genetik. Lembaga Penelitian Universitas Lampung. 144 hlm.

Table 1. The short description of cassava clones evaluated

No.	Clones	Source of planting material	Description
1	Gayor		Local clone
2	SL 103	Liwa, Lampung Barat	F1 derived from female parentSayurLiwa
3	CMM 25-27-57	Balitkabi, Malang, JawaTimur	F1 derived from female parent CMM 25-27
4	Thailand Emas	Terbanggi, Lampung Tengah	Local clones
5	CMM 96-1-106	Balitkabi, Malang, JawaTimur	F1 derived from female parent96-1
6	UJ 5	TulangBawang Barat	National cultivar
7	CMM 96-1-151	Balitkabi, Malang, JawaTimur	F1 derived from female parent 96-1
8	Bendo 2	Sragen	F1 derived from female parent Bendo
9	CMM 96-1-3	Balitkabi, Malang, JawaTimur	F1 derived from female parent 96-1
10	Duwet 1	Sragen, Jawa Tengah	F1 derived from female parent Duwet
11	UJ 3	Natar, Lampung Selatan	National cultivar
12	SL 9	Liwa, Lampung Barat	F1 derived from female parent SayurLiwa
13	Duwet 4	Sragen, Jawa Tengah	F1 keturunantetuabetinaklonDuwet
14	CMM 25-27-301	Balitkabi, Malang, JawaTimur	F1 derived from female parent CMM 25-27
15	MU 109	Balitkabi, Malang, JawaTimur	F1 derived from female parent MentikUrang
16	Malang 4	Malang, JawaTimur	National cultivar
17	MU 104 Bunga	Balitkabi, Malang, JawaTimur	F1 derived from female parent MentikUrang
18	CMM 96-1-109	Balitkabi, Malang, JawaTimur	F1 derived from female parent 96-1
19	Mesa	Terbanggi, Lampung Tengah	Local clone
20	TB 28	Terbanggi, Lampung Tengah	F1 derived from female parent UJ3
21	CMM 25-27-271014-5	Balitkabi, Malang, JawaTimur	F1 derived from female parent CMM 25-27
22	CMM 96-1-102	Balitkabi, Malang, JawaTimur	F1 derived from female parentKlon 96-1

Table 2.Harvest index, number of fresh roots per plant, starch rendement, and fresh-root weight per plant of 20 cassava clones compared to the standards UJ 3 and UJ 5

No.	Clones	Harvest index (%)	Number of fresh roots per plant	Starch rendement (%)	Fresh-rootweight per plant (g)
1	Mesa	64.5	6.5	23.0	2341.7
2	Gayor	63.0	9.2	27.1	3358.3
3	Bendo 2	48.3	7.5	27.8	2783.3
4	CMM-25-27-271014-5	55.0	8.7	25.5	3583.3
5	CMM-25-27-301	63.2	7.7	24.3	3825.0
6	CMM-25-27-57	30.9	3.0	22.5	712.5
7	CMM-96-1-102	59.8	8.7	23.6	2387.5
8	CMM-96-1-106	60.7	9.7	23.7	2658.3
9	CMM-96-1-109	56.4	7.2	25.1	3700.0
10	CMM-96-1-151	44.4	3.6	22.2	1395.8
11	CMM-96-1-3	54.5	7.0	23.4	1841.7
12	Duwet 1	59.1	11.5	24.9	3383.3
13	Duwet 4	57.4	8.0	19.8	2400.0
14	Malang 4	59.4	8.3	27.3	3150.0
15	MU 104 Bunga	62.5	4.5	20.5	1925.0
16	MU 109	57.7	7.3	24.8	1691.7
17	SL 103	58.0	9.7	22.4	6425.0
18	SL 9	53.5	11.5	25.5	3200.0
19	TB 28	64.9	11.2	21.9	3691.7
20	Thailand Emas	47.9	7.0	22.0	2125.0
21	UJ 3	56.7	7.7	26.2	2683.3
22	UJ 5	58.7	6.8	22.8	1883.3

Table 3. The selected best five clones based on the fresh root number and fresh root weight per plant

No	Clones	Fresh root number per plant	Clones	Fresh root weight per plant (g)
1	Duwet 1 SL 9	11,50	SL 103	6425
2	TB 28	11,17	CMM 25-27-301	3825
3	CMM 96-1-106 SL 103	9,67	CMM 96-1-109	3700
4	19 Daniel	9,17	TB 28	3691,67
5	CMM 25-27-271014-5 CMM 96-1-102	8,67	CMM 25-27-271014-5	3583,33
6	UJ 3	7,67	UJ 3	2683,33
7	UJ 5	6,83	UJ 5	1883,33

Table 4. The selected best five clones based on harvest index and starch rendement

No	Clones	Harvest index (%)	Clones	Starch rendement (%)
1	TB 28	64.9	Bendo 2	27.8
2	Mesa	64.5	Malang 4	27.3
3	CMM 25-27-301	63.2	Gayor	27.1
4	Gayor	63.0	CMM 25-27-271014-5 SL 9	25.5
5	MU 104 Bunga	62.5	CMM 96-1-109	25,10
6	UJ 3	56.7	UJ 3	26.2
7	UJ 5	58.7	UJ 5	22.8

Table 5. The selected best five clones based on fresh root number and fresh root weight per plant harvest index and starch rendement

No.	Clones	Root number per plant	Fresh-rootweight per plant (g)	Harvest index (%)	Starch rendement
1	Duwet 1	11.5(1)	3383.3	59.1	24.9
2	SL 9	11.5(1)	3200.0	53.5	25.5(4)
3	TB 28	11.2(2)	3691.7(4)	64.9(1)	21.9
4	SL 103	9.7(3)	6425.0(1)	58.0	22.4
5	Bendo 2	7.5	2783.3	48.3	27.8(1)
6	Malang 4	8.3	3150.0	59.4	27.3(2)
7	19 Daniel	9.2(4)	3358.3	63.0(4)	27.1(3)
8	CMM 25-27-301	7.7	3825.0(2)	63.2(3)	24.3
9	CMM 96-1-109	7.2	3700.0(3)	56.4	25.1(5)
10	CMM 25-27-271014-5	8.7(5)	3583.3(5)	55.0	25.51(4)
11	Mesa	6.5	2341.7	64.5(2)	23.0
12	MU 104 Bunga	4.5	1925.0	62.5(5)	20.5
13	CMM 96-1-106	9.7(3)	2658.3	60.7	23.7
14	CMM 96-1-102	8.7(5)	1575.0	59.8	23.6