

## Evaluation of orange-fleshed sweetpotato genotypes for yield and yield contributing parameters in two environments

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Manuscript received: 6 November 2016. Revision accepted: 19 June 2017.

**Abstract.** Rahajeng W, Rahayuningsih SA. 2017. Evaluation for yield and yield contributing parameters of orange-fleshed sweetpotato genotypes in two environments. *Nusantara Bioscience* 9: 275-281. Orange-fleshed sweetpotatoes (OFSP) is one of the most important sources of betacaroten and carbohydrates. OFSP showed varying responses to different environments, depending on the adaptability of the genotypes. The objective of this study was to evaluate the correlation between yield and yield component of OFSP genotypes at two different agroclimatological environments (Mojokerto and Blitar) from May to September 2013. Twenty four OFSP genotypes (twenty two clones and two varieties as the check) were used in this study and arranged in a randomized complete block design with three replications. Results showed that responses of OFSP genotypes to the environments varied and genotypes had highly significantly affected all parameters. Based on the criteria of high yield, amyllum content, and dry matter production four clones were selected (MSU 09008-54, MSU 07009-113, MSU 07025-45, and MSU 09025-71) from Blitar and two clones (MSU 07009-113 and MSU 070-64) from Mojokerto. Clone MSU 07009-113 showed good performance in both environments for yield, amyllum content, and dry matter production parameters. The result of the correlation analysis reveals that root yield is highly significant and positively correlated with dry matter production, number of roots, diameter of root, and harvest index in two locations (Blitar and Mojokerto). Based on the correlation and path analysis, dry matter production, root diameter, and harvest index can be used as an effective indicators selection for high yield OFSP genotypes.

**Keywords:** Environment, correlation, orange-fleshed sweetpotatoes, path analysis, yield

### INTRODUCTION

Sweetpotato (*Ipomoea batatas*) is one of the crops that is potentially good enough to be developed in Indonesia for a food security program. Sweetpotato roots have a fairly high carbohydrate content so it can be used as food, industrial, and bioethanol. Globally sweetpotato is an important food crop in the world after wheat, rice, maize, potatoes, barley, and cassava (FAOSTAT 2012; Teshome-Abdissa and Nigussie-Dechassa 2012; Wera et al. 2014). Ambarsari et al. (2009), state that in Indonesia sweetpotato ranks fourth after rice, maize, and cassava. Besides carbohydrates, sweetpotatoes are also rich in fiber, minerals, vitamins, and antioxidants (Kure et al. 2012; Mbah and Eke-Okoro 2015; Rodriguez-Bonilla et al. 2014). Orange-fleshed sweetpotatoes (OFSP) is one of the most important sources of carbohydrates and vitamins (beta carotene).

The OFSP varieties contain beta-carotene which is useful for the body to produce vitamin A (Agili et al. 2012; Burri 2011; Wariboko and Ogidi 2014). Vitamin A is an essential nutrient, which has many roles in the regulation of genetic, visual cycle, normal growth, and development, as well as for immune function. According to Kapil and Sachdev (2013), vitamin A deficiency can cause blindness and reduced immune system so that it can easily get infections causing death. Children are easier to suffer from Vitamin A deficiency than adults. The need of vitamin A in children is high because of their physical growth and low food intake. Therefore, OFSP has the potency to overcome

the shortage of vitamin A because it is cheap and easily cultivated. According to Sindi and Low (2016) 125 grams of most OFSP varieties can supply the recommended daily allowance of vitamin A for children and non-lactating women.

The OFSP varieties option in Indonesia is still limited. So far, there are only three OFSP varieties with high beta-carotene levels that have been released; Beta1, Beta 2, and Beta 3. To fulfill the need of food and industry, the breeding of OFSP varieties which have high beta-carotene levels and high yield is still necessary to be conducted. Root yield is a very complex character which associating with many interconnected components. Therefore, the breeding program to gain high yield potency varieties should be supported by information about the relationship between the yield and the parameters contributing to the yield to determine the selection criteria (Tsegaye et al. 2006).

The information required to determine the selection criteria is the correlation coefficient and path analysis between yield and yield components. According to Mohanty et al. (2016), correlation analysis provides information about the relationship between the important characters and as a useful index to predict the yield potency based on the value change of certain characters. The relationship between yield and yield components in correlation analysis still shows a very complex chain. Therefore, path analysis is done to explain the direct and indirect associations and to identify the most prominent character which contributes to the increasing yield.

A previous study of the correlation and path analysis showed that stem diameter, root number and weight of big and medium roots are the indicators for the selection of high-yield potency (Wang et al. 2012). The research of Sasmal et al. (2015) reported that fresh root weight, root number plot<sup>-1</sup>, root diameter, length of vines, and leaf size were correlated with the root yield. Meanwhile, the research of Egbe et al. (2012) and Tsegaye et al. (2006) showed that the characters of root weight per plant and harvest index were appropriate characters used as selection criteria to obtain high yield potency.

Besides information on the correlation and path analysis, evaluation of the interaction of genotype and environment also needs to be done, due to the unstable response of sweetpotato genotypes in many environments and also the environmental differences which greatly affect yield and yield-related trait. Therefore, the objectives of this study were to evaluate the root yield potency and the correlation between yield and yield component of OFSP genotypes in two different environments (Mojokerto and Blitar).

## MATERIALS AND METHODS

### Study area and procedures

This study was conducted at Pacet (Mojokerto) and Srengat (Blitar), from May to September 2013. The experiment was arranged in a randomized complete block design with three replications. A total 24 OFSP genotypes which consisted of twenty two OFSP selected clones and two released OFSP varieties (Beta-1 dan Beta-2) as the check varieties. Each genotype was planted on a 3 m wide x 5 m long plot (3 rows) with the spacing between rows and plants was 100 cm x 25 cm. 2/3 dose of fertilizer (300kg/ha NPK Phonska) was applied at planting, and the remaining was applied 5 weeks after planting. Weeding was done at 4, 7, and 10 weeks after planting. Earthing down was done at 4 weeks after planting, earthing up was done at 7 or 8 weeks after planting. Irrigation, pest, and disease control was applied as needed. Harvesting was done at 4.5 months. Rainfall data is presented in Figure 1. The graph showed that the rainfall in Mojokerto was higher than the rainfall in Blitar, especially during the study period (May to September 2013).

### Data analysis

The observations were recorded for number of root plot<sup>-1</sup>, root length and diameter, dry matter content, harvest index, root yield, dry matter production, and amyllum content. Data were processed by combined analysis of variance procedures for two environments to determine the interaction of genotype and environment by using MINITAB 14 program. Least significant differences (LSD) at 5% level of probability were used to detect differences between treatment means. Analyzes of correlation were conducted to determine the relationship among yield and yield components. Direct and indirect contributions of various characters to yield were calculated through path coefficient analysis according to Singh and Chaudary (1985).

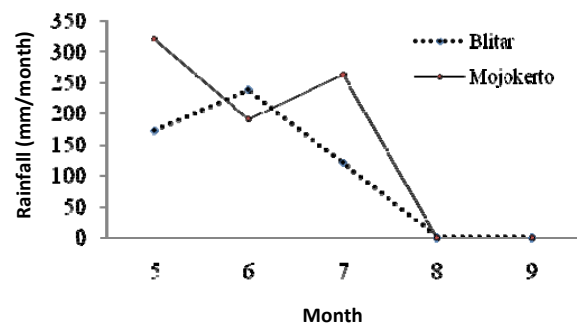


Figure 1. Graphic rainfall in Blitar and Mojokerto, East Java, Indonesia from January to December 2013

## RESULTS AND DISCUSSION

### Analysis of variance and average of genotype performance in two locations

The combined analysis of variance in two locations (Blitar and Mojokerto) showed the result of interaction between genotype and an environment that was highly significant for all the observed characters (Table 1). It means that the 24 tested genotypes give different responses in the different growing environment so that the selection can be done in each environment. The tested genotypes also showed significantly different in all the observed characters. Moussa et al. (2011); Kathabwalika et al. (2013) and Rahajeng et al. (2014) reported that they gained almost the same results on the conducted research. It indicates that each tested genotype showed and had a different genetical character, it also had a significant impact, especially for the yield and yield components character. At the analysis of variance for location, almost all characters showed significantly different results, except in the root diameter. The growth and the yield of crops are affected by characteristics of the two different environments (Blitar and Mojokerto). According to Pimsaen et al. (2010), the environment has a considerable contribution to the diversity of production factors such as the weight and the size of the root.

Based on the character of the root yield, dry matter production, root length and root diameter, sweetpotato genotypes in Mojokerto had a higher average than the average in Blitar. On the characters of amyllum content, dry matter content, number of roots plot<sup>-1</sup>, and harvest index, sweetpotato genotypes in Blitar showed higher average than in Blitar (Figure 2, Table 2 and 3). High root yield did not always show high yield components as well, especially for the characters of amyllum content and dry matter content. It was indicated from almost all the sweetpotato genotype in Mojokerto having higher result than those in Blitar. In the other hand, they were lower for the amyllum content and dry matter contents. It confirms the results of correlation analysis which showed that the character of starch content and the root yield did not correlate ( $r = -0.252^{ns}$ ) while the root dry matter content and the root yield was negatively correlated ( $r = -0.609^{**}$ ) (Table 4). Based on the correlation value, the root yield is more determined by the root size, especially the root diameter.

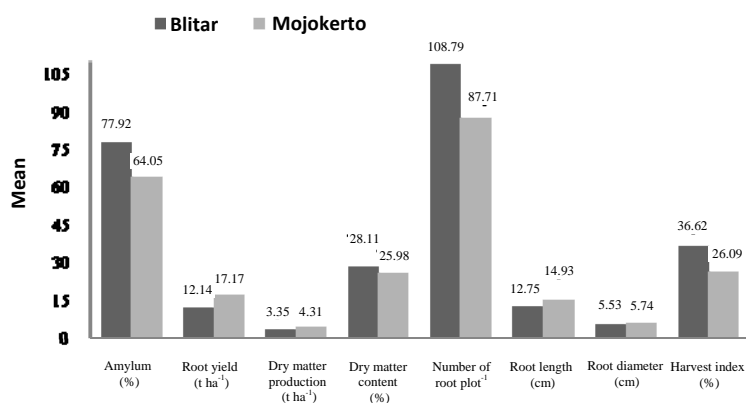


Figure 2. Comparison of the average values of the quantitative characters in Blitar and Mojokerto, East Java, Indonesia

Table 1. Analysis of variance and coefficient of variance of sweetpotato genotypes. Mojokerto and Blitar, East Java, Indonesia in 2013.

Characters	Mean			CV (%)
	Location (L)	Genotype (G)	G x L	
Amylum content	6,925.43**	6.47**	36.56**	0.42
Root yield	910.83**	230.25**	72.39**	20.34
Dry matter production	33.30*	13.17**	5.51**	20.85
Dry matter content	163.39**	50.91**	24.75**	2.83
Harvest index	3,988.03**	856.84**	202.90**	15.34
Number of rootplot <sup>-1</sup>	16,000.14*	5,107.61**	2,489.46**	19.51
Root length	172.11**	43.91**	11.15**	10.91
Root diameter	1.71 <sup>ns</sup>	9.04**	2.65**	11.79

Note: \*\* significant at p< 0.01, \* significant at p< 0.05, ns= non significant

Table 2. Number of root plot<sup>-1</sup>, root length, and root diameter of 24 OFSP genotypes in two environment (Blitar and Mojokerto, East Java, Indonesia), 2013

Genotypes	Number of root plot <sup>-1</sup>		Root length		Root diameter	
	Blitar	Mojokerto	Blitar	Mojokerto	Blitar	Mojokerto
MSU 09008-54	137.67	100.00	17.11	20.07	4.89	5.40
MSU 09008-92	93.67	170.00	9.22	16.00	6.66	7.77
MSU 09013-10	90.33	63.00	14.22	17.53	5.63	5.53
MSU 09013-48	78.67	69.67	9.44	14.53	6.11	5.57
MSU 09016-80	123.33	29.33	13.33	12.13	4.60	2.20
MSU 09016-87	73.67	78.33	15.11	17.10	5.00	5.37
MSU 09017-11	100.33	86.33	13.89	16.00	5.32	6.07
MSU 09017-32	95.00	65.67	13.55	18.00	4.33	5.57
MSU 09018-27	92.67	31.67	14.56	11.07	4.47	2.33
MSU 07023-27	106.00	101.67	9.11	12.03	7.33	7.77
MSU 07025-05	93.00	83.33	9.34	15.10	6.61	7.53
MSU 070-64	115.67	121.33	17.45	17.83	3.56	5.70
MSU 07009-149	106.33	19.70	8.99	8.33	5.49	2.67
MSU 07024-82	120.67	52.67	8.67	8.43	5.67	3.77
MSU 07024-43	104.00	82.33	10.78	11.33	5.53	6.30
MSU 07021-56	48.67	49.67	13.67	16.97	4.94	5.50
MSU 07009-112	130.00	64.00	15.22	14.33	3.95	5.93
MSU 07009-123	123.33	105.00	17.56	18.27	3.83	5.87
MSU 07009-113	176.67	145.67	13.44	16.57	5.83	6.33
MSU 07024-36	161.33	122.33	11.45	14.70	6.00	6.17
MSU 07025-45	131.00	96.00	10.67	13.77	7.10	7.90
MSU 09025-71	110.67	84.00	11.33	14.07	6.95	7.10
Beta 1	77.00	90.67	17.33	16.10	5.43	5.63
Beta 2	121.33	192.67	10.45	18.10	7.39	7.90
Average	108.79	87.71	12.75	14.93	5.53	5.75
CV (%)		19.51		10.91		11.79
LSD 5% Environment		15.91		1.20		0.31
Genotypes		21.98		1.73		0.76





While in Mojokerto, dry matter production and harvest index had a correlation coefficient of significant value to 0.962\*\* and 0.886\*\* (Table 4). The value of that correlation coefficient is equivalent to path coefficient of its direct effect, ie 0.834 and 0.075 (Table 5). Amylum content and harvest index had an indirect effect on root yield in Blitar, while in Mojokerto root diameter had an indirect effect on root yield. The results of previous studies indicated that harvest index had a direct effect on the root yield (Jha 2012; Dash et al. 2015). The fact that characters have direct effects on root yield indicate that these characters (dry matter production and root diameter in Blitar and dry matter production and harvest index in Mojokerto) can be used as effective selection criteria for a higher root yield character.

In conclusion, the result of the correlation analysis reveals that root yield is highly significant and positively correlated with dry matter production, number of root, diameter of root, and harvest index in two locations (Blitar and Mojokerto). Based on the correlation and path analysis, dry matter production, root diameter, and harvest index can be used as an effective indicators selection for high yield OFSP genotypes.

#### ACKNOWLEDGEMENTS

The authors would like to thank the Indonesian Legumes and Tuber Crops Research Institute (ILETRI), the Indonesian Agency for Agricultural Research and Development (IAARD) Ministry of Agriculture for the financial support, and to Gatot Santoso for helping during the research.

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