CarakaTani
Journal of Sustainable Agriculture
ISSN 2613-9456 (Print) 2599-2570 (Online)

Caraka Tani: Journal of Sustainable Agriculture, 37(2), 321-332, 2022
URL: https://jurnal.uns.ac.id/carakatani/article/view/58346
DOI: http://dx.doi.org/10.20961/carakatani.v37i2.58346

Farmers, Traders and Households' Preference to IVegRI's Open-Pollinated Chili Varieties in Lembang, West Java, Indonesia

Asma Sembiring[1*], Laksminiwati Prabaningrum[2] and Tonny Koestoni Moekasan[2]

[1]Research Center for Behavioral and Circular Economics, National Research and Innovation Agency (BRIN), Jakarta, Indonesia; [2]Research Center for Horticultural and Estate Crops, National Research and Innovation Agency (BRIN), Jakarta, Indonesia

[*]*Corresponding author:* rangkayoamah@gmail.com

Abstract

The majority of Indonesian farmers plant open pollinated (OP) chili because the seed price is affordable. However, the chili has weaknesses, such as the productivity is lower and the seed is not uniform. Indonesian Vegetables Research Institute (IVegRI) attempts to create high-quality OP chili varieties that farmers could access. The study aimed to identify farmers, traders and households' preferences for OP chili varieties that IVegRI has released. The study was carried out in Lembang Sub-district, West Java Province, Indonesia, from March to November 2019. A total of 82 respondents, consisting of farmers, traders and households, were asked about their preference for three OP chili varieties, namely Tanjung, Carvi and Ciko. The respondents were selected purposively. Data were analyzed using perceived quality. The results of this study have revealed that production per plant was the most important chili attribute for farmers, while fruit shape and color were the most essential chili attributes for traders and households, as evidenced by the final scores of 4.93, 4.83 and 4.45, respectively. Traders preferred Tanjung chili variety, as indicated by a score of 1.04. Meanwhile, the farmers and households preferred Carvi to Tanjung and Ciko varieties, with a score of 1.05. Farmers' preference for Carvi for all attributes was higher than the average among varieties, especially for production per plant and fruit weight. This implies that Carvi, as the IVegRI OP chili variety, can be disseminated widely to other locations in West Java and other provinces in Indonesia. The findings of this study are expected to provide useful information for a better understanding of factors necessarily considered to further improve IVegRI's OP chili varieties.

Keywords: Carvi; chili attributes; farmers' preference; horticulture; perceived quality

Cite this as: Sembiring, A., Prabaningrum, L., & Moekasan, T. K. (2022). Farmers, Traders and Households' Preference to IVegRI's Open-Pollinated Chili Varieties in Lembang, West Java, Indonesia. *Caraka Tani: Journal of Sustainable Agriculture*, *37*(2), 321-332. doi: http://dx.doi.org/10.20961/carakatani.v37i2.58346

INTRODUCTION

Chili is one of the vegetables that Indonesians consume on a daily basis and is one of five vegetables essential to Indonesian horticulture products. Moreover, the price of chili often fluctuates and then triggers inflation (Mariyono, 2019; Muflikh et al., 2021). Hence, it made the government give full attention to chili (Setiawati et al., 2016). Indonesian chili production in 2020 achieved 2.83 million tons, consisted of the big chili about 1.26 million tons and bird's eye chili for about 1.57 million tons. Around 91% of the total chili production is consumed by households (BPS-Statistic Indonesia, 2020a). Indonesian chili consumption in 2020 achieved 1.03 million tons. The average red chili (big chili) and bird's eye chili

[*] *Received for publication January 10, 2022*
Accepted after corrections July 14, 2022

consumption per capita per week in 2019 for each achieved 0.04 kg (BPS-Statistic Indonesia, 2020b). The three biggest chili producing provinces (for big and bird's eye chili) in Indonesia in 2019 were East Java, West Java and Central Java, contributing 640,775 tons (24.7%); 392,443 tons (15.16%) and 313,656 tons (12.12%) of the national chili production (BPS-Statistic Indonesia, 2020a).

A sustainable agricultural system is necessary to implement chili production to guarantee the chili sufficiency for the future generation in terms of quality and quantity. The sustainable agriculture system is an attempt to increase crops' yield by minimizing the negative impacts of production on the environment (Martínez-Castillo, 2016). Implementing a sustainable production system on chili affects not only production but also natural resource use, the environment and community welfare. The application in developing countries such as Indonesia by improving chili cultivation, conserving water and land, avoiding the use of hazardous chemicals and implementing diverse farm systems (Arumugam et al., 2014; Muliastuty et al., 2016; Rocchi et al., 2020).

There are two kinds of chili seed distributed in Indonesia, hybrid and open-pollinated (OP) (Kusmanto et al., 2015). Farmers use hybrid chili because it produces high yield (Herison et al., 2014). However, farmers should buy seeds for each planting season, which is costly for them (Ferniah et al., 2014). The OP chili has some benefits such as the low seed price, use of fewer fertilizers, stability in production and more resistance to pests and disease (Ferniah et al., 2014). Nevertheless, the yields of hybrid variety is lower because the quality of the OP cannot be clearly measured (Kusmanto et al., 2015).

According to Basuki et al. (2014), farmers would like to plant a particular chili variety because of the lower seed price, early harvest, lower production cost and consumer demand. Farmers allocated the chili seed from the previous harvest continuously. Recent studies related to OP chili showed that it has the potential to generate a high-quality chili with a high yield (Kusmanto et al., 2015; Cholifah et al., 2018). Kusmanto et al. (2015) stated that from 10 OP chili lines planted; 7 straits show a higher yield than the control. They were Tit super, Gelora and Trisula varieties.

Since chili is one of the priority crops in the research program, the Indonesian Vegetables Research Institute (IVegRI) has been continuing to work on generating high yield OP chili varieties. Recently, IVegRI has released two OP chili varieties, i.e. Carvi Agrihorti and Ciko. Carvi has the advantage of being resistant to mottle virus (Chi VMV) disease and having a high yield, averaging 21 to 23 tons ha^{-1}. It is best planted in the highlands during the rainy season. Carvi can be harvested 91 to 96 days after planting. The flavor is spicy and it can be stored for 14 to 15 days after harvesting (Varitas.net, n.d.-a). At the same time, Ciko has the advantage of providing high production. It produces between 13.4 and 20.5 tons ha^{-1}. Ciko is suitable for cultivation in medium highland, 510 to 550 m above sea level during rainy and wet-dry seasons. It could be harvested 81 to 84 days after planting. Ciko's fruit performance lasts longer and the taste is spicy (Varitas.net, n.d.-b). IVegRI should conduct a dissemination activity to raise potential users' awareness and promote these newly released varieties.

One of the advantages of consumer preference is to improve the quality of products. In agriculture, a study on consumer's preference could be conducted to generate high-quality crop varieties as well as meet consumers' preferences. The study by Gamboa et al. (2018) in Andes-Peru related smallholders' preference for Quinoa varieties, where they preferred cheaper varieties with a shorter maturation period, has encouraged some seed breeders to assemble the varieties that the smallholders demanded.

Chili preferences vary greatly depending on consumer target. When purchasing chili, for example, households consider some attributes, such as color, freshness, skin appearance and price (Adiyoga and Nurmalinda, 2012; Puspitasari et al., 2020; Sembiring et al., 2020). Meanwhile, farmers are concerned with attributes such as resistance to pests and disease, high productivity and affordable price. They are also influenced by market, yield age, seed price (Adiyoga et al., 2014; Kusmana et al., 2019; Sembiring et al., 2020) and plant height. The height of the chili plant is always observed as an indicator of whether the chili is growing well or poorly (Purnomo et al., 2018). For traders, the most important chili attributes are freshness, fruit shape, skin appearance, color, fruit harshness,

market favorability and long fruit (Sembiring et al., 2020).

It is critical to understand the preferences of consumers for chili varieties; thus, when the chilies are released, they are expected to meet consumer demand. Before the chili is released, a consumer preference study must be conducted. However, due to the study's limited budget, the consumers' preference study was limited to one type of consumer, such as chili farmers or households with fewer respondents.

This research was part of the IVegRI's OP chili varieties dissemination study. In line with the study, the authors would like to comprehensively observe consumers' views (based on three types of consumers) toward the IVegRI's OP chili varieties. The data would be useful for completing previous consumer preferences and providing feedback to IVegRI's chili breeder in order to create chili varieties that meet future consumer demands. So far, there has been little research into farmers, traders and households' preferences for chili using the perceived quality approach. The research on farmers, traders and households' preferences for chili based on perceived quality is still limited. Hence, the study's objective was to collect farmers, traders and households' preferences on IVegRI OP chili varieties.

MATERIALS AND METHOD

This study was conducted in Lembang, Bandung, West Java, from March to November 2019. The location was selected purposively due to its status as the second biggest chili producer in the West Bandung Regency in 2018 (BPS-Statistic of West Bandung, 2019).

The field trial was conducted in IVegRI's field in Lembang to evaluate the performance of Tanjung, Carvi and Ciko varieties. Each was planted in 300 m^2 and the yield was used for the consumer's preference study. The survey involved 82 respondents, consisting of 6 chili traders, 31 households and 45 chili farmers, selected purposively. The respondents answered some questions in the questionnaire regarding their evaluation and preference for the attributes of three OP chili varieties, Tanjung, Carvi and Ciko. Before providing responses, farmer respondents observed the chili plant and the chili yield in a field. Meanwhile, trader and household respondents also observed the chili visually. Household respondents specifically tasted it directly.

Respondents' preference for OP chili varieties

Respondents' preferences for OP chili attributes were measured using the perceived quality (PQ) assessment method (Basuki, 2009; Rahayu, 2012). The PQ technique was started by determining attributes that respondents would consider when choosing a preferred product. The steps to assess respondents' preference toward characteristic attributes of chili use some calculations (Rahayu, 2012) as follows in equations 1, 2, 3, 4, 5 and 6.

The weight level of characteristic attributes (WA) was defined by scoring using questions. The scores were: definitely important = 5, generally important = 4, slightly important = 3, slightly not important = 2, definitely not important = 1 (Basuki, 2009).

$$\text{ARC} = \frac{\text{TWA}}{\text{n}} \quad (1)$$

Where, ARC = the average respondents' attribute; TWA = total score of weight attributes all respondents; n = number of respondents.

$$\text{RAW} = \frac{\text{ARC}}{\sum \text{ARC}} \quad (2)$$

Where, RAW = the relative attribute weight; $\sum$ ARC = total score of attributes.

Respondents' preference toward variety characteristic attributes (VA) was measured by scoring using questions. The scoring results were categorized: very likely = 5, likely = 4, neither likely nor likely = 3, unlikely = 2 and very unlikely = 1 (Basuki 2009).

$$\text{APR} = \frac{\text{TVA}}{\text{n}} \quad (3)$$

Where, APR = the average preference rate per respondent; TVA = total score of VA of all respondents.

$$\text{APRC} = \frac{\sum APR}{\text{total varieties}} \quad (4)$$

Where, APRC = the average preference rate per characteristic attributes of all varieties; $\sum$ APR = total APR scores per attribute of all varieties.

$$\text{RPR} = \frac{\text{APR}}{\text{APRC}} \quad (5)$$

Where, RPR = the relative preference rate.

$$WRPR = RAW \times RPR \quad (6)$$

Where, WRPR = the weight of relative preference rate. The total preference rate of respondents towards each variety was evaluated from the total WRPR scores from a variety attribute. The highest score defines the respondent's preference for the variety.

A farmer considers fruit shape, skin appearance, fruit length, pest and disease resistance, production per plant, weight per fruit, plant height, canopy width and fruit color. Meanwhile, when purchasing a new OP chili variety, traders consider attributes: fruit shape, skin appearance, fruit length, market preference, fruit harshness, pungency and color. Furthermore, when purchasing chili, households look for fruit shape, skin appearance, fruit length, freshness and color.

RESULTS AND DISCUSSION

The important chili attributes for the farmers, traders and households

According to the farmers, the essential chili attribute was production per plant and the score was 4.93 (Table 1). The second important chili characteristic was resistance to pests and diseases, while the third was fruit shape; the score was similar to the second attribute, 4.78.

Previous studies showed that productivity was important for farmers (Acheampong et al., 2018; Agyeman et al., 2021), regarding the chili's resistance to pests and diseases, which farmers frequently complain about (Kirana et al., 2021; Rahayu and Febriani, 2021). Farmers prefer resistant chili varieties because they reduce pest and disease infestation and the risk of crop failure (Moekasan et al., 2015; Kusmana et al., 2019; Lubis et al., 2019). Resistance varieties could also lower pesticide costs and increase yield (Acheampong et al., 2018).

Meanwhile, when compared to other attributes, fruit shape was the most important attribute of OP chili for traders, with a score of 4.83. (Table 1). A similar study found that when selling the new OP chili to market, traders took into account the shape and color of the fruit (Cahyaningrum and Respatijarti, 2018). Color was the most important chili attribute for households, with a score of 4.45. (Table 1). It is a household indicator of chili quality that they consider when purchasing chili (Adiyoga, 2011). Respondents preferred dark red for the chili because the color of the dish's appearance after cooking is more exciting or robust; thus, it may be evocative to appetite (Cahyaningrum and Respatijarti, 2018).

The OP chili farmers' preference rate analysis to Tanjung, Carvi and Ciko varieties

Chili farmers' preferences for the three chili varieties varied. The farmers preferred Carvi for its fruit shape, skin appearance, fruit length, plant height, canopy width and color attributes, with the scores of 4.04, 4.18, 3.98, 3.58, 3.62 and 4.33, respectively (Table 2). Meanwhile, farmers preferred Ciko for its resistance to pests and disease and production per plant attributes, with APR of 3.58 and 4.00, respectively. The resistance of Ciko to pests and disease was shown from farmers' visual observation in the field. Pests and diseases had a smaller impact on Ciko than on Tanjung and Carvi, as evidenced by damage to the leaves, stems and chili fruit.

Another study that supported this research found that, when compared to Tanjung and Carvi, Ciko produced the most healthy chili fruit (Prabaningrum et al., 2020). Farmers preferred the weight per fruit for Tanjung chili varieties, with a score of 3.84. The total fruit weight may indicate yield potential as an important factor in motivating farmers to adopt a chili variety (Kusmanto et al., 2015). It becomes one factor in encouraging farmers to grow a chili variety (Bhattarai and Mariyono, 2016; Hussain et al., 2021).

With the exception of weight per fruit, chili farmers preferred Carvi's attributes over those of other varieties. Farmers claimed that the Carvi plant's height and canopy are superior to the Ciko and Tanjung varieties. These two growth variables would have an impact on yield and productivity (Singh et al., 2014). Farmer desired narrow canopy size because it would ease the harvest as the chili plant is not overly tall (Cahyaningrum and Respatijarti, 2018).

Meanwhile, for Tanjung, only fruit length and weight per fruit were greater than the average of all varieties, while the remaining attributes were lower (< 1). According to Herison et al. (2014), chili fruit length is defined by genetics. Basuki et al. (2014) stated that even though the consumer's demand for the Tanjung chili is small, the farmers plant it as the demand is constant; hence the revenue can be counted on for life.

Table 1. OP chili attributes average score according to the farmers, traders and households

Attributes	Attributes average score		
	Farmers	Traders	Households
Fruit shape	4.78	4.83	4.06
Skin appearance	4.51	4.33	4.35
Fruit length	4.64	4.67	3.81
Resistance to pest and disease	4.78		
Production per plant	4.93		
Weight per fruit	4.58		
Plant height	3.98		
Canopy width	3.93		
Fruit color	4.56	4.50	4.45
Market preference		4.67	
Fruit hardness		4.67	
Pungency		3.00	3.55

Table 2. The average preference rate score (APR) and the average preference rate per attribute of all varieties (APRC) of Lembang chili farmers to Tanjung, Carvi and Ciko varieties

Attributes	APR			APRC
	Tanjung	Carvi	Ciko	
Fruit shape	3.49	4.04	3.87	3.80
Skin appearance	3.36	4.18	3.76	3.77
Fruit length	3.96	3.98	3.40	3.78
Resistance to pest and disease	3.40	3.53	3.58	3.50
Production per plant	3.78	3.91	4.00	3.90
Weight per fruit	3.84	3.64	3.69	3.72
Plant height	3.29	3.58	3.24	3.37
Canopy width	3.40	3.62	3.49	3.50
Fruit color	3.56	4.33	3.89	3.93

Meanwhile, when compared to the average of all varieties, farmers preferred Ciko for fruit size, resistance to pests and disease and production per plant. However, the rates of the rest attributes were lower than that of average for all varieties (Table 3). Carvi received the highest total preference score of 1.05 from the farmers (Table 4). This variety was preferred over Ciko and Tanjung because it had a smoother skin surface, better skin appearance and higher plant height than the other two. Farmers liked it because it ensured that when they sprayed pests and diseases on the plant, the spraying result was evenly distributed.

Table 3. The relative preference rate (RPR) of Lembang chili farmers to Tanjung, Carvi and Ciko varieties

Attributes	RPR			
	RAW	Tanjung	Carvi	Ciko
Fruit shape	0.12	0.92	1.06	1.02
Skin appearance	0.11	0.89	1.11	1.00
Fruit length	0.11	1.05	1.05	0.90
Resistance to pest and disease	0.12	0.97	1.01	1.02
Production per plant	0.12	0.97	1.00	1.03
Weight per fruit	0.11	1.03	0.98	0.99
Plant height	0.10	0.98	1.06	0.96
Canopy width	0.10	0.97	1.03	1.00
Fruit color	0.11	0.91	1.10	0.99

Table 4. The weight relative preference rate (WRPR) of Lembang chili farmers to Tanjung, Carvi and Ciko varieties

Attributes	WRPR		
	Tanjung	Carvi	Ciko
Fruit shape	0.11	0.13	0.12
Skin appearance	0.10	0.12	0.11
Fruit length	0.12	0.12	0.10
Resistance to pest and disease	0.12	0.12	0.12
Production per plant	0.12	0.12	0.12
Weight per fruit	0.11	0.11	0.11
Plant height	0.10	0.11	0.10
Canopy width	0.10	0.10	0.10
Fruit color	0.10	0.12	0.11
Total preference score	0.96	1.05	0.99
Rank	3	1	2

The OP chili traders' preference rate analysis to Tanjung, Carvi and Ciko varieties

Traders' preferences for OP chili varieties varied. The traders preferred Tanjung for fruit shape, fruit length and market preference, as evidenced by the scores of 4.17, 4.00 and 4.00, respectively (Table 5). In the meantime, they preferred Carvi for skin appearance, fruit harshness and color, with the scores of 3.83, 4.00 and 4.50, respectively. In terms of pungency, the respondents favored Ciko with a score about 3.50. Pungency is an ultimate quality attribute on chili (Colney et al., 2018; Das et al., 2021). Many people around the world enjoy spicy foods and approximately 25% consume chili on a daily basis (Spence, 2018). Nevertheless, the study of Lillywhite et al. (2013) revealed different findings. Even though a majority of US consumers considered the spicy chili likers, however in terms of pungency, the favorite chili was not automatically the “hottest” or “the mildest” ones.

The chili traders' preference level to Tanjung in terms of fruit shape, fruit length, market preference and pungency attributes were higher than the average of all varieties. Meanwhile, Carvi had a higher preference level than the average of all varieties for skin appearance, fruit hardness and color attributes. Only pungency had higher level of preference than the average of all varieties for Ciko, while the other attributes had lower level of preference than the average of all varieties (Table 6).

Table 7 presents the total values of three OP chili varieties for the Lembang chili traders. Tanjung received the highest score of 1.04. The traders preferred this variety because it has long been popular with consumers, particularly those from West Java. Tanjung is popular among consumers because it is suitable for making chili sauce (*sambal*) (Basuki et al., 2014).

Table 5. The average preference rate score (APR) and the average preference rate per attribute of all varieties (APRC) of Lembang chili traders to Tanjung, Carvi and Ciko varieties

Attributes	APR			APRC
	Tanjung	Carvi	Ciko	
Fruit shape	4.17	3.50	3.17	3.61
Skin appearance	3.33	3.83	3.17	3.44
Fruit length	4.00	3.50	3.50	3.67
Market preference	4.00	3.67	3.33	3.67
Fruit hardness	3.33	4.00	3.17	3.50
Pungency	3.33	2.83	3.50	3.22
Color	4.00	4.50	3.83	4.11

Table 6. The relative preference rate (RPR) of Lembang chili traders to Tanjung, Carvi and Ciko varieties

Attributes	RPR			
	RAW	Tanjung	Carvi	Ciko
Fruit shape	0.16	1.15	0.97	0.88
Skin appearance	0.14	0.97	1.11	0.92
Fruit length	0.15	1.09	0.95	0.95
Market preference	0.15	1.09	1.00	0.91
Fruit hardness	0.15	0.95	1.14	0.91
Pungency	0.10	1.03	0.88	1.09
Color	0.15	0.97	1.09	0.93

Table 7. The weight relative preference rate (WRPR) of Lembang chili traders to Tanjung, Carvi and Ciko varieties

Attributes	WRPR		
	Tanjung	Carvi	Ciko
Fruit shape	0.18	0.15	0.14
Skin appearance	0.14	0.16	0.13
Fruit length	0.16	0.14	0.14
Market preference	0.16	0.15	0.14
Fruit hardness	0.14	0.17	0.14
Pungency	0.10	0.09	0.11
Color	0.15	0.16	0.14
Total preference score	1.04	1.03	0.93
Rank	1	2	3

The OP chili households' preference rate analysis to Tanjung, Carvi and Ciko varieties

Households preferred Carvi for fruit shape, skin appearance and pungency, with the scores of 4.23, 3.94 and 3.68 (Table 8). This result was in line with that of study by Adiyoga and Nurmalinda (2012). When purchasing vegetable products, consumers considered freshness as a quality indicator (Chamhuri and Batt, 2015) and in the case of chili, they considered the appearance and color of the chili skin. Tanjung was preferred by respondents for its fruit length and color. The respective scores were 4.23 and 4.13.

Table 8. The average preference rate score (APR) and the average preference rate per attribute of all varieties (APRC) of Lembang households to Tanjung, Carvi and Ciko varieties

Attributes	APR			APRC
	Tanjung	Carvi	Ciko	
Fruit shape	3.74	4.23	3.84	3.94
Skin appearance	3.39	3.94	3.61	3.65
Fruit length	4.23	4.13	3.52	3.96
Pungency	3.55	3.68	3.55	3.59
Color	4.13	3.94	3.55	3.87

Table 9. The relative preference rate (RPR) of Lembang households to Tanjung, Carvi and Ciko varieties

Attributes	RPR			
	RAW	Tanjung	Carvi	Ciko
Fruit shape	0.20	0.95	1.07	0.98
Skin appearance	0.21	0.93	1.08	0.99
Fruit length	0.18	1.07	1.04	0.89
Pungency	0.19	0.99	1.02	0.99
Color	0.22	1.07	1.02	0.92

Table 10. The weight relative preference rate (WRPR) of Lembang households to Tanjung, Carvi and Ciko varieties

Attributes	WRPR		
	Tanjung	Carvi	Ciko
Fruit shape	0.19	0.21	0.20
Skin appearance	0.20	0.23	0.21
Fruit length	0.19	0.19	0.16
Pungency	0.19	0.19	0.19
Color	0.23	0.22	0.20
Total preference score	1.00	1.05	0.95
Rank	2	1	3

The households preferred all Carvi variety attributes more than the attributes of other varieties. Meanwhile, their preference level to Tanjung was higher than that to other varieties only for the fruit length and color attributes. The level of households' preference to all Ciko attributes was lower than those of other varieties (Table 9).

Carvi received the highest score of 1.05 (Table 10) among the three OP chili varieties because its color was more attractive than the others. The study by Andrade et al. (2020) reported that consumers rated dark red as the best chili fruit color. In terms of pungency, it was hotter than Ciko and Tanjung. Moreover, the shape is nice and the skin looks nice and fresh.

This study has revealed that farmers' and households' preferences for chili varieties differ among traders. IVegRI can improve the OP chili varieties based on households' and farmers' demands by developing the OP chili with dark red color, favorable pungency, nice and fresh skin appearance, high yielding and resistance to pests and disease.

CONCLUSIONS

The study suggested that farmers, households and traders had different preferences for chili variety attributes. Farmers preferred plant yield, households favored skin color, while traders selected fruit shape as the most important factor in choosing a chili variety. Moreover, farmers and households preferred the Carvi variety, while chili traders favored the Tanjung variety. These distinctions may exist primarily because Tanjung has been widely available in the market for a long time, whereas Carvi has not. Furthermore, this study on preference was drawn from a field trial of several promising chili varieties, including Carvi. There was still limited information available about Carvi's marketability. Therefore, despite Carvi's agronomic advantages, traders have chosen Tanjung because they are already familiar with its marketability. Traders are important links in the chili supply chain and they have played a key role in promoting Carvi's market acceptance. Hence, it is necessary to educate traders about Carvi's dissemination activities. More information and knowledge about Carvi's agronomic benefits as well as potential marketability are expected to change their attitudes toward this promising variety. The findings of this study are expected to provide useful information for a better understanding of the factors that must be considered to further improve IVegRI's OP chili varieties.

ACKNOWLEDGEMENT

The authors thank the Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agricultural Indonesia, for funding the research and the Indonesian Vegetables Research Institute (IVegRI) for facilitating the study.

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