Survey of Farming System Farmers Perception for *Phenacoccus Manihoti* in Sukaraja-Bogor District, Indonesia

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ABSTRACT
One of the canters for cassava cultivation in Bogor Regency is Sukaraja District. Farmers in this area have been growing cassava several decades ago. This survey aims to determine the characteristics of cassava farmers, cultivation methods, knowledge and attitudes and perceptions of farmers with the arrival of a new invasive pest mealybug *Phenacoccus manihoti* Matt-Ferr. Surveys were conducted during September until November 2017, by interviewing 60 farmers distributed in three villages. Our studies revealed as much as 52% of respondents aged over 60 years, with the main occupation is farming. In term of level of education, about 83% of the farmers were graduates or have been in elementary school. Land area used for cassava cultivation generally (88%) were less than 0.50 ha. Most of the farmers (87%) were cultivator, with over 15 years experiences in cassava farming. Cassava varieties widely grown by farmers were Roti (90%), followed by Manggu (15%) and Jimbul (5%). The majority (97%) of farmers used goat manure, and the rest (3.3%) chicken manure. Manure was given when the plant 15-30 days. with a dosage of 11-15 ton/ha. Urea was given twice when the plant aged 3 and 7 months, with a dosage of 200-500 kg/ha. Weeding generally (68%) were conducted twice when the plant 4 and 8 months old. Harvest generally (92%) was carried out at 10-13 months. Farmers generally (87%) considered *P. manihoti* as the most important pests of cassava. The most farmers (82%) mentioned that the mealybug began attacking cassava since 2007. It seems that they equated *P. manihoti* with the papaya mealybug (*Paracoccus marginatus*) which also attacked cassava. Nearly half the respondents said that attacks by the cassava mealybug caused yield losses about 40-50%. Nevertheless, farmers generally do not perform control measures.

Keywords: *Farmer survey, cassava, mealybug, Phenacoccus manihoti*

1. INTRODUCTION

In Indonesia, farmers generally cultivate cassava plants traditionally, without special technology, both how to plant, fertilize and maintain and harvest. This situation is more due to cassava is a plant that has an agronomic advantage which can provide high yields despite growing on infertile land (marginal) or land with low rainfall [1][2].

Over time, demand for cassava increased at a rate of 3.63% per year and absorbed 62-78% of national production [3]. Cassava is used for food and industrial needs. The role of cassava in industry will continue to increase along with the government's program to use alternative energy sources derived from agricultural products (liquid biofuel), such as biodiesel and bioethanol and diversification of food based on local food. To be able to support the government program, cassava production must be increased. Increasing cassava production can be done through increasing harvested area and applying appropriate cultivation techniques [4].

Cultivation techniques applied by farmers so far are generally still simple, with little fertilization and no pest control, because plant-disturbing organisms associated with cassava are relatively few. The main pest that is often found in cassava plants is the red mite pest that appears in the dry season. For diseases that are commonly found are diseases caused by the bacterium *Xanthomonas manihotis*, and leaf spot disease by fungus (*Cercospora henningsii*) which is often found attacking old leaves [4]. However, with the entry of new *P. manihoti* pests, it can become a threat because it causes the loss of cassava yields to reach 90% [5][6]. These lice suck the liquid leaves and shoots of plants. Pests can reduce the length

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of the internode and cause leaves to shrink and dwarf bunchy tops. Further symptoms will cause the leaves to dry out and fall out, if a severe attack can cause defoliation in plants. Pests will also leave scars in the form of distortion on the stem. Heavier attacks occur in the dry than the wet season [7].

The existence of information on the effects caused by these lice pests, farmers will realize that these pests need to be considered and controlled. But this requires a process because farming is used to the simple cultivation techniques that have been carried out so far.

Generally, pest control decisions made by farmers are determined by four factors: (1) pest problems involving the level of attack and loss of results, (2) control options available to farmers, (3) farmers' perceptions of pest problems and (4) motivation to farm [8].

The pest control program is successful if the pest control actions or decisions made by the farmers are right. And this control program is expected to be in accordance with the principles of Integrated Pest Management (IPM). The accuracy of pest control is greatly influenced by the way farmers perceive these pests, their attitudes and beliefs, and control actions taken. This information is one of the important components that need to be explored in the context of developing IPM [9]. According to [10] the act of applying innovation is influenced by several factors including factors from within the farmer and environmental factors. Factors in farmers include age, education, social status, patterns of relationship between attitude towards renewal, courage to take risks, fatalism, aspirations and dogmatism. Environmental factors include distance from information sources, frequency of attending counselling, infrastructure and facilities, and the process of obtaining production facilities.

P. manihoti is a new pest in Indonesia. Therefore, to develop *P. manihot* control techniques on cassava plants that are in accordance with IPM principles, it is necessary to survey the cultivation practices and perception of cassava farmers on *P. manihoti*.

2. METHODOLOGY

The research was conducted from September to November 2017, in three villages namely Ngampar, Sukaraja, and Cikeas Villages, which administratively included Sukaraja District, Bogor Regency. The three villages were chosen because they are the center of cassava planting in Bogor Regency. In addition, *P. manihoti's* attack on cassava plantations in the three villages was quite severe. The study site is a dry land agroecosystem, with rain-fed irrigation.

The study was conducted by survey method, by interviewing cassava farmers using a structured questionnaire with some open-ended questions. In addition, the survey also used teaching aids in the form of *P. manihoti* specimens and cassava plants that were attacked by *P. manihoti*. Interviews are conducted when the farmer is in the cassava garden or by visiting the farmer at his home. For this purpose, 20 cassava farmers were selected in each study village, so that 60 respondents were interviewed.

The questionnaire used consisted of three main information components, namely (1) characteristics of cassava farmers, (2) characteristics of cassava cultivation, and (3) farmers' perceptions of pests and diseases, specifically of *P. manihoti*. The collected data is tabulated, and then frequency analysis.

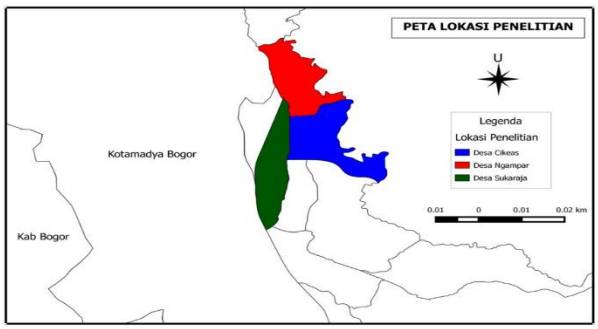

Figure 1 Research location map

3. RESULTS AND DISCUSSION

3.1. Characteristics of Cassava Farmers

Cassava farmers who are the youngest respondents are aged 35 years and the oldest are 80 years. As many as 51.7% of the cassava farmers interviewed were elderly, over 60 years (Table 1). With the condition of most of the older cassava farmers, is a limiting factor in the acceptance of technological innovation through counselling. This condition also shows that the average cassava farmer is no longer productive, when viewed in terms of age classification. Age of productive farmers according to [11] is in the range of 15-55 years. The age of the farmer in general determines the farming process. According [10], the highest diffusion of innovation is in farmers who are half old or around 40-50 years old. This condition is different from the survey of farmers in the cultivation of potato and pineapple plants, where the average age of farmers ranges between 20-50 years [12] [13]. When the age of a productive farmer, it will support his farming activities so as to increase the productivity of his farm, conversely when the age of the farmer is no longer productive, his physical will tend to weaken and require labour from outside to do his farming, or do his farming as best he can if he does not have the funds to pay for labour from outside. This situation will affect cassava farming in the sample villages, which tend to do cassava farming in modest conditions. However, due to the nature of cassava farming which has an agronomic advantage that can provide quite high yields even though

it is not growing well on land [1], this situation is not so an obstacle in cassava farming. Many farmers are trying to farm in old age because on average farmers who plant cassava have been farming since a young age, and continue to the present, while their children generally choose not to farm but choose other jobs which are considered better , such as working in a factory, trading or office work. So that only their parents are still working on the land. This is also evident from the results of the survey, none of the cassava farmers who were respondents were less than 30 years old.

Table 1 Characteristics of cassava farmers in Sukaraja District, Bogor Regency

Characteristics	Frequency	%
Age (year)		
≤ 30	0	0
31-40	3	5.0
41-50	15	25.0
51-60	11	18.3
> 60	31	51.7
University/ Not school		
Not school	27	45.0
Elementary	23	38.3
Junior high school	5	8.3
Senior high school	5	8.3
University	0	0
Family dependents		
≤ 2	20	33.3
3-5	32	53.3
≥ 6	8	13.3
Farmer group		
Member	20	33.3
Non member	40	66.7
Contact with Extension Service		
Yes	16	26.7
No	44	73.3

Education will affect the way and the mindset of farmers in farming. The level of education of farmers in the sample villages is relatively low (not finished primary school) or not in school (45%), and 38.33% graduated from elementary school, the remainder graduated from junior and senior high school. The situation is almost the same as the portrait of Indonesian farmers in general, namely, low-educated or elementary school. On the other hand, farmers who have access to information technology tend to have relatively high education because information technology is a new communication medium that requires a higher level of knowledge because it is more complicated than other communication media [14]. With this limitation, it is necessary to do more intensive counselling to farmers.

Family dependents generally (53.33%) amount to 3-5 people. This amount is large enough to be borne by the head of the family whose main income is as a tiller farmer, because of all the respondent farmers (100%) interviewed, farming is their main source of income. Family dependents should be a source of family labour in farming [11], but in the condition of the sample villages, labour for cassava cultivation is generally carried out only by the head of the family, due to the relatively narrow farm area, and also the nature cassava cultivation is relatively simple.

Most respondents (66.67%) are not members of farmer groups, because it seems that not many farmers' groups have been formed. This seems related to the absence of encouragement from outsiders. Most farmers (73.3%) said they had never had contact with extension workers. Among the existing farmer groups, namely the Tani Jaya and Jaya Mukti farmer groups, are only active in rice cultivation and not in cassava plants. However, the existence of active farmer groups will increase the frequency of meetings and cooperation between farmers. Because with the existence of farmer groups there will be collaboration between individual group members in the learning process, the production process, processing and marketing of results to improve the welfare of farmers. The formation of this group can be based on equality of domicile or commodity, with 10-20 members.

3.2. Cassava Cultivation

The area of land cultivated for cassava cultivation in general (53%) ranges from 0.25-0.50 ha, even 35% of farmers cultivate cassava on <0.25 ha (Table 2). The narrowness of the land used for cassava crops is due to the other land farmers grow crops that can be harvested quickly such as vegetables or grow more profitable crops such as papaya. According to [15], the area of land for the farming of subsistence cassava is 0.5 ha / KK, resulting in the fulfilment of food needs but there are no funds available for the procurement of production facilities and labour costs. Therefore, most farming activities are carried out with family labour with minimal input. Farmers who have large tracts of land tend to make technological changes with a view to increasing the productivity of their farming [16].

Most farmers cultivate cassava on other people's land with a status of only 86.67% of tenants and the rest are farmers who own tenants (Table 2). From interviews with farmers it was revealed that initially in their village, they were landowners who were generally quite large on average more than 5 ha, but because in these three villages the development of development was quite rapid, so many factories, houses, and also toll roads, so that the land around the development is valued at a high price. Many farmers sell their land and leave little for housing and improvised cultivation. Lately, their arable land has also been sold to land investors who are mostly located in Jakarta, so that now most of them are only working as cultivators. Changing the status of farmers from smallholders to smallholders is inseparable from the low welfare of farmers in the sample villages, so they prefer

to sell their land to get capital rather than increase their farming to be able to get higher yields. This behaviour is common among farmers in Indonesia because they assume that their farming products cannot cover their consumptive needs. According to [17] it is said that high-quality agricultural lands and rice fields are generally concentrated and shifted in function around large cities, especially on the island of Java. From the physical aspect of land, conversion is influenced by two things namely aspects of agricultural land ownership and spatial aspects. The ownership aspect is related to absolute land rights which in the process then causes the ownership of the land to be fragmented and become very small because it is given to his descendants as inheritance. This small ownership makes it prone to the conversion of agricultural land due to difficulties in controlling spatial use.

Table 2 Land characteristics and cassava planting in Sukaraja District, Bogor Regency

Characteristics	Frequency	%
The area of cassava (ha)		
< 0.25	21	35.0
0.25-0.5	32	53.3
0.6-1.0	7	11.7
> 1.0	1	1.7
Land ownership status		
Owner of cultivators	8	13.3
Cultivator	52	86.7
Cassava planting experience (years)		
< 5	2	3.3
6-10	4	6.7
11-15	3	5.0
> 16	51	85.0
Cropping system		
Continuously	4	6.7
Rotate	56	93.3
Planting time		
Rainy season	0	0
Dry season	0	0
Uncertain	60	100.0
Varieties		
Roti	48	80.0
Manggu	9	15.0
Jimbul	3	5.0
Source of cuttings		
Own garden	60	100.0
Other farmers	0	0

The average cassava farmer has long experience in growing cassava that is above 16 years 85% (Table 2). There are even farmers who have been cultivating cassava for 40 years. So, it can be said that in selected villages the farmers had indeed already planted cassava. According to [16] farming experience is closely related to attitudes and decisions that occur in farmers. The more experience experienced by farmers the higher the level of understanding of farmers about farming. So, the better the decisions taken by farmers in trying to farm

Cassava cultivation techniques are generally in rotation with other cropping patterns such as vegetables and papaya (93.33%). The average reason given for crop rotation is to maintain the soil so that it remains fertile for planting. This cropping pattern is highly recommended because this system leads to a sustainable farming system because it can cut the life cycle of pests, improve the physical and chemical soil and linkages with capital or production costs for commodities that are rotated [1].

All respondent farmers said that they started planting cassava independent of the season and they planted it whenever the cassava field was no longer planted. This planting system might be appropriate if cassava planting is carried out continuously on marginal land that cannot be planted with other plants. However, for land that is relatively fertile and can be planted with other agricultural commodities, planting cassava is usually carried out during the long dry season due to the drought-resistant nature of cassava.

In general, respondent farmers (90%) grow bitter cassava (Roti varieties). The reason for using Roti varieties is because these varieties grow better, and their production is relatively high. Other varieties planted are Manggu (15%) and Jimbul (5%). All respondent farmers (100%) used cassava seed cuttings originating from their own gardens. The use of cassava seedlings from the results of propagation itself is not a problem because the vegetative propagation system produces the same individuals as its parents [18]. Planters of the same seeds will continue to be a problem for pests and diseases in the crop. In [19], it is said that the rotation of cassava plants with other plants can reduce cassava bacterial blight and prevent the decrease in cassava yield by 14-37%.

Cultivation of cassava by farmers by cultivating the land and spacing used 1m x 1m. Generally (96.7%) farmers use goat manure, and the rest (3.3%) use chicken manure (Table 3). More farmers use goat manure as manure, because many farmers keep goats in their yard. The average manure given with one-time usage when the plants were 15-30 days after planting (79.31% of respondents) with a dose of manure used 11-15 tons / ha (53.45% of respondents) and only 13.79% gave manure above 15 tons / ha. The use of manure is quite good and in accordance with the recommended use of 5-10 tons / ha [1].

In addition to manure, farmers also provide urea fertilizer for cassava plants, which are given an average of two times with a response frequency of 65% of farmers, which are given when the plants are 3 months and 7 months old. Uses of urea fertilizer used are generally 200-500 kg / hectare (80% of respondents) and only 6.67% use urea fertilizer above 500 kg / ha. Urea use in cassava farmers in this village is quite high, but it is

not followed by the using of other fertilizers such as Phosphate and KCl. Because the land used by farmers for cassava plants is often rotated with vegetable and papaya plants that are fertilized with complete fertilizer, so the cassava plantations in this area are quite well developed. Farmers generally only use these two fertilizers (cages and urea) in cassava cultivation because of their limited costs and knowledge in good cassava cultivation. For balanced fertilizing cassava recommended is manure, urea, P, and KCl according to soil conditions. The range of balanced fertilization in cassava plants is 150-200 kg urea, 100 kg SP36 and 100-150 kg KCl per ha [20].

Table 3 Characteristics of cassava plant maintenance in Sukaraja District, Bogor Regency

Characteristics	Frequency	%
Use of manure		
Yes	58	96.7
No	2	3.3
Types of manure		
Chicken manure	4	6.7
Goat manure	56	93.3
Dosage of manure (ton/ha)		
< 5	4	6.9
5-10	16	25.9
11-15	32	53.4
> 15	8	13.8
Time to manure (dap)		
< 15	4	6.7
15-30	48	80.0
> 30	8	13.3
Dosage of urea (kg/ha)		
< 200	8	13.3
200-500	48	80.0
> 500	4	6.7
Use of Urea (time)		
1	21	35.0
2	39	65.0
Weed cleansing (time)		
1	17	28.3
2	41	68.3
3	2	3.3

In crop maintenance, all farmers weeding manually using sickles. Weed weeding is done by respondent farmers in general twice (68.33%), when the plants are around 4 months and 8 months old. If done once, weed weeding is done at the age of 6 months, while weeding is done for three times when the plants are 2, 5 and 8 months. Weed cleaning activities carried out manually by farmers are in accordance with IPM rules and can increase cassava tubers produced. According to [21], weeding at 1, 2, 3, 6 and 9 months can increase cassava yields, both on planted in the rainy season and the dry season.

3.3. Harvesting and Selling of Cassava

Farmers interviewed generally (92%) harvested cassava at the age of 10-13 months, and only 8% of farmers harvested cassava at the age of 8-9 months (Table 4). Farmers harvesting cassava are usually adjusted to the needs of funds or when the coming of religious holidays such as the birth of the prophet, *Isra mikraj* and before fasting. Harvesting is done in the dry season because the results of cassava are sold to cassava processing entrepreneurs into cassava shavings, for this processing the sun's heat is needed to dry the shavings from cassava. Cassava yields, after peeled, are sold in bulk to milling businessmen. The entrepreneur then sells the dried cassava shavings to the cassava flour maker. Farmers will only receive sales from cassava if the shavings are dry and have been sold to a flour factory. The main criteria for cassava harvest age is optimum starch content, which is when the plants are 7-9 months old. The tuber weight increases with increasing age of the plant, whereas starch content is usually more stable, so it can be said that the age of harvest of cassava is flexible, the plant can be harvested at 7 months or more than 12 months depending on the variety of cassava planted [1].

Table 4 Harvesting characteristics and sales of cassava yields in Sukaraja District Bogor Regency

Description	Frequency	%
Age of harvest (month)		
8-9	5	8.3
10-11	11	18.3
12-13	44	73.3
Cost per tree (Rp)		
< 1000	3	5.0
1000-1500	37	61.7
1600-2000	18	30.0
> 2000	2	3.3
Yield per tree (kg)		
$x \leq 1$	0	0
$1 < x \leq 2$	52	86.7
$2 < x \leq 3$	8	13.3
$x > 3$	0	0
Crop sales		
Factory	60	100.0
Market	0	0
How to sell		
Wholesale before harvest	0	0
Wholesale after harvest	60	100.0

Estimated profits obtained by farmers in this survey are based on simple calculations, namely the average cost of planting cassava per stem and yields per tree. Cassava farmers interviewed generally (62%) spent between Rp. 1000 up to Rp. 1500 per tree, which includes land management, manure purchase, urea purchase and harvesting. Every 1 ha there are 10,000 cassava plants, so the total costs incurred by farmers range from Rp. 10-15 million. Usually labour from farmers is not counted. From the issued capital, the yield obtained generally (86.67%) is around 1-2 kg per stem. For cultivation as

practiced by farmers in this village the yield of cassava is quite good, because the results of the study show that the production that can be produced is an average of 1.7 kg / stem for less fertile soils [20].

The price at the harvest time will determine the profit of the farmers. The price of cassava on farmers varies. In the last two years the price of cassava at the farm level ranged between Rp. 1100 - 1600 per kg of peeled cassava. With that price, farmers earn Rp. 18.7-27.2 million. So, there is a difference in profits between farmers in cassava farming, which depends on the price of cassava when the crop is harvested. One reason for the small profit is the reduced production which is followed by low prices at harvest.

3.4. Farmers' Perceptions About P. manihoti

When farmers were asked to name the main pests of cassava found in the field, 86.7% mentioned *P. manihoti* was the most important pest (Table 5). While there are 13.3% of farmers who mentioned uret as the most important pest in cassava. According to [22] the type of uret that causes heavy damage to cassava is *Leucopholis rorida* F. (Coleoptera: Scarabaeidae). So far, the main damaging pest in cassava plantations is red mites (*Tetranychus bimaculatus*) [23]. However, during the interview none of the farmers reported mites as the most important pest in cassava. They put mites as pests in the 3rd rank after white lice and uret. Uret is considered more important than mites by farmers, perhaps because this first-mentioned pest can cause direct damage to the tubers, while the mites attack the leaves.

One of the natural enemies that is often found in cassava plantations is the predator *Plesiochrysa ramburi* (Neuroptera: Chrysopidae). These predators are polyphagous that can prey on white mites and red mites in cassava plantations. When the farmers were shown the Chrysopidae imago specimen, all said that they had never seen the insect in a cassava plantation. This suggests the need for counselling to farmers, including the introduction of natural enemies.

P. manihoti is a new pest in Indonesia. When asked the respondents, whenever this starts to cause problems, 81.7% answered what started to cause problems since 2007 (Table 5). A small proportion (8.3%) began in 2008, and a small proportion (6.7%) answered it since 2009, and the least (3.3%) was added since 2010. According to [24] and [25] *P. manihoti* was first discovered in Indonesia in 2010. Farmers who responded that this pest had existed since 2007 might refer to papaya mealybug, *Paracoccus marginatus*, which can also attack cassava. The size and shape of these two mealybugs are almost the same and difficult to distinguish. This is in line with the assumption of all farmers that mealybug that attack cassava also attack other plants. They assume that the mealybug on the cassava plant are mealybug that move from the papaya plant. The results of laboratory tests showed that the mealybug on the papaya plant was *P. marginatus*, white in colour and had a winged stage (male). Conversely on cassava plants that cause leaves to contract and stunt (bunchy top) are *P. manihoti*, which are pink (pink), without winged stages (all individuals are females) and do not attack papaya.

Table 5 Perception of cassava farmers towards *P. manihoti* in Sukaraja District, Bogor Regency

Characteristics	Frequency	%
Main pest		
Mealybug	52	86.7
Uret	8	13.3
Mite	0	0
Existence Chrysopidae		
Yes	0	0
No	60	100.0
Starts on *P Manihoti*		
2007	49	81.7
2008	5	8.3
2009	4	6.7
2010	2	3.3
Found in other plants		
Yes	60	100.0
No	0	0
Attack rate		
Light	6	10.0
Medium	51	85.0
Weight	3	5.0
Lost yeald		
$0 \leq x < 20\%$	6	10.0
$20 \leq x < 40\%$	23	38.3
$40 \leq x < 60\%$	28	46.7
$60 \leq x < 80\%$	2	3.3
$80 \leq x > 100\%$	1	1.7

The opinion of farmers about the level of attack, as much as 85% of respondents said that the level of mealybug attacks on cassava plants was classified as moderate, and 5% said it was classified as heavy, and 10% answered that it was classified as mild. Based on the estimated yield loss, as many as 38% of farmers mentioned a decrease in yield of 20-40% due to *P. manihoti.* Even 47% of respondents said that the yield loss due to mealybug attacks ranged from 40-50% compared to before the attack. The variety of effects of an attack on yield loss is affected by when the attack occurred. If the attack occurs when the cassava plant is still young, it can result in a high decrease in yield compared to when the attack occurs at an advanced age. The mealybug attack also depends on the season. Based on his experience, farmers mentioned that severe attacks usually occur in the dry season. In Africa, where the climate is dry, mealybug attacks on cassava can cause yield losses of up to 90% [5][6].

Although mealybug attacks cause significant yield losses, farmers generally do not take planned control measures. The main reason for farmers is because of

ignorance, lack of funds, and farmers' perception that the mealybug attack will stop when the rainy season arrives. From field observations, there are a small number of farmers who control by cutting the shoots of plants affected by mealybug. It is necessary to develop a mealybug pest management strategy based on an understanding of the socioeconomic aspects of cassava farmers.

4. CONCLUSION

Cassava farmers in the survey area are generally elementary school education, with a narrow planting area (<0.5 ha), and the status of tenants. Although they have been cultivating cassava for a long time (> 16 years), they are not part of a farmer group, and there is generally no contact with agricultural extension workers. Cassava varieties that are widely planted are Roti and Manggu. Good cultivation such as fertilizing with manure and urea and weeding has been done by farmers. The main pest according to farmers and causing many losses is *P. manihoti*, with a yield decrease of about 50%. However, no planned control efforts were made by farmers to overcome this new pest attack. It is necessary to design training for farmers on the management of mealybug in cassava, taking the socio-economic background of farmers.

AUTHORS' CONTRIBUTIONS

Conceptualization, N.W and A.R; methodology, N.W, A.R, I.W.W, and S.S; formal analysis, N.W. and A.R.; writing-original draft preparation and visualization, N.W., A.R., I.W.W., S.S; review-editing, A.R., J.B.; writing - review and editing, N.W, and J.B.

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