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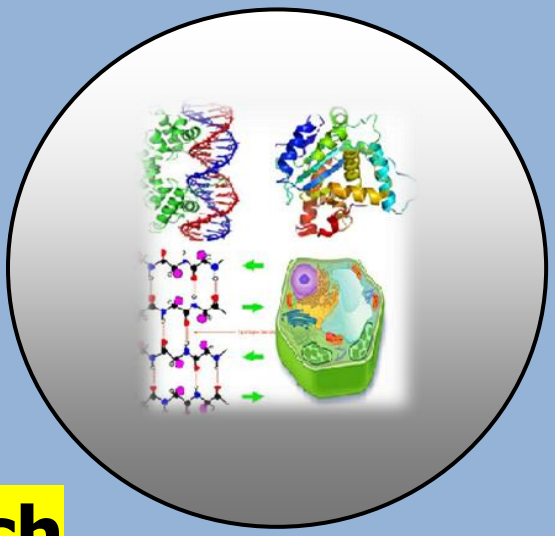

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Opportunity and Strategy Development of Clonal Nutmeg at Moluccas, Indonesia

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ABSTRACT

Nutmeg (Myristica faragrans Houtt.) is original crop of Indonesia, which coming from Moluccas islands. Nutmeg including important crops among other spice plants for producing high-value products such as seed of nutmeg and fuly/mace. The area of nutmeg in Moluccas in the last four years (2009-2012) has increased from 11,970 ha with a production of 2,618 tons in 2009 to 25,355 ha with a production of 2,752 tons in 2012 or an average planted area increased by about 35% per year. Nutmeg production in the last four years an average of 2,549 tons. Opportunities of increase nutmeg production in Moluccas still open with changed the old crop and expansion of planting area. Such efforts require the availability of seeds in large quantities and quality. The main obstacle in the development of plants from seed is nutmeg with the problem of sex ratio where nearly half of the planting material is androgynous male who cannot produce fruit. The problem can be addressed through the development of nutmeg clonal (vegetative) mainly seedling from grafting and connecting shoots. This method can solve the problem in addition to sex ratio, can also accelerate the flowering period (shorter juvenile period), and increase productivity and to improve the yield quality. Development of clonal nutmeg in Moluccas likely because it is supported by the resources of land and labor is available, quite a lot of genetic resources, innovative technologies available, and the market prospects are quite bright.

Keywords: Clonal Nutmeg, Sex Ratio, Connecting Shoots and Grafting.

INTRODUCTION

Nutmeg (*Myristica fragrans* Houtt) is one of the potential export commodities in the Moluccas, because the raw material is abundant and reliable as a source of economic growth and regional income Moluccas. This commodity is known as herb plants native Moluccan islands, which have been hereditary cultivated as a cash crop and cultivated in plantations form the majority of the people in the Moluccas islands (Komalig, 1970).

Based on CBS data of Moluccas in 2012, increasing the total area of nutmeg in Moluccas average of 35% per year. The area of nutmeg in a timeframe of four years (2009-2012) increased from 11,970 ha in 2009 to 25,355 ha in 2012 ha with an average production of 2,549 tonnes/ha per year. Spread nutmeg plantation area in 2012 include West Southeast Moluccas Regency 289 ha, Southwest Moluccas 73 ha, Southeast Moluccas 2,056 ha, Central Moluccas 12,529 ha, Buru 198 ha, South Buru 1,491 ha, Western Ceram 2,424 ha, Eastern Ceram 4,632 ha, Ambon 1,610 ha, and Tual 53 ha (CBS Moluccas Province, 2012; Susanto, 2013 the rationalization of data). Looking ahead, the world will need more nutmeg increased with increasing market demand so as to increase production and export of nutmeg should be developed in Moluccas. Based on the potential of land resources are still available, then the nutmeg is still likely to be developed. AEZ approach can be argued that the potential of land in Moluccas suitable for plantations including nutmeg is still very open, spread over an area of Eastern Ceram regency 332,328.49 ha, Central Moluccas 16,584,7 ha, Western Ceram 97052.6 ha, Buru 25,079.21 ha, South Buru 9,844.15 ha, Southeast and Tual about 61906.86 ha, Aru Archipelagic about 232,317.69 ha, and West Southeast Moluccas and Southwest Moluccas approximately 339,199.4 ha (Irianto *et al*., 1997; Rieuwpassa *et al*., 1998; Susanto & Bustaman, 2003a; 2003b; 2003c; 2006, and Bustaman & Susanto, 2003a; 2003b). Nutmeg in Moluccas generally less productive because most immature plants. Nutmeg from existing acreage in 2012 covering an area of 25,355 ha, approximately 52.48% of nutmeg plant area and 15.49% immature plants classified as old/broken (CBS Moluccas Province, 2012; Susanto, 2013 the data rationalization). Replacement of old plants (rejuvenation) and the expansion of planting area by using plant material (seeds) are superior and productive to support efforts to increase the production and export of nutmeg. However, the problems that arise in the development of plants from seed is nutmeg with the problem of sex ratio. Sex nutmeg plants, generally only be known when the plant has reached the age of flowering which is about five to seven years.

Nutmeg seedlings produced from seeds can be segregated into male and female plants with almost equal proportions. Thus, nearly half of the population are male planting material is that it cannot produce fruit, so that production will be obtained per unit area is low. Until now there has been no practical method that can easily and quickly be able to tell which of nutmeg males and females where nutmeg before reaching the age of flowering plants (Purseglove *et al*., 1995). To overcome the problem of sex ratio, one of which is to provide plant material (seeds) are vegetative or clonal seedlings through vegetative propagation of the graft, grafting, buds or leaf cuttings. Vegetative propagation by cuttings has been successfully applied to the plantations of nutmeg in Grenada (GCNA, 2001). Almost all the nutmeg plantations in Grenada using the seed planting the grafts. With this system, the sex ratio of the population of the plant can be set up ideally with the male and female ratio is 1: 10 or 1: 20.

Another advantage possessed by the clonal seed nutmeg gender (male or female) can be determined earlier, shorter juvenile period, so that the problem of sex ratio can be controlled. In Moluccas, almost all the nutmeg crop, both owned by the public or by the companies, the plant material derived from the generative seeds (beans) that sex ratio problem persists. Therefore, in the Moluccas nutmeg development efforts need to be done using materials derived from seed planting clonal (vegetative) through graft, grafting (grafting shoots), leaves, buds or cuttings though the chances of success are low.

In the era of regional autonomy, nutmeg clonal development is one strategy accelerated economic growth and regional income Maluku rightly realized this time, given that the potential of land and labor is available, quite a lot of genetic resources, development of technologies already available and future market prospects quite bright because world demand is increasing every year nutmeg.

Introduce any one strategy development nutmeg using clonal seeds in order to increase production, to overcome the problem of sex ratio, accelerate early flowering (juvenile period), and improve the quality of the results.

Potential and Opportunities of Nutmeg Development

Production and productivity of nutmeg in the Moluccas relatively low at less than 1,500-3,000 points per tree per year, because farmers generally use random seed (Hadad & Mansur, 1992). Noted that almost all the people in the Moluccas nutmeg plantations using seedlings nutmeg seed origin (generative) so that in a unit area of nutmeg plantations, trees can produce (nutmeg females) only 45% of the population of existing plants and the rest are not in production (nutmeg male).

Nutmeg seed development using clonal (vegetative) has several advantages including plant populations can be set with the ideal male and female ratio is 1: 10 or 1: 20, a shorter juvenile period, crop production and productivity can be increased unity and quality of the results can be widely guaranteed. When the seedlings are planted with nutmeg clonal 9 mx 9 m distance, the plant population in the approximately 123 acres of trees by the number of male trees were 12 trees and female trees 111 trees (1: 10) or male trees 6 trees and female trees 117 trees (1: 20). When nutmeg already in production with an average productivity of 1500 grains per tree per year, it can be estimated that the production per hectare can reach 166,500-175,500 eggs per year. When the results are compared with the results of the production of plant origin nutmeg nutmeg seed with a population of only 45 females per hectare with an average production of 67,500 eggs per acre per year, then increase the result of clonal populations of nutmeg on average per hectare per year to reach 146.66 % - 160%. Nutmeg plant in Maluku have the potential and opportunity to be developed because of several factors that can support the development of nutmeg include:

Land Potential Available

ZAE based approach, the potential of land in Maluku suitable for plantation crops including nutmeg is still quite extensive (630,151 ha), scattered in Eastern Ceram district covering 332,328.49 ha, Central Moluccas 165,847 ha, Western Ceram 97,052.6 ha, Buru 25,079.21 ha, South Buru 9,844.15 ha, Southeast Moluccas and Tual about 61,906.86 ha, Aru Archipelagic 232,317.69 ha, and West Southeast Moluccas and Southwest Moluccas approximately 339,199.4 ha. The land does not include agroforestry land and dryland.

Climate and Land Suitability

Climate

Requirements include appropriate climate in Moluccas until very suitable for the development of nutmeg. Rosman *et al*., (1989) explains that the environment is very suitable for the growth and production of nutmeg is the environment of a hot climate with rainfall between 2,000 and 3,500 mm/year, rainy days 100-160 days, rather evenly distributed throughout the year, the air temperature environment 25-28° C, humidity between 60-80%, and spread at an altitude of 0-700 meters above sea level. While the appropriate environment, rainfall ranged from 1,500 – 2,000 mm/year with rainy days 80-100 or 160-180 days, 20-25°C air temperature, air humidity 55-60% and spread at an altitude of 700-900 m in above sea level.

Ground

Pala need loose soil, fertile and well drained. Land is suitable for development nutmeg volcanic soils that have good drainage with soil pH ranging from 5.5 to 6.5 (Sunanto, 1993). According to Rosman *et al* (1989), nutmeg grows very well on textured soils of sand, sandy loam or sandy clay with high organic matter content, soil pH slightly acid to neutral and well drained to somewhat better. Nutmeg plant is sensitive to waterlogging, therefore good drainage needs to be created when the plant is developed. AEZ approach can be seen that the types of arable land is Tropudalfs nutmeg, Dystropepts, Dystrandepts, Eutropepts, Hapludolls, Rendolls, Paleudults and Tropudults and suitable to be developed on land with slopes of 16-40%. These lands are scattered mostly in the island of Ceram, the south and north of the island of Buru, Banda islands, islands and Kesui Kai, Aru islands, Tanimbar islands, Wilyaru, Molo, Damer and Romang island.

Self Employment Available

The labor force in the Moluccas (15 years and above) to as many as 651,339 lives in 2010 consisted of residents who are working in various sectors of the population as much as 586 430 people and is still looking for a job (TK available) of 64,909 inhabitants. Sector is the most labor-intensive agricultural sector is as much as 301,508 people or 51.42% of the population who are working (CBS Moluccas Province, 2011). The number of workers who are still available and looking for work is a resource that can be employed in the agricultural sector, plantation sub-sector when developing the future of this field.

Pretty Much Genetic Resources

Types found in the Moluccas nutmeg enough variety that is *Myristica fragrans* Houtt, *Myristica argentea* Ware, *Myristica fattua* Houtt, *Myristica specioga* Ware, *Myristica Sucedona* BL, and *Myristica malabarica* Lam. Of the six types of these, which has important economic significance is *Myristica fragrans*. This type of cultivated society than other types, followed by the type and *Myristica argentea* and *Myristica fattua*. Type *Myristica specioga, Myristica sucedona,* and *Myristica malabarica* production is so low that the low economic value as well. Although the data and the potential for the spread of each variety is not known at this time, but the bioavailability is already a guarantee of nutmeg genetic resources invaluable for future development. Based on the Decree of the Director General of Plantation No. KB. 010/42/SK/DJ.BUN/9/1984, dated September, 22 1984, has been appointed and established PT. Plantations of Nutmeg Banda in the Banda Islands and Nutmeg Plantations People in Mamala and Hila village as a source of nutmeg seeds in Moluccas by the number of trees each 4,800 trees and 115 trees (Directorate Genaral of Plantations, 1985).

Strategy of Nutmeg Development

Local Government Policy

Nutmeg plantation commodity exports that can be relied upon as a source of economic growth and income Moluccas region in the present and future. Therefore there is need for Government policy in development activities in the Moluccas nutmeg. Clonal nutmeg development in Moluccas should be a top priority in the development of the plantation sub-sector, as a strategic move that has implications far into the future. These efforts need to be put in the form of integrated programs and activities among relevant agencies, including (1) Zone Mapping System Faming development area nutmeg scale of 1: 50,000, (2) Establishment of seed orchards and nutmeg clonal propagation (vegetative) to meet the requirement of planting material for nutmeg farmers and plantation companies, specifically those in Moluccas (3) The opening of a new planting area using clonal nutmeg seed, (4) Rejuvenation nutmeg plants with clonal seedlings, (5) Training to improve the technology skills of the nutmeg seed clonal propagation (grafting, grafting , buds, and leaf cuttings) to farmers, (6) Education and training of farmers on cultivation techniques nutmeg post clonal nursery, includes watering, fertilizing, pest/disease, transplanting, and maintenance in the garden, and (7) Support funding for implementing activities. Measures to be undertaken by the local government is to encourage and facilitate the implementation of such programs for the realization of clonal nutmeg gardens superior, productive and quality in Moluccas.

Technology Support

Tech support was instrumental in the development of activities in the Moluccas nutmeg. Parent tree selection and clonal propagation (vegetative) through graft, graffting (continued shoots), buds, leaf cuttings or by tissue culture, are two important technological component in the development of nutmeg. Nutmeg trees that can be used as the parent tree is a healthy tree and lead to the potential production of at least 2,000 fruits/tree/year (Directorate Genaral of Plantations, 1985). The nutmeg tree can be used for transplantation, nutmeg seedlings about one year old rootstock for grafting and maintenance after clonal nursery.

Technology Propagation of Clonal Nutmeg

1. With Graft Propagation Method (Marcoteren)

Nutmeg plant propagation by grafting aims to get plants that have the properties of the original parent (grafted tree). Points to consider in selecting stems/branches to be grafted is the healthy growth of trees and can produce enough fruit, trees that have been aged 12-15 years, stems/ branches that are woody, but not too old or too young. How to grafting (marcoteren) are as:

a) Trunk/branch exfoliated skin with a sharp knife along the 3-4 cm circumferentially. Graft position about 25 cm from the base of the stem/branch. Mucus/cambium wood coat pearled removed by the cambium, the transplanted stem that will be left for several hours until it dried wood that looked right. The margins of the base of the seedlings will be transplanted stem smeared with root stimulating hormone (Rootone).

b) Take the loose soil and manure are mixed with the wet and lumpy. The land attached/ wrapped on the shaft that had been flayed shaped mound. Mound is then covered with coconut fiber/plastic. So that the land can be firmly attached to the stem which is skinned, then the coconut fiber / plastic bandage was tied with a rope firmly at the bottom, middle and top.

When using the pads of plastics, then the top and bottom should be a small hole to enter the water spray (upper hole) and a drainage channel (bottom hole). If the transplant is successful, then after 2 months will grow roots. If root grafts were ready, cut and then immediately transferred into baskets or planted directly in the field.

2. Propagation by Connection (Enten and Grafting)

The connection system is placing the selected plants in other parts of the plant as a parent to form a joint plant. Switching systems, there are two ways, namely:

a) Grafting Shoots (enten, grafting). Grafting shoots there are three kinds:

1. Enten gap (scions and rootstocks of the same)
2. Enten barbershop or copulation
3. Enten side (triangles)

b) Connection of the eye (grafting). Splicing eye there are three kinds:

1. Grafting regular (rectangular)
2. Grafting "T"
3. Forkert

After 3-4 months after grafting with graft or graft system was done and if it shows the growth of the stem (the graft) and buds (on grafting), while the plant has to be planted in the field.

3. Propagation with Breast feeding Method (Inarching or Approach Grafting)

Breastfeeding in the system, the size of the rootstock and scions should be as large (more or less large adult fingers). How to do this is as follows:

a) Select the lower and upper stem candidates that have the same size.

b) Do an incision on the upper trunk and lower trunk to form sizes up exposed parts of the wood.

c) Attach the lower stem to the stem right at the incision and tie the stems had the right at the incision and tie with a strong rope.

After some time, the two stems will grow together as if rootstock feeds on the stem as its parent. Within 4-6 weeks, breastfeeding is already visible results. If the stem above the leaves do not wilt, then it can be ensured successful breastfeeding. After 4 months, the bottom of the stem and the top is no longer needed and should be cut and allowed to grow perfectly. If it has grown, the seeds of the breastfeeding results can already be planted in the field.

4. Propagation with Cuttings Way

Nutmeg plant can be propagated by cuttings of young and old using a 0.5% solution of IBA hormone. Penyetekan using hormone IBA 0.5%, usually at the age of 4 months after the penyetekan already out by the roots. Then the next three months are pretty much grown roots.

Another experiment is to use IBA 0.6% in the form of lime. Cutting using IBA 0.6%, usually after 8 weeks already formed callus on the bottom of the cuttings. Then if necessary a second time with 0.5% IBA solution, then after 9 months later've looked rooting (Anonymous, 2001).

Improving the Quality of Human Resources

Training

Nutmeg farming involves a lot of small farmers in traditional and appropriate experience in the hereditary, use of planting material at random by post-harvest scratch.

As a result, productivity and quality of results are low so the price of nutmeg in the market is low and farm income is not optimal. Therefore, the quality of the resources nutmeg farmers need to be improved through training in order to equip farmers with innovative technology.

Demonstration plots

Demplot or demonstration plot was to introduce and transfer technology clonal nursery nutmeg. Each plot (area) nutmeg plant propagation techniques do demo graft, grafting, buds or leaf cuttings. In addition, post-breeding technology clonal plant maintenance which includes: watering, fertilizing, pest/disease, transplanting, and maintenance in the garden need to be socialized.

Public Participation

Socio-cultural aspects and habits of the people whose descendants still very influential in the cultivation of nutmeg in Maluku. Nutmeg development patterns have not been touched by technology, because farmers have not adopted the technology development clonally nutmeg. Public participation in adopting technologies depends on the type/kind of technology, a technology that is teknisdapat done, socially acceptable and economically profitable and environmentally friendly.

Another alternative is sufficient to determine the active participation of the community is through the use of institutional (informal and formal) as Village Unit Cooperative (VUC), Agricultural Extention Agency (AEA), Village Community Resilience (VCR), Farmers Group, Youth Farm, Youth Leaders, Religious Leaders, Indigenous Institute, and others.

Supporting External Factors

External factors that influence the development of nutmeg in Moluccas is the marketing, transportation, and institutional. Therefore, intervention is needed to address the issue of local government market, providing transportation facilities and infrastructure in these areas to development and deliver marketing institutions such as cooperatives, the National Association of Nutmeg and Banking in efforts to use nutmeg for agribusiness. Traditional institutions need to be enabled so that development does not harm the environment nutmeg, but well maintained and sustained.

CONCLUSIONS AND RECOMMENDATIONS

1. Nutmeg is a plantation commodity exports as a reliable source of economic growth and revenue that the Moluccas nutmeg development in Moluccas needs to be done with the support of Government policy.
2. Development of nutmeg can be done using nutmeg seeds clonal because it has several advantages, namely sex ratio can be determined early, shorter juvenile period and the production of broadly higher unity.
3. Opportunities in the Moluccas nutmeg development supported by the available land resource potential, the potential for quite a lot of genetic resources, manpower and technology available clonal multiplication of seeds already exist.
4. Development strategy as outlined in the form of program activities as much as 7 points, are necessary to be on the field with a driven and facilitated by the local government, so that the future will form nutmeg gardens clonal superior, productive, and quality in Moluccas.

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