

Intercropping of Several Cultivars of Banana and Plantain under Coconut Based in North Sulawesi, Indonesia

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Abstract. The Research has been conducted in Pandu Experimental Garden, Talawaan Bantik Village, North Sulawesi, titled “Intercropping of Several Cultivars of Banana and Plantain under Coconut Based in North Sulawesi, Indonesia”. The aims of the research were to study suitability of several banana and plantain intercropped into coconut based farming system. The materials and methods used were monoculture coconut plantation, hybrid Khina-1 planted in 1986, designed in RCBD, 5 treatments were the banana and plantain cultivars Mas, Gapi, Gepok Tanjung, Goroho and Raja. Then the Least Significant Difference Test (LSD) was used for mean separations. Significantly, was determined at the $p=0.05$ probability level. In this experiment also, using t-test to compare the effect of natural shade of the coconut canopy with an open field for the five varieties tested. Then, using 20 plants for each variety and treatment, served as replication. Two dwarf cultivars, Mas (banana) and Goroho (plantain) indicated the significant vegetative and generative growth shorter than the three tall cultivars, Gapi, Gepok Tanjung and Raja. It is also concluded that coconut based using Hybrid Khina-1 varieties, spacing 8m x 8m square system is suitable for intercropping with banana and plantain, especially the Dwarf Mas and Goroho.

1 Introduction

Coconut plantations have valuable land for other purposes, such as for intercropping system implementation. On the other hand, in Indonesia most coconut lands are cultivated in monoculture system or unarranged mix cropping system. This farming practice results low productivity referring to farmer income as well as their welfare. Since the farmer has only an average of 1 ha where the annual productivity of copra is only 1.1 t ha⁻¹, their income is very low. For example, in North Sulawesi, the main coconut production center in Indonesia, the price of copra in 2019 is average IDR 5,500,000 t⁻¹ (US\$ 1= IDR 13,200), meaning the farmer's income is only about IDR 6,050,000. If the farmer only has the job, they are recorded as the poor or live under poverty line, less than US\$ 1.9 a day [1]. This problems

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bring about many farmers sell their lands or convert it into other uses.

There are many opportunities to solve the problem of in efficiency of coconut cultivation, such as optimizing the land with intercropping. There are several economic commodities suitable for intercropping in coconut land. Rationally, monoculture of coconut plantation can't guarantee the prosperous farmers [2]. In Indonesia, most coconut land (97%) are cultivated in monoculture [3]. Although, it is managed in high density, monoculture practices is not profitable. On the other hand, the monoculture coconut is believed that there are very much opportunities to optimize such a intercropping purpose. For example, coconut monoculture only produce 100 nut a year, it is only 17.1 ton/ha or 6.1% of the maximum biomass production potency [4].

The light transmission trough the canopy varies follows plant age and almost it is contrary with the covering of canopy [5]. Furthermore, it is recorded that the highest coconut canopy coverage was in 8-30 years age, in conventional spacing 9m x 9m triangular pattern, the canopy coverage is only 60% , then, over 30 years, the coverage could be only 20% [4] Another research conducted in Indonesia, recorded that based on the calculation of plant density 100-200/ha, the effective area used is only 12.57-25.14%, therefore, the rest effective land is 87.43 – 74.86% [6]. It is reported also that 86% of coconut root was only be found in 30-130 cm in depth [7]. Therefore, the land maximum effectively used is only at radius 2 m [8].

For effectiveness of intercropping it is necessary to consider the kind of intercrops in developing coconut-based farming system tolerant for environmental limitation especially light. For, example, banana. Light has influence on the growth and yield of banana. On the other hand, there are many reasons considered that banana is still possible to use as intercrops within coconut based farming system, such as the light transmission to the grown still possible for certain varieties like dwarf banana. Banana widely popular and important food usually cultivated in intercropping system around the world, for example, in Ghana 99% of young coconut were intercropped with food crops, mainly [9], while in the Philippines, 60 to 70 % of estimated 3.1 million hectares of coconut is intercropped with recommended crops including banana [8]. In Kenya, plantain or banana intercropped are reported to be one of the most profitable coconut intercrops [7]. Meanwhile, in North Sulawesi, the most important coconut production in Indonesia, banana and plantain is commonly planted

Bananas originate from South East Asia [10, 11]. Since the banana is a tropical plant, it requires warm temperatures and an adequate supply of water. Although sensitivity to photoperiod has been noted in certain cultivars [12], banana is an almost non-seasonal crop that reliably provides a carbohydrate source year-round which makes it vitally important to both nutrition and food security. Plantain is considered an excellent source of energy and nutrients: it is estimated that 100 g of the edible part of raw plantain provides 122 kcal, contains 1.30 g of protein, 0.37 g of fat, 0.6 mg of iron, 0.14 mg of zinc and 457 µg of β-carotene [13]. Iron and zinc deficiencies are commonly reported in children and women of reproductive age in many developing countries [14, 15, 6]. Iron deficiency is the prevailing nutritional deficiency in the world and is the main cause of anemia [11].

In order to solve the problems mentioned above and to optimize the coconut-based farming system by using coconut and plantain intercropped in North Sulawesi. Therefore, this research was conducted aimed to study suitability of several banana and plantain intercropped into coconut based farming system.

2 Materials and Methods

The research was carried out during two years (2014-2016) in Pandu Experimental Garden, North Sulawesi, Indonesia using coconut based planted in 1986. The coconut variety used

was Khina-1, a hybrid crossed by Tenga Tall Variety and Nias Dwarf Variety, both was local Indonesian varieties.

In this experiment five banana and plantain cultivars were tested intercropped into the coconut-based plantation conducted by using a complete randomized block design with three replications. The treatments were the banana and plantain cultivars: A=Mas, B=Gapi, C=Gepok Tanjung, D=Goroho and E=Raja. Then the Least Significant Difference Test (LSD) was used for mean separations. Significantly, was determined at the $p=0.05$ probability level.

In this experiment also, using t-test to compare the effect of natural shade of the coconut canopy with an open field for the five varieties tested. Then, using 20 plants for each variety and treatment, served as replication.

The planting materials of banana used sword suckers having two leaves, whereas, it is different weight and height among the cultivars. The suckers of Dwarf Mas Cultivar and Goroho average 60 cm in height, while the tall cultivars, Gapi, Gepok Tanjung and Raja average 85 cm in height. The banana and plantain was cultivated in a row between two coconut rows, 3 m spacing in row. The suckers planted in 40 m x 40 m x 40 m holes prepared before. The banana and plantain was fertilized conventionally, 4 times a year. First, in 1 month after planting 150 g Urea (45% N), 400 g SP-36(36% P₂O₅), 200 kg KCl (60% K₂O). Then, in the next, every 3 months was applied 150g Urea, and 100g KCl.

The parameters measured were (1) number of ratoon in certain age, 3, 6, 9 and 12 months after planting (map); (2) number of leaves in certain age, 3, 6, and 9 map; (3) Plant height at inflorescence of main crop, I ratoon and II ratoon; (4) Plant girth at inflorescence of main crop, I ratoon and II ratoon; (5) Number of hands/bunch of main crop, I ratoon and II ratoon; (6) days of flowering of main crop, I ratoon and II ratoon; (7) Days of harvesting of main crop, I ratoon and II ratoon; (8) Average hand weight of main crop, I ratoon and II ratoon; and (9) Number of fingers/hand.

3 Results and Discussion

The result shown in Table 1, determine that there were significant differences in the parameter of number of ratoon in certain age of several banana and plantain intercropped into coconut based in Talawaan Bantik, North Sulawesi. In the 3 months old, when the plants just in rapid juvenile growing, except between Gapi and Raja Cultivars, all cultivars were significantly different. However, the higher number of ratoon found in Mas Cultivar (5.5 ratoon), followed by Goroho, Raja, Gapi, and Gepok Tanjung, respectively. In 6 months old, the dwarf cultivars, Mas (9.25 ratoon) and Goroho (6.50 ratoon) shown the higher number of ratoon than other cultivars. In fact, Mas and Goroho are two kind of banana and plantain classified into fast grow cultivars. These seem that in the next level of age, 9 months and 12 month the production of ratoon pattern became similar. In the 12 months, when the generative of the first ratoon, the number of ratoon produced research 15.50; 13.75; 10.50; 9.75 and 9.75, respectively for Mas, Goroho, Gapi, Gepok Tanjung and Raja. In farmer practices, the excessive ratoon is usually catting or thinning. The thinning remain 2 or 3 ratoon in fruiting phase. It is important to be conducted in banana cultivation because the needs to produce well bunches. In addition, banana and plantain are easy to produce, implying their plantations and production can be beneficial in association with other crops in various environments including home gardens. However, a main handicap for these crops' production remains the quality of suckers [16, 17].

Table 1. Number of Ratoon in Certain Age of Bananas and Plantains under Coconut in Talawaan Bantik Village, North Sulawesi, 2015-2016.

Cultivars	No. of Ratoon (3 month)	No. of Ratoon (6 month)	No. of Ratoon (9 month)	No. of Ratoon (12 month)
Mas	5.50 d	9.25 c	12.50 c	15.50 c
Gapi	1.25 b	4.25 a	8.50 b	10.50 a
Gepok Tanjung	0.25 a	4.25 a	6.75 a	9.75 a
Goroho	2.75 c	6.50 b	8.75 b	13.75 b
Raja	1.75 b	4.50 a	8.00 b	9.75 a

Notes: The numbers followed by the same letter in the same column are not significantly different in 5% LSD test.

In this experiment, the number of leaves were not different significantly in mature crops, this only different in earlier, 3 months where Gepok Tanjung, Gapi and Raja seem to grow lower than the Dwarf Mas and Goroho (Table 2). The number of leaves is important to maintain banana itself. The energy used further in plant growth produce in leaves by photosynthetic process [18]. According to [8], that only the heaviest shade affected banana vegetative growth. When the density of a commercial banana plantation is high and light transmitted to the understory is reduced to 10% of the above canopy intensity, growth and production of the plants are severely affected [10]. That the reason why in general cultivation, arrangement of spacing, cutting off the old leaves is always prioritized.

Table 2. Number of Leaves in Certain Age of Bananas and Plantains under Coconut in Talawaan Bantik Village, North Sulawesi, 2015-2016.

Cultivars	Number of Leaves at 3 Months	Number of Leaves at 6 Months	Number of Leaves at 9 Months
Mas	5.25 b	5.75 a	5.75 a
Gapi	3.50 a	5.25 ab	6.75 a
Gepok Tanjung	3.25 a	4.75 b	6.50 a
Goroho	4.50 b	6.25 a	6.25 a
Raja	3.75 a	5.25 ab	6.00 a

Notes: The numbers followed by the same letter in the same column are not significantly different in 5% LSD test.

The plant height and plant girth measured at inflorescence emerging shown similar pattern where that the Dwarf Mas and Goroho was shorter than other Tall cultivars (Table 3). Moreover, Mas (181.34 cm) was significantly shorter than Goroho (223.33 cm), then Goroho very significantly different with the 3 tall cultivars, Raja (346.83 cm), Gapi (352.65 cm) and Gepok Tanjung (392 cm). On the other hand, among the three tall cultivars, Gapi and Raja have height and girth not significant different on all stage, where the Gepok Tanjung was different with the two other tall cultivars.

Table 3. Plant height and plant girth at inflorescence emerging of 5 varieties under coconut in Talawaan Bantik Village, North Sulawesi, 2015-2016.

Cultivars	Plant height at inflorescence (cm)			Plant girth at inflorescence (cm)		
	Main crop	I ratoon	II ratoon	Main crop	I ratoon	II ratoon
Mas	181.34 a	193.37 a	193.69 a	38.23 a	36.89 a	38.89 a
Gapi	352.65 c	344.84 c	350.54 c	60.28 c	62.19 c	63.37 c
Gepok Tanjung	392.58 d	421.56 d	423.23 d	92.40 d	100.30 d	103.24 d
Goroho	223.33 b	223.35 b	227.11 b	42.70 b	45.45 b	43.56 b
Raja	346.83 c	356.22 c	355.01 c	62.38 c	64.80 c	66.40 c

Notes: The numbers followed by the same letter in the same column are not significantly different in 5% LSD test.

It was surprised where the Dwarf Mas (banana) and Dwarf Goroho (plantain) got flowering very early. Mas flowered in 191 dap and Goroho 223.33 dap. These much earlier than the dwarf cultivars identified in India, Grand Naine took 280 days to flower and 386 days for harvest of main crop [19] and Dwarf Cavendish took 275 days to flower [20]. The days of harvesting also have shown that the dwarfs were harvesting earlier that that in India [19, 21, 22]. Meanwhile, the tall varieties Gapi and Raja flowering were not significantly different. Gapi flowered in 302.75 dap where Raja flowered in 316.83 dap. On the other hand, they were different compared with Gepok Tanjung Cultivar having 382.58 dap to flower for the main crop.

In General, in lowland Indonesia days of banana harvesting around 85-100 after flower emerged, while in highland took 98-115 days after flower [23]. In this experiment was found that the Dwarf Mas 60.25 days and Goroho 53.67 days after flowering. Goroho harvested earlier due to it plantain character where the fruit have to be harvested before ripping. The fruit harvesting when it is suitable to consume. Moreover, the experimental results shown that Mas and Goroho, two cultivars of banana and plantain expressed as extreme dwarf. They were about 25-28 days ripe earlier than general banana or plantain. In the contrary, the tall cultivars recorded that Raja was ripe 84.92 days after flowering, followed by Gapi ripe 87 days after flowering and the longest was Gepok Tanjung 99.92 days after flowering

Tabel 4. Days of Flowering and Days of Harvesting of 5 varieties under coconut in Talawaan Bantik Village, North Sulawesi, 2015-2016.

Cultivars	Days of flowering			Days of harvesting		
	Main crop	I ratoon	II ratoon	Main crop	I ratoon	II ratoon
Mas	191.00 a	203.25 a	201.75 a	251.25 a	259.00 a	250.25 a
Gapi	302.75 c	304.75 c	300.50 c	389.75 c	379.25 c	385.50 c
Gepok Tanjung	382.58 d	361.50 d	363.25 d	482.50 e	455.50 d	462.00 e
Goroho	223.33 b	223.25 b	227.00 b	277.00 b	278.25 b	282.00 b
Raja	316.83 c	326.22 d	325.01 d	401.75 d	412.75 d	411.75 d

Notes: The numbers followed by the same letter in the same column are not significantly different in 5% LSD test.

Tabel 5. Bunch characters and yield of the five varieties under coconut, North Sulawesi, 2008-2009

Cultivars	No. of hands/bunch			No.of fingers/hand			Average Hand weight (g)		
	Main Crop	I ratoon	II Ratoon	Main crop	I ratoon	II ratoon	Main crop	I ratoon	II ratoon
Mas	8.00 b	8.25 b	8.75 b	15.25 a	15.00 a	15.25 a	867 a	712 a	723 a
Gapi	8.25 b	8.00 b	9.00 b	14.50 a	15.00 a	15.25 a	1497 c	1423 b	1472 c
Gepok Tan.	16.50 c	16.25 c	18.00c	17.75 c	18.25 b	18.00 b	1778 c	1623 c	1633 c
Goroho	5.75 a	6.00 a	5.75 a	15.00 a	15.25 a	15.25 a	1224 b	1230 b	1247 b
Raja	8.75 b	8.75 b	9.00 b	16.25 b	16.50 a	16.00 a	1465 c	1482 bc	1482 c

Notes: The numbers followed by the same letter in the same column are not significantly different in 5% LSD test.

The tall cultivar Gepok Tanjung recorded as the highest in number of hands/bunch (16.5) followed by other tall cultivar Raja (8.75) and Gapi (8.00), while the dwarfs were lower, Mas (8.00) and Goroho (5.75). The high hands/bunch of Gepok Tanjung due to its bundles, all the female flower was developed to be fingers despite of they became smaller

in tips of the bunch. Then, like in parameter number of hands/bunches, Gepok Tanjung also recorded as the hinges in number of fingers/hand (17.75), it was significantly different with other cultivars, followed by Raja (16.5) different to other cultivars. Then, the rest tall cultivar Gapi and the two dwarf cultivars were not significantly different in fingers/hand parameter.

3.1 Comparison of the Natural Shade of Coconut Canopy and Open Field for Banana and Plantain Growth and Production

The effects of natural shade under coconut plantation of banana and plantain growth and production are shown in Table 6. The effect on vegetative characters determined are number of ratton in 3 stages (3, 9 and 15 months age), number of leaves also in 3 stages (3.6 and 9 months age), plant height, and plant girth in inflorescence; while the generative characters are days of flowering, days of harvesting, number of hand/bunch, average hand weight and number of fingers/hand. Based on the observation on the 5 varieties both in vegetative and generative characters, then they were classified into two groups, namely dwarf and tall varieties. There are two dwarf varieties, such as, Mas and Goroho; while the rest three varieties are Gapi, Gepok Tanjung and Raja.

3.2 Dwarf Varieties

The results showed that the dwarf varieties were more adaptive against coconut canopy shade than the tall varieties both in vegetative and generative characters. Mas variety was only different in plant height. It is natural, shading produced taller plants due to shoot growth as they look for light, indicating the activation of some phototropism responses [18, 24, 25]. It was also stated by other researchers that plant grown under low light levels have shown more epical dominance than those grown in high light environment resulting in taller plants under shade [26]. It is also possible that the dwarf varieties have ability to continue photosynthesis at light deficit conditions [4]. Meanwhile, on other characters shown there were no significantly different, meaning that the shade of coconut (Khina-1 varieties) spacing 8 m x 8 m square could be ignore for the production of the two banana dwarf varieties. Development of dwarf banana cultivar that tolerant to shade is very important, because with the dwarfing banana the population or plant density per unit area will be higher, so that the potential production will be higher also [4].

Mas varieties is a dwarf banana, while Goroho is a dwarf plantain. In Indonesia, Mas is very popular consuming as fresh fruit and for the special use to feed baby, the old as well as for sick person. Goroho is plantain more specific food in Manado City, North Sulawesi Province. The plantain often use as rice substitution especially for diet purpose such a diabetes diet [24]. The starch content of raw plantain up to 60-80 % of its dry weight similar to starch of corn and potato [27]. Goroho has antioxidant activity 13.34 % of the phenol total contain 0.05 mg/100 g, vitamin C 69.25% and tannin 0.13%. The phytosterol and glucoside sterol in goroho flesh is believed that it is could be use as antioxidant [28].

Table 6. A comparison of the Natural Shade of Coconut Canopy and Open Field for Banana and Plantain Growth and Production

Treatments	Banana and plantain varieties				
	Mas	Gapi	Gepok	GoroHo	Raja
No.ratoon. (3 months):					
<i>Under coconut</i>	5.50 a	1.32 a	0.23 a	2.74 a	1.67 a
<i>Open field</i>	5.30 .a	1.30a	0.25 b	2.61 b	1.70 a
No.ratoon. (9 months):					
<i>Under coconut</i>	9.30 a	4.28 a	4.25 a	6.53 a	4.50 a
<i>Open field</i>	8,95 .a	3.80 b	5.20 b	5.43 b	6.10 b
No.ratoon. (15 months):					
<i>Under coconut</i>	12.50 a	8.47 a	6.87 a	8.79 a	8.00 a
<i>Open field</i>	11.97 a	6.98 b	8.67 b	7.21 b	9.10 b
No.ratoon. (21 months):					
<i>Under coconut</i>	15.50 a	10.50 a	9.75 a	13.75 a	9.75 a
<i>Open field</i>	16.02 a	8.67 b	11.03 b	11.27 b	11.13 b
No.Leaves (3 months)					
<i>Under coconut</i>	5.22 a	3.57 a 3,37 a	3.53 a	4.50 a	3.75 a 5,13 a
<i>Open field</i>	5.30 a		3.47 a	4.57 a	
No.Leaves (6 months)					
<i>Under Coconut</i>	5.75 a	5.28 a	4.77 a	6.24 a	5,30 a
<i>Open field</i>	6.08 a	6.27 b	6.12 b	6.11 a	6.57 b
No.Leaves (9 months)					
<i>Under coconut</i>	5.76 a	6.76 a	6.49 a	6.27 a	5.97 a
<i>Open field</i>	5.82 a	7,80 b	7.87 b	6.44 a	7.33 b
Plant height at inflorescence (cm)					
<i>Under coconut</i>	181.34 a	352.65 a	392.58 a	223.33 a	346.83 a
<i>Open field</i>	16.,67 b	349.67 b	363.37 b	200.54 b	312.17 b
Plant girth at inflorescence (cm)					
<i>Under coconut</i>	38.45 a	60.28 a	92.40 a	42.70 a	62.38 a
<i>Open field</i>	39.22 a	62.67 b	94.56 b	43.16 a	60.08 b
Days of Flowering					
<i>Under coconut</i>	191.08 a	302,75 a	382,58 a	223.33 a	336.83 a
<i>Open field</i>	187.67 a	310.25 a	380.27 a	209.36 a	337.67 a
Days of Harvesting					
<i>Under coconut</i>	251.25 a	389.75 a	482.50 a	277.00 a	421.75 a
<i>Open field</i>	254.33 a	386.67 a	485.14 a	279.91 a	425.25 a
No. Of hand/bunch					
<i>Under coconut</i>	8.25 a	8.27 a	13.50 a	5.76 a	8.75 a
<i>Open field</i>	8,23 a	8,23 a	15.45 b	5.67 a	9.05 a
Av. Hand weight (g)					
<i>Under coconut</i>	867.33 a	1496.28 a	1778.68 a	1224.03 a	1482.56 a
<i>Open field</i>	882.67 a	1609.67 b	1896.33 b	1216.89 a	1602.67 b
No.of fingers/hand					
<i>Under coconut</i>	15.33 a	14.50 a	17.78 a	15.33 a	16.13 a
<i>Open field</i>	15.56 a	16.23 b	18.98 b	15.02 a	16.27 a

Notes: Mean followed by the same letter in a column each parameter is not different at 5% based on t test analysis

3.3 Tall Varieties

The three Tall Varieties, Gapi, Gepok Tanjung and Raja tended to show that they were not

quite suitable cultivated under coconut. Gepok Tanjung, the Tall Plantain, in this experiment is more extreme unsuitable indication. There were not significantly different between planting into natural shade of coconut canopy and open field on parameters: (1) number of leaves measured in 3 months after planting, (2) days of flowering and (3) days of harvesting only. Otherwise, most of the parameters were significantly different, such as: (1) number of ratoon measured in 3 months, (3) number of ratoon measured in 9 months, and (4) number of ratoon measured in 15 months after planting; (5) number of leaves measured in 6 months after planting (6) number of leaves measured in 9 months after planting (7) height in inflorescence, (8) plant girth in inflorescence, (9) Number of hands/bunch, (10) average hand weight, and (11) number of fingers/hand.

Gapi the Tall Banana Variety, was more tolerant toward shade compared with Gepok Tanjung. It has 5 of 14 parameters having indication of tolerance, namely, (1) number of ratoon measured in 3 months after planting, (2) number of leaves measured in 3 months after planting, (3) days of flowering, (4) days of harvesting, and (5) number of hands/bunch. The rest 9 parameters were significantly different between natural shade and open field condition. Then, the other Tall Banana variety, Raja, having better performance under natural shade of coconut canopy with Gepok Tanjung and Gapi varieties. It has 6 of 14 parameters having indication of tolerance, namely, (1) number of ratoon measured in 3 months after planting, (2) number of leaves measured in 3 months after planting, (3) days of flowering, (4) days of harvesting, and (5) number of hands/bunch and (6) number of Number of fingers/hand. The rest 8 parameters were significantly different between natural shade and open field condition. However. The results are still cannot recommend that using the tall varieties as intercrops under coconut based despite of several parameters were not significantly different between shade and open field condition, except any other pattern of spacing of the coconut plantation.

The different responses of dwarf varieties and the tall varieties lead to trial the suitable intercrops into coconut plantation. It is necessary to strive on this due to the important value of the intercropping system. Plantain or banana intercropped are reported to be one of the most profitable coconut intercrops [29]. In addition, plants may interact differently in reduced light compared to full sun [30]. Banana and plantain can even grow well in higher shaded level up to 80%. Fruit production will be delayed by several months if plant is excessively shaded. For commercial production of banana, full sun is usually best and a maximum of 50% shaded is recommended. Reduced irradiance resulted in a significant decrease in fruit production, A reduction to 60% of full sunlight resulted in a 7% decrease of bunch weight, and a reduction to 30% of full sunlight resulted in a decrease of 32% in bunch weight [31]. Another research correlates to this result, that 50% shading of full sunlight does not reduce yield of banana [29].

4 Conclusion

There are two dwarf cultivars, Mas (banana) and Gorocho (plantain) indicated the significant vegetative and generative growth shorter than the three tall cultivars, Gapi, Gepok Tanjung and Raja. The higher number of ratoon recorded on the Dwarf Mas Cultivar, while the least on the Tall Gepok Tanjung. Meanwhile, the number of leaves were mostly similar among the dwarf and the tall banana and plantain intercropped into the coconut based. The plant height and girth at inflorescence were still different mainly between the dwarf and the tall cultivars. The differences were also reported for generative characters of the dwarf and the tall, such as days of flowering, days of harvesting, number of hands/bunch, number of fingers/hand and average hand weight.

The trials conducted in Lowland Talawaan Bantik Village, North Sulawesi lead to conclude that coconut based using Hybrid Khina-1 varieties, spacing 8m x 8m square

system is suitable for intercropping with banana and plantain, especially the Dwarf Mas (banana) and Gorocho (plantain), most parameters of the dwarfs were not different between planting under natural shade of coconut canopy and planting in open field. In the contrary, the tall cultivars, Gapi, Gepok Tanjung and Raja are not recommended. Nevertheless, the tall could be consider to other wider models of coconut spacing, due to the facts that some parameters were not different between planting under natural shade and in open field.

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