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Effect of Plant Density on the Yield of Taro in Paddy Field[1]

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Abstract : Taro, cv. Betelnut, were planted in paddy fields in 1979 and 1980 showed that the higher the plant density, the higher the plant and yield. However, size, weight and number of main corm or cormels produced on each plant were negatively correlated to the plant density. The highest main corm yield was recorded in the plot with a spacing of 60 × 20 cm (83,300 plants/ha) of 36 tons/ha and 55 tons/ha and the lowest in the spacing of 60 × 60 cm (26,600 plants/ha) of 17 tons/ha and 21 tons/ha respectively in 1979 and 1980. Total yield (main corm + cormels) also showed the highest in the spacing of 60 × 20 cm of 43 tons/ha and 63 tons/ha and the lowest in the spacing of 60 × 60 cm of 22 tons/ha and 26 tons/ha respectively in 1979 and 1980. This information is valuable for the farmers to cultivate taro in the paddy fields.

Taro (*Colocasia esculenta* (L.) Schott) is a herbaceous perennial of the Arum family. It probably originated in Northern India and is a crop widely cultivated in most tropical and subtropical areas of the world[3]. It contains lots of carbohydrates, minerals and vitamins and is widely used, either boiled or pasted, as the staple food of the people in the tropical and subtropical Pacific Basins[11,12,13]. In Taiwan, it is commonly used in the preparation of ice cream and cake[1,6,14]. It can also be used to make taro chips. The housewives use main corm, cormels, young leaves and petioles as vegetables. The farmers like to grow it because it is easily to be cultivated under high temperature and resistance to waterlogging during tropical monsoon season.

Taro is mainly grown in paddy fields in central and southern parts of Taiwan. However, scattered plantings also were observed in the upland or slope land[15]. The acreage of taro cultivation was increasing year by year. Up to 1981, 4,407 hectares were planted[2]. In general, the farmers favored the row spacing of ca. 60 cm. However, the spacing between plants was varied among locations and farmers. This study was attempted to evaluate the effect of plant density on the yield of taro grown in the paddy field[4,5,6,12,13].

Material and Methods

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The most common cultivar Betelnut was planted in the loam soil of the research farm of Fengshan Tropical Horticultural Experiment Station on March 6, 1979 and January 18, 1980. A randomized complete block design with four replications were used in the experiments. Each experiment unit was 3.6 m × 5 m containing 6 rows of plants with 60 cm between rows. The spacing between plants were adjusted to 20, 30, 40, 50 and 60 cm which resulted in the density of 83,300; 53,300; 40,000; 33,300 and 26,600 plants/ha, respectively. Seedlings were obtained from the nursery of last year. Twenty-five tons of compost, 6 tons of chicken manure, 500 kgs of ammonium sulfate, 1,000 kgs of calcium superphosphate and 200 kgs of potassium chloride per hectare were used. All composts and chicken manures, 50% of ammonium sulfate, 80% of calcium superphosphate and 50% of potassium chloride were broadcasted as basal fertilizer during land preparation. The remainder fertilizers were applied 1, 3 and 5 months after planting. Crop was harvested on November 6, 1979 and September 11, 1980 respectively. Important horticultural characters, such as size of main corm, fresh weight of main corm, cormels, main corm + cormels, number of cormels, size of cormels, plant height and yield of main corm, cormels, main corm + cormels were recorded during harvest. All investigation data were processed by the methods of Duncans' multiple range test. Crop was managed in accordance with general cultivation of paddy field taro.

Results

As shown in Table 1, the width of main corm was increased as plant density decreased. However, no significant difference in length of main corm was observed. Table 2 showed that no difference was observed in the fresh weight of main corm per plant produced on each treatment. However, the fresh weight of cormels or main corm plus cormels was increased as plant density decreased. Number of cormels per plant was increased as plant densities descreased in the experiment of 1979 but no difference was observed in the test of 1980 (Table 3). No difference in fresh weight per cormel was observed among plant densities in the experiment of 1979 but it was increased as plant density decreased in 1980 (Table 4). Plant height was found positively correlated to the plant density (Table 5). Table 6 showed that the yield of main corm increased as the plant density increased. However, there was no difference in cormel production among plant densities. The main corm yield showed the highest in the plot with the spacing of 60 × 20 cm (83,300 plants/ha) of 36 tons/ha and 55 tons/ha and the lowest in the spacing of 60 × 60 cm (26,600 plants/ha) of 17 tons/ha and 21 tons/ha respectively in 1979 and 1980. If both main corms and cormels were used in the calculation of production, total yield was increased with increased plant density. The total yield (main corm+cormels) showed the highest in the spacing of 60 × 20 cm of 43 tons/ha and 63 tons/ha and the lowest in the spacing of 60 × 60 cm of 22 tons/ha and 26 tons/ha respectively in 1979 and 1980.

Discussions

Many factors such as fertilizer, herbicide, spacing etc. were regarded to be able to affect taro growth and yield[7,8,9,10]. Plant density might be the most important. Horti-

cultural characters of Betelnut taro, such as size (length and width) of main corm, cormels and main corm plus cormels per plant, number of cormels per plants, fresh weight per cormel, plant height and yield were strongly influenced by the plant density of taro grown in paddy fields. Some farmers thought the size of main corm per plant will be increased when density is decreased. However, no difference of fresh weight of main corm wes observed in both of the experiments conducted in 1979 and 1980. Since this variety is mainly used for the production of main corm, therefore, a higher yield is derived from a higher number of plant density plot. The main corm production per hectare for the plots with 60 × 20 cm (83,300 plants/ha) spacing was 2 times more than that of 60 × 60 cm (26,600 plants/ha) spacing plot. The most suitable plant density for the plants of Betelnut taro in paddy field in Southern Taiwan was 60 × 20 cm or 83,300 plants per hectare. This information is valuable for the farmers to cultivate taro in the paddy fields.

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Table 1. Effect of plant density on the length and width of main corm

Plant density (cm)	Length (cm)		Width (cm)	
	1979	1980	1979	1980
60×20	15.3 a	16.6 a	7.6 c	8.7 d
×30	17.7 a	17.5 a	8.4 abc	9.2 abc
×40	17.6 a	18.2 a	8.4 abc	9.3 ab
×50	17.6 a	18.1 a	8.6 ab	9.5 a
×60	17.8 a	17.6 a	8.8 a	9.5 a
FLSD 5%	N S	N S	0.8225	0.4404
1%	N S	N S	1.3649	0.7309

Table 2. Effect of plant density on the fresh weight of main corm, cormels and main corm + cormels per plant g/plant

Plant density (cm)	Main corm		Cormels		Main corm + cormels	
	1979	1980	1979	1980	1979	1980
60×20	427.5 a	662.9 a	84.6 d	96.8 c	512.1 b	759.7 c
×30	555.8 a	738.1 a	121.8 bcd	129.3 bc	677.6 ab	867.4 abc
×40	578.7 a	802.4 a	161.2 abc	154.3 abc	739.9 ab	956.7 abc
×50	565.9 a	793.8 a	170.4 ab	205.0 a	736.3 ab	998.8 a
×60	623.4 a	778.5 a	193.1 a	188.9 ab	816.5 a	967.4 ab
LSD 5%	N S	N S	49.7405	74.7457	238.6524	200.7188
1%	N S	N S	82.5447	124.0411	396.0458	333.0947

Table 3. Effect of plant density on the number of cormels per plant

Plant density (cm)	No. of cormels per plant	
	1979	1980
60×20	3.0 c	3.3 a
×30	4.1 abc	3.5 a
×40	4.8 ab	4.0 a
×50	4.5 abc	3.6 a
×60	5.1 a	4.1 a
LSD 5%	1.8737	N S
1%	3.1049	N S

Table 4. Effect of plant density on the average fresh weight of cormel

Plant density (cm)	Fresh weight/cormel (g)	
	1979	1980
60×20	29.6 a	29.6 b
×30	29.3 a	36.8 ab
×40	33.4 a	39.2 ab
×50	38.9 a	54.6 a
×60	38.1 a	47.8 ab
LSD 5%	N S	21.5739
1%	N S	35.8022

Table 5. Effect of plant density on the plant height of lowland taro

Plant density (cm)	Plant height (cm)	
	1979	1980
60×20	142.3 a	143.3 a
×30	136.9 ab	138.6 ab
×40	135.4 b	138.3 abc
×50	132.8 b	132.8 d
×60	131.1 b	131.0 d
LSD 5%	6.8849	5.2044
1%	11.4255	8.6368

Table 6. Effect of plant density on the yield of lowland taro

(ton/ha)

Plant density (cm)	Main corm		Cormels		Main corm + cormels	
	1979	1980	1979	1980	1979	1980
60×20	35.6 a	55.2 a	7.1 a	8.1 a	42.7 a	63.3 a
×30	29.6 ab	39.3 b	6.5 a	6.9 a	36.1 ab	46.2 b
×40	23.2 bc	32.1 bc	6.4 a	6.2 a	29.6 bc	38.3 bc
×50	18.9 c	26.5 cd	5.7 a	6.9 a	24.6 c	33.4 cd
×60	16.6 c	20.7 d	5.2 a	5.1 a	21.8 c	25.8 d
LSD 5%	9.6202	7.6571	N S	N S	11.0817	9.0330
1%	15.9648	12.7071	N S	N S	18.3902	15.0733

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水芋種植密度對產量之影響[1]

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摘 要

檳榔心芋於1979及1980年分別種植於行距 60公分，株距 20，30，40，50及60公分即每公頃種植83,300株；53,300株；40,000株；33,300株及26,600株等五種不同種植密度之水田，試驗採用逢機完全區集設計四重複，每小區種植6行，行長5公尺，小區面積爲18平方公尺。兩年之試驗結果顯示植株之高度與產量均隨種植密度之增加而顯著增加，然而單株母芋或子芋之大小、鮮重或數目均與種植密度呈負相關之趨勢，母芋之產量或母芋加子芋之總產量均以60公分×20公分即每公頃種植83,300株者爲最高，而以60公分×60公分即每公頃種植26,600株者爲最低，此資料顯示在臺灣南部地區檳榔心芋水田栽培之最適種植距離應爲60公分×20公分即每公頃種植83,300株，此可提供農民種植水田芋頭之依據及學術研究之參考。

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