INFLUENCE OF SOIL, CLIMATIC FACTORS, AND NUTRITIONAL STATUS ON THE PRODUCTIVITY OF YMD X WAT "MAWA" COCONUT HYBRIDS IN THE PHILIPPINES[1]

S.S. Magat, L.M. Alforja, and R.Z. Margate[2]

The yield performance of Ivory Coast (YMD x WAT) hybrid coconuts grown under varied soil and climate conditions in different pilot farms established in the Philippines in 1977 was evaluated.

The YMD x WAT hybrids with balance nutrition produced generally higher nut and copra yields under areas that are coastal and have low typhoon frequency, wet climate, and high soil water holding capacity. These areas are found in Mindanao (Southern Philippines) which is almost typhoon-free and has adequate and uniformly distributed rainfall year-round.

The highest nut production (150 nuts/tree) and highest copra yield (4.3 tons/ha) per year were obtained in the pilot hybrid farm in Sta. Cruz, Davao Sur, Southern Mindanao. Averages of 58 nuts/tree and 1.7 tons copra/ha were produced under the same condition (1981-87 production years).

For future plantings of YMD x WAT hybrids in the country, the conditions cited above should be considered by planners in the choice of the best agronomic advantages and economic interest.

INTRODUCTION

A series of evaluations on the adaptability of the Ivory Coast hybrids tested in pilot hybrid farms (PHF) in the Philippines was conducted since the hybrids were established in 1977. These were the same hybrids intended for the initial replanting program of the government.

Earlier observations revealed that on the basis of growth and precocity, the hybrids generally performed well in areas with more or less even distribution of rainfall (Magat, et al. 1978 and 1979; Prudente et al. 1980; Santos et al. 1982, and Margate et al. 1983). Conversely, the same workers pointed out that the hybrids did poorly under dry areas with uneven distribution of rainfall.

In 1985, Alforja, et al. attempted to include typhoon frequency as another factor affecting the productivity of the hybrids, in addition to land form and climate which were previously considered. They found out that the hybrids appear to be selective with the following seemingly ideal environmental conditions: wet to humid climate with no or low typhoon frequency, and flat lands with good internal and external drainage.

De Nuce Lamothe et al. (1986) cited that PB 121 or "Mawa" hybrids have been tested in 40 countries and found to have a large spectrum of adaptation in almost a hundred different ecologies. In sub-optimal or even marginal conditions, the hybrids still yield higher than the local talls, even if the yields are relatively very low. However, same report mentions that other hybrids are more adapted to specific types of environment. For instance, PB 111 (CRD x WAT hybrids) grown on well drained soils with no water deficit give higher yields than those of the PB 121, but have less tolerance to drought.

This paper, aside from verifying earlier results, also attempts to extract additional information on the importance of soil water holding (retention) capacity as an additional significant factor influencing the production of the YMD x WAT hybrids introduced in the Philippines.

MATERIALS AND METHODS

Source of Data

The yield data obtained from 26 of the 133 Pilot Hybrid Farms (PHF) established in 1977 were used in this study. The YMD x WAT hybrid was chosen in the evaluation because it is the only hybrid that is widely

[1]Presented during the Final Pilot Coconut Hybrid Farm (PHF) Conference, October 1987, PCA-DRC CETC Complex, Davao City.

[2]Manager, Agricultural Research Management Department; Senior Science Research Specialist, Agricultural Research Division; and Chief Science Research Specialist, Agro-soils Division, Philippine Coconut Authority.

represented in the different agro-climatic conditions in the Philippines.

Observations were recorded from 1981 to 1986. The yield characters evaluated specifically were nut production and copra yield.

Methodology

The 26 PHFs shown in Table 1 were grouped based on the following factors:

	Factors	Level	Description	Code
1.	Typhoon frequency (Based on the 20-yr normal values from 1950-1971, PAGASA)	1	Low (0-10%)	I
		2	Medium (11-20%)	
		3	Medium high (21-30%)	
		4	High (31-40%)	
2.	Climate type (Based on Hernandez 1975, PAGASA)	1	Wet: Rainy throughout the year with more than 9 wet months	A
		2	Humid: Rain evenly distributed throughout the year with 7.5 to 9 wet months	B
		3	Moist: Rain sufficiently distributed with 6-7.5 months	C
		4	Dry: Rain not sufficiently distributed, at most 4.5 to 6 wet months; and	D
		5	Arid: More dry than wet months, at most 4.5 wet months	E
3.	Land form	1	Coastal flat	CF
		2	Coastal upland	CU
		3	Inland flat	IF
		4	Inland upland	IU
4.	Soil water holding (retention) capacity (PCARRD 1976)	1	High (clay, clay loam, and sandy clay)	HR
		2	Medium (loam, silty clay loam, and sandy clay loam)	MR
		3	Low (silt loam, sandy loam silt, and gravely loam)	LR
		4	Very low (loamy sand, sand, and stony land)	VLR

RESULTS AND DISCUSSION

Influence of Typhoon

The main effects of typhoon occurrence on the yield performance of the YMD x WAT hybrid are shown in Table 2a. The highest annual mean nut and copra production (51.0 nuts/tree and 1.511 tons copra/ha., respectively) were observed on areas with low typhoon frequency. The average annual maximum yields of 150.7 nuts/tree and 4.258 tons copra/ha were also obtained in the same area. In comparison, low yields were observed on areas with typhoon frequency of medium high to high.

Generally, the performance of YMD x WAT hybrid is negatively influenced by the higher typhoon frequency as shown in Figure 1. This result is consistent with an earlier report (Alforja et al. 1985), supporting that typhoon is a destructive and negative factor in coconut production.

Yield reduction estimates of YMD x WAT hybrid on areas with higher typhoon frequencies are shown in Table 2b. On the average, a reduction of about fifty percent on nut and copra production was noted on areas with typhoon frequencies of medium to high.

Influence of Climate

Shown in Table 3 is the main effect of climate types on the yield performance of YMD x WAT hybrid. The highest annual mean nut and copra production was observed in the wet climate areas with 57.8 nuts/tree and 1.663 tons/ha, respectively. It was also noted that highest maximum yield was observed under the same climate type. The lowest yield was observed in the arid climate, with 14.1 nuts/tree and 0.401 ton copra/ha.

Figure 2 shows how climate exerted a strong influence on the yield. More nuts and copra were produced as climate changed from arid to wet type areas, with the highest produced at the latter. Magat (1977), in an attempt to map Philippine rainfall distribution in relation to coconut suitability, had shown that suitable coconut plantings predominate in areas with no long dry season or with more wet months (most of Mindanao, Eastern Visayas, and Eastern areas of the country). The effect on a normal "Mawa" hybrids grown under said conditions are shown in Figure 3.

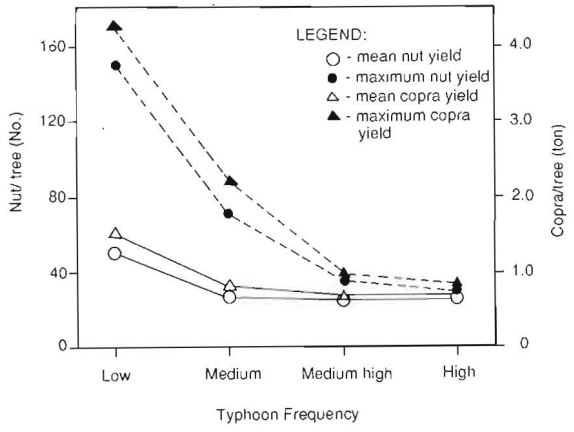

Figure 1. Effects of Typhoon frequency on mean yield of YMD x WAT hybrids.

Region	PHF Location	Soil Condition: Drainage[1] Int.	Drainage[1] Ext.	Soil Texture[2]	WHC[3]	Water Table Depth	Physical Feature: Land Form[4]	Average Elevation	Topography	Climate Type[5]	Typhoon Freq.[6]
I	1. Bauang, La Union	G	G	CL	HR	Shallow	CF	5 m	Flat	E	II
I	2. Sanchez Mira, Cagayan	G	G	Fine S	VLR	Moderate	CF	10 m	Flat	B	IV
I	3. San Andres, Romblon	G	G	Fine S	VLR	Moderate	CF	10 m	Flat	D	III
II	4. Sto Tomas, Batangas	F	G	CL	HR	Moderate	IU	80 m	Flat-rolling	D	III
II	5. Gasan, Marinduque	G	G	L	MR	Moderate	CF	6 m	Flat	B	III
II	6. Calapan, Mindoro Or.	G	G	CL	HR	Moderate	CU	15 m	Flat-rolling	B	III
II	7. General Luna, Quezon	F	G	C	HR	Deep	IF	180 m	Flat	B	III
III	8. Baao, Camarines Sur	G	G	CL	HR	Moderate	IF	80 m	Flat	B	III
III	9. Sn. Mig. Tabaco, Albay	G	G	CL	HR	Moderate	IU	50 m	Flat-rolling	B	III
III	10. Guinlajon, Sorsogon	G	G	CL	HR	Moderate	IU	60 m	Flat-rolling	A	IV
IV	11. Banga, Aklan	F	FG	CL	HR	Moderate	IU	50 m	Flat-rolling	A	I
IV	12. Toledo, Cebu	G	G	Gravelly L	LR	Moderate	CU	40 m	Flat-rolling	A	II
IV	13. Zamboanguita, Neg. Or.	G	G	SiL	MR	Moderate	CF	60 m	Flat-rolling	D	II
V	14. Catbalogan Samar	G	G	CL	MR	Moderate	CU	100-150 m	Steep-Slope	A	II
V	15. San Julian, E. Samar	G	G	CL	MR	Moderate	CF	50 m	Flat-rolling	A	II
V	16. Macrohon, S. Leyte	G	G	C	HR	Moderate	CU	50 m	Flat-rolling	B	II
VI	17. Talisayan, Zambo City	G	G	SiL	MR	Deep	CF	40 m	Flat	B	I
VI	18. Balangasan, Zambo Sur	G	G	CL	HR	Deep	CU	180 m	Flat-rolling	A	I
VI	19. Sindangan, Zambo Norte	F	F	SiL	MR	Shallow	CF	10 m	Flat	B	I
VII	20. Kauswagan, Lanao Norte	G	G	CL	HR	Deep	CU	65 m	Rolling	A	I
VII	21. Medina, Misamis Or.	G	G	L	MR	Moderate	CF	14 m	Flat	A	I
VII	22. Taguibo, Butuan	G	F	CL	HR	Moderate	IF	120 m	Flat	A	I
VIII	23. Mabini, Davao Norte	G	G	CL	HR	Moderate	CF	20 m	Flat	A	I
VIII	24. Santa Cruz, Davao Sur	G	G	C	HR	Moderate	CU	45 m	Flat-rolling	A	I
VIII	25. Mati, Davao Oriental	G	G	C	HR	Moderate	IU	60 m	Flat	A	I
VIII	26. Malapatan, S. Cotabato	G	G	L	MR	Moderate	CF	15 m	Flat	D	I

[1]G-good; FG-fairly good; F-fair
[2]C-clay; L-loam; S-sand; Si-silt
[3]HR-high WHC (Water holding (retention) capacity; MR-medium WHC; LR-low WHC; VLR-very low WHC
[4]CF-Coastal-flat; CU-Costal upland; IF-inland flat; IU-inland-upland
[5]A-wet; more than 9 wet months; B-humid: 7.5 to 9 wet months; C-moist; 6 to 7.5 wet months;
D-dry; 4.5 to 6 wet months;E-arid: lower than 4.5 wet months;
[6]I-low (1-10%); II-medium (11-20%);
III-medium-high (21-30%; IV-high (31-40%).

TABLE 1. Environmental conditions prevailing in the 26 Pilot Hybrid Farms(PHF) in the Philippines (1977-1987)

Typhoon Frequency	N	Nut/tree Mean	Nut/tree Min.	Nut/tree Max.	Copra/ha Mean	Copra/ha Min.	Copra/ha Max.
		Number			Ton/ha		
Low	11	51.0	18.5	150.7	1.511	0.517	4.258
Medium	6	27.1	13.2	72.0	0.831	0.400	2.233
Medium high	7	25.1	13.5	35.5	0.670	0.400	0.970
High	2	25.6	20.8	30.3	0.716	0.570	0.862

[1]Mean of 6-yr production.
N - Number of sample PHFs

TABLE 2a. Main effects of typhoon occurrence on annual mean yield of YMD x WAT hybrid grown in the Philippines[1]

Typhoon Frequency	Nut/tree Mean	Nut/tree %	Copra/ha Mean	Copra/ha %
	Number		Ton	
Low	-	-	-	-
Medium	23.9	46.9	0.680	45.0
Medium high	25.9	50.8	0.841	55.7
High	25.4	49.8	0.795	52.6
Average	25.1	49.2	0.772	51.1

[1]Mean of 6-yr production.
N - Number of sample PHFs

TABLE 2b. Yield reduction estimates of YMD x WAT hybrid at higher typhoon frequency areas

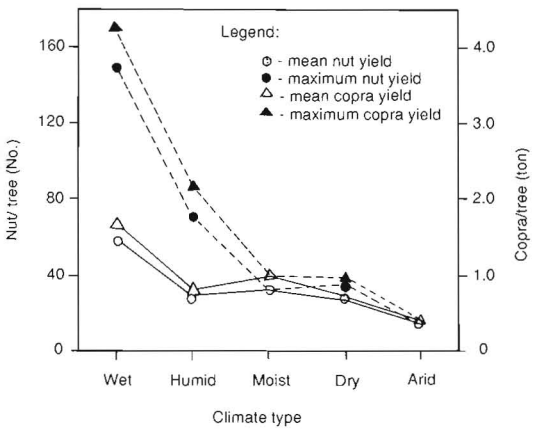

Figure 2. Effects of Climate type on mean yield of YMD x WAT hybrids.

Figure 3. A normal productive MAWA hybrid grown at Pilot Hybrid Farm Sta. Cruz, Davao del Sur.

Climate Type	N	Nut/tree Mean	Nut/tree Min.	Nut/tree Max.	Copra/ha Mean	Copra/ha Min.	Copra/ha Max.
Wet	10	57.8	18.5	150.7	1.663	0.517	4.258
Humid	9	28.9	13.2	70.0	0.836	0.408	2.155
Moist	1	32.0	-	-	0.988	-	-
Dry	5	27.1	13.2	35.5	0.736	0.400	0.970
Arid	1	14.1	-	-	0.401	-	-

[1]Mean of 6-yr production.
N - Number of sample PHFs.

TABLE 3. Main effects of climate on annual mean yield of YMD x WAT hybrid grown in the Philippines

Land Type	N	Nut/tree Mean	Nut/tree Min.	Nut/tree Max.	Copra/ha Mean	Copra/ha Min.	Copra/ha Max.
		Number			T/ha		
Coastal flat	11	42.1	14.1	95.8	1.236	0.401	2.765
Coastal upland	7	36.7	13.5	150.7	1.029	0.408	4.258
Inland flat	3	44.7	22.5	64.2	1.309	0.604	1.938
Inland upland	5	25.0	18.5	49.8	0.645	0.400	1.208

[1]Mean of 6-yr production.
N - Number of sample PHFs.

TABLE 4. Main effects of land form on the annual mean yield of YMD x WAT hybrid grown in the Philippines[1]

Influence of Land Form

The coastal areas produced generally higher yields while inland upland areas had relatively low yields (Table 5). An analyses of the nationwide PCA data (for soil and leaf) confirmed that nut and copra yields of existing stands of coconut (local talls) were generally higher in coastal areas compared to inland areas (Cosico and Fernandez 1983; Magat et al. 1983).

Higher yields obtained in coastal areas could be attributed to better chlorine nutrition (due to nearness to sea water). The beneficial role of chlorine in producing high copra weight per nut and copra yield was reported by several workers (Mendoza and Prudente 1972; Magat et al. 1975; and Margate et al. 1979). Menon and Pandalai (1958) on the other hand, mentioned that higher humidity and more stable temperature in coastal areas explain the higher yield in these areas.

Influence of Soil Water Holding Capacity (WHC)

In terms of mean nut and copra production, the different WHC capacities appeared to influence the YMD x WAT hybrids. The highest maximum nut and copra production were observed on soil with high water holding capacity (Table 5). This indicates that adequate soil moisture is likely required year-round by hybrids to attain high yield of nuts and copra. In this regard, soils with high WHC such as the clay, clay loam, and sandy clay types (having high clay and silt contents) are desirable. This finding support a recent report that among soil properties, only the % silt and % clay of soil positively influence the yields of foreign and local hybrids (Ilagan 1987).

WHC	N	Nut/tree Mean	Nut/tree Min.	Nut/tree Max.	Copra/ha Mean	Copra/ha Min.	Copra/ha Max.
High	15	32.5	13.5	150.7	0.869	0.400	4.258
Medium	8	38.4	13.2	72.0	1.143	0.513	2.234
Low	1	32.0	-	-	0.988	-	-
Very low	2	26.4	17.4	35.5	0.770	0.750	0.970

[1]Mean of 6-yr production.
N - Number of sample PHFs.

TABLE 5. Main effects of soil water holding capacity (WHC) on annual mean yield of YMD x WAT hybrid grown in the Philippines[1]

CONCLUSION

In general, the results clearly indicate that under adequate, balanced nutrition, the YMD x WAT or "Mawa" hybrid produces higher nut yields (70-150 nuts/tree/year) in coastal areas with low typhoon frequency, wet climate, and high soil water holding capacity (WHC). These areas are limited to Mindanao which is almost typhoon-free and has adequate and uniformly distributed rainfall year-round (wet and humid climate types).

In copra terms, the same hybrid under balanced nutrition produced higher yields (2.15-4.26 tons/ha/yr) in the same areas found highly suitable for producing high nut yields. However, in areas with medium typhoon frequency and medium soil WHC, average nut yields of 72 nuts/tree/yr and 2.23 tons copra/ha/yr can be produced if the hybrid is grown in wet climate and on coastal flat land form (as in San Julian, Eastern Samar, and East Visayas).

Hence, for future plantings of the YMD x WAT hybrid in the country, planners must opt not only for the best economic interest, but also the best agronomic advantage and in certain areas of the country, namely, those that are:

1. Under low typhoon frequency (0-10%);
2. With wet to humid climates (rainfall adequate and uniformly distributed year-round);
3. With well drained soils with high water holding (retention) capacity (clay, clay loam, and sandy clay texture);
4. Coastal;
5. With adequate and balanced levels of major nutrients (N, K, Cl, P, Ca, Mg, G, and Na) and micro nutrients (B, Fe, Mn, Zn, and Cu).

ACKNOWLEDGMENT

We, the authors, express our appreciation to the eight Regional Offices of the PCA for providing the field data of this report. To all who supported us in putting up this paper for the interest of coconut development, particularly in using the coconut hybrids for replanting/new planting, our sincerest gratitude.

REFERENCES

ALFORJA, L.M., R.Z. MARGATE and S.S. MAGAT. 1985. Some productivity factors affecting yield performance of YMD x WAT hybrids in the Philippines. Annual Report '85, Agricultural Research, PCA p 70.

COSICO, W.C. 1983. Land and soil utilization of areas planted to coconut (*cocos nucifera*, Linn.) in the Philippines. Thesis Doctor of Philosophy, UPLB.

COSICO, W.C. and N.C. FERNANDEZ. 1983. Effect of some land qualities and soil properties on productivity of coconut in the Philippines. *Phil. J. Coco. S.* 8(1&2):25-30.

DE NUCE LAMOTHE, M and F. ROGNON. 1986. A choice based on results: Hybrids or talls. *Coconuts Today* 4(1):69-70.

ILAGAN, M.C. 1987. Determination of widely adaptable coconut (*cocos nucifera*, L.) genotypes based on soil and climatic factors. MS thesis, UPLB.

MAGAT, S.S., V.L. CADIGAL, and J.A. HABANA. 1975. Yield improvement of coconut in elevated areas of Davao (Philippines) by KCl fertilization. *Oleagineux* 30(10):413-516.

MAGAT, S.S. 1978. An evaluation of early growth response of Ivory Coast hybrids planted in some PCA hybrids farms. First National Conference/Workshop on PHF, Philippine Coconut Authority Davao Research Center.

MAGAT, S.S. et al. 1979. An assessment of the early growth response of Ivory Coast coconut hybrids (dwarf x tall) under different agro-climatic conditions in the Philippines. Second National Conference/Workshop on PHF, PCA Zamboanga Research Center.

MAGAT, S.S. et al. 1983. Mineral nutrition survey of coconut areas in the Philippines. 2. Soil characterization and coconut yield. Annual Report 1983, Agricultural Research, PCA.

MARGATE, R.Z. L.M. ALFORJA, and V.L. CADIGAL. 1983. Growth and early yield performance of IRHO coconut hybrids in the Philippines. Fifth National Conference/Workshop of PHF, Tacloban City.

MENDOZA, A.M.R. and R.L. PRUDENTE. 1975. An influence of NPK fertilization on coconuts. *Proc. Crop Science Soc.* Philippines, May 1972.

MENON, K.P.V. and K.M. PANDALAI, 1958. The coconut palm. A monograph. *Ryarcial*. Fifth ed. India Press, Bombay, India.

PHILIPSON, W.R., M.E. LAYESE, and J.A. MARIANO. 1972. Philippine crop occurrence according to Corona's climate types. *Phil. Agric.* 56:48.

PRUDENTE, R.L. et al. 1980. An assessment of the early growth response of Ivory Coast coconut hybrids (dwarf x tall) under different production suitability classifications in the Philippines. Third National Conference/Workshop on PHF, PCA, Albay.

SANTOS, G.A. et al., 1982. Flowering and early yield performance of four I.R.H.O. hybrids in the Philippines. *Oleagineux* 37(12):571-582.