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Coconut Breeding in Indonesia—II

The Yield Potential of Improved Varieties of Coconut

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ABSTRACT

The analyses of yield data collected from 986 progenies of Indonesian Tall × Indonesian Tall showed their high production capability: 123 nuts/32.29 kg copra per palm/yr. Six of them produced 168 nuts/58.11 kg copra per palm/yr. Two families showed general combining ability and no inbreeding depression. They will be very useful for breeding for high yield of copra.

INTRODUCTION

High-yielding mother palms of Indonesian Tall (IT) (*Cocos nucifera*, var *typica*, form *typica*) have been selected by P. M. L. Tammes from coconut groves in the village gardens near Manado, North Sulawesi Indonesia. He planted their open-pollinated progenies in 1926 and 1927 at the Coconut Experimental Station, Mapanget, North Sula wesi (Tammes, 1958). This constitutes the first generation of palms.

Subsequently, A .F. Innes used the Mapanget population for a crossing programme and planted the progenies between 1957 and 1959 at Kima Atas Experimental Station, near Manado, North Sulawesi—the second generation.

A large number of palms are dead. H. Soedasrip and T. Toar at the Manado Branch of the Lembaga Penelitian Tanaman Industry have collected whatever data available regarding the Kima Atas population of palms and re-constructed the layout of the trials and the numbering of the palms. The results presented in this paper are based on these records. Further, it is a continuation of the series. Coconut Breeding in Indonesia-1 (*Liyanage, etal* 1986).

The climatic conditions at Kima Atas are satisfactory for coconut cultivation. The soil is fertile being of volcanic origin. The plantation has been neglected over the years until management practices with application of NPK fertilizer were introduced in 1975.

MATERIAL AND METHODS

Numbering of palms

The system of numbering of palms adapted by Tammes in the Mapanget population is unique, *eg* 32 g 11, 83 f IV, etc.

32 g II : represents seedling number *g* derived from mother palm number 32 and planted in block number 11.

83 f IV : similarly, seedling *f* from mother 83 planted in block *IV*.

Material

The Kima Atas population is composed on 11 field trials covering 986 palms (Appendix 1). The trials are as follows:

TrialsA I, A II	..	4 half sibs crossed to another half sib and 3 other palms.
,, B I	..	3 half sibs crossed to 2 half sibs and another palm.
,, B II, B III	..	reciprocal crosses between two half sibs.
,, C I	..	6 half sibs crossed to 3 half sibs and 3 other palms.
,, C II	..	5 half sibs crossed to 2 half sibs and 3 other palms.
,, D I, D II	..	4 half sibs crossed to 1 half sib and 3 other palms.
,, E I	..	4 palms crossed to other palms.
,, F I	..	5 palms crossed to other palms.

Half sibs are taken as open-pollinated progenies of a single palm, *eg* half sibs of palm no. 1: I c II, I g III, I h III , etc.

Method of recording

Yield records of the 986 palms at Kima Atas were kept from August 1975 to July 1977. Data recorded at each pick were number of bunches, number of nuts and weight of husked-nuts. Six picks were harvested each year at bimonthly intervals. A sample of 5 husked-nuts taken at random from each pick was weighed. The total weight of husked-nuts at each pick per palm was calculated on the basis of the sample weight. Then 100 husked-nuts taken at random from each trial was weighed and turned into copra. The relationship between husked-nuts and weight of copra was 26 per cent. This ratio was used to convert husked-nut weight into copra.

Prior to commencement of yield recording, it was reported that there was considerable theft of nuts at Kima Atas. In order to reduce the error in yield data due to the loss of nuts, the following procedure was adapted.

Prior to the first yield recording, the bunches on the crown of each palm were numbered serially 1, 2, 3 .... beginning with the oldest bunch and ending with the inflorescence just open. Then the number of fruits/female flowers on each bunch was recorded and was continued at six- monthly intervals.

If there was a loss of nuts or bunches from any palm, an adjustment in the yield data of that palm was made as follows. Say, the bunch marked 10 has been removed. The number of female flowers borne on that bunch is available. The mean percentage of female flowers developed into fruits of the 9th and 11th bunches was calculated and the number of fruits on the 10th bunch was estimated on that basis. The weight of husked-nuts was also recorded on a similar basis. Fortunately as loss of nuts was negligible, it was not necessary to apply this formula.

Statistical analyses

The field trials have been planted in a randomized lay:-out, presumably with an equal number of progenies per treatment. However, due to the neglect of the plantation, a number of palms are dead resulting in fewer than four progenies in some treatments. Consequently statistical analyses was done on a full randomization basis. The statistical analyses was restricted to yield of copra, as it is the most important economic character of the palm. Statistical significance is indicated in the following pages as significant at P=0.05, **significant at P=0.01, ***significant at P 0.001, *ns*=denotes not significant.

RESULTS

The summary of data collected for the two years 1975/76 and 1976/77 is presented in Table 1.

Table 1. *Mean yield of kima atas Trial*

Trial No.	*No. of palms*	*Per Palm Per Year*			*Calculated yield ha/yr*	
		No. of bunches	*No. of nuts*	*Weight of copra(kg)*	*No. of nuts*	*Weight of copra(kg)*
A I	121	15.4	108	29.15	13,284	3,585
A II	118	15.8	124	33.28	15,252	4,093
B I	78	15.3	125	35.35	15,375	4,340
B II	59	15.6	111	25.16	13,653	3,095
B III	42	16.5	130	34.14	15,990	4,199
C I	141	16.3	134	33.33	16,482	4,100
C II	73	15.9	125	31.63	15,375	3,890
D I	50	16.1	119	32.35	14,637	3,979
D II	62	14.9	114	36.61	14,022	4,503
E I	149	16.0	127	30.94	18,161	4,424
F I	93	15.9	124	34.49	15,252	4,242
Population mean	(986)	15.9	123	32.29	15,129	3,972

(Trial E I has 143 palms per hectare, all the others 123 palms per hectare)

The analysis of variance done for each trial separately with respect to copra production, showed that there were significant differences between treatments only in 5 out of 11 trials. They are :

Trial	A	I	:	Cross	B>A*
,,	A	II	:	,,	A, C>D**
,,	C	I	:	,,	E>F*
					A, D>F***
,,	D	I	:	,,	B>C**
,,	E	I	:	,,	A, B, C>G*
					D, E, F>G*

For definition of Cross A, B etc., see Appendix I.

Generally, the out-crossed progenies are superior to those of sib matings.

When the data of 11 field trials at Kima Atas are regrouped, six families could be distinguished, each having selfed and out-crossed progenies (Table 2). Selfed is taken as crosses between half sibs, and out-crossed as crosses between unrelated palms.

eg selfed : I c II × 1 g III
out-crossed : I h IV × 2 e II

Family No 1 has originated from palm No. 1 of IT selected by Tammes from the village groves and similarly for the others.

The out-crossed progenies in families 1,2 and 99 have given significantly more copra than the selfed, indicating a loss in vigour due to selfing.

Table 2. *Data of kima atas palms on a family basis*

Family No.		*No. of Progenies*	*Mean per palm per year* *No. of bunches*	*No. of nuts*	*Weight of copra* *kg*	*t value*	*CV%*	*Inbreeding depsession %*
1 selfed	...	34	16	102	26.43 ± 1.20		26.5	12.4
out-crossed	...	138	16	113	30.18 ± 0.60	2.79**	23.3	
2 Selfed	...	25	16	111	28.89 ± 1.34		23.2	14.1
Out-crossed	...	140	16	128	33.65 ± 0.74	3.11**	26.0	
32 Selfed	...	11	15	120	36.38 ± 2.27		20.7	nill
Out-crossed	...	57	16	110	36.26 ± 1.01	0.02	21.0	
55 Selfed	...	46	16	115	33.44 ± 1.06		21.6	nill
Out-crossed	...	148	15	121	32.62 ± 0.57	0.56	21.4	
83 Selfed	...	49	16	131	35.80 ± 1.01		9.17	nill
Out-crossed	...	98	15	117	35.46 ± 0.83	0.20	23.3	
99 Selfed	...	70	16	123	29.85 ± 0.83		23.2	14.6
Out-crossed	...	147	16	137	34.95 ± 0.60	4.90***	20.7	

Table 3. *Yield data of progenies of reciprocal crosses*

Trial No.	*Cross*	*No. of progenies*	*No. of bunches*	*No. of nuts*	*Weight of copra* *kg*	*t value*	*CV %*
B ll	80 b lll x 80 c lla	27	16	103	23.35 ± 1.00		22.3
	80 c lla x 80 b lll	32	14	116	26.70 ± 1.29	1.25	27.4
B lll	82 f lla x 82 h lla	25	17	129	34.01 ± 1.60		22.0
	82 h lla x 82 f lla	17	18	136	35.36 ± 0.94	0.43	11.0

Table 4. *Exceptionally high-yielding palms at kima atas*

Block No.	*Palm No.*	*Cross*	*Per palm per year* *Bunches*	*Nuts*	*Copra kg*	*Copra per nut (g)*
A ll	276	55 e lla x 55 g lla	15	150	55.69	370
B l	437	83 c lla x 83 f lll	18	173	54.04	310
D l	1,455	31 f IV x 55 g lla	18	180	68.87	380
D ll	1,668	32 g ll x 83 g lll	19	148	52.16	350
D ll	1,686	– do –	18	187	52.90	280
F l	2,379	1205/33 x 1230/33	17	170	64.97	380
		Mean	18	168	58.11	345

There are two field trials covering reciprocal crosses between half sibs (Table 3).

The difference between reciprocal crosses with respect to yield of copra is not significant.

DISCUSSION

Yield potential

The Kima Atas population of palms has given 123 nuts/32, 3 kg copra per palm/yr., equivalent to 15,130 nuts/3,970 kg copra per ha/yr. with a low density of 123 palms per ha. Further, each nut has given 260 g of copra. These figures are generally far above the data for the *typica* palms reported so far for a large population of palms.

The present tendency is to plant 170 palms per ha. The estimated yield of Kima Atas palms on that basis will be about 18,000 nuts ha/yr, after allowing a 15% drop in the yield of the individual palms owing to the higher density of plants.

A population of 5,700 progenies of Sri Lankan Tall × Sri Lankan Tall growing at the Seed Garden in Sri Lanka, has given an average yield (5-year period) of 18,000 nuts ha/yr, with a range of 17,500 to 25,000, under rainfed conditions. The variations are related to the rainfall pattern. The block has 165 palms per/ha.

The Indonesian and Sri Lankan examples cited above clearly demonstrate the high yield potential of improved varieties of the *typica* var of coconuts.

There are six palms amongst the Kima Atas population that have given more than 52 kg copra per palm/yr: (Table 4). They have produced per palm/yr: 18 bunches and 168 nuts /58 kg copra with 345 g copra per nut. The best yielder recorded 180 nuts/69 kg copra per year.

General combining ability

It is possible to assess the general combining ability of a coconut palm by crossing it to a number of unrelated palms and studying the family mean realative to the F 1 population mean.

The Kima Atas population has progenies of half sibs crossed to the other palms, which are distributed over a number of field trials. They are grouped into six families (Table 2). Comparision of the family means (yield of copra) using the 't' test gave the following results:

Family Number ..	32	83	99	2	55	1
32 ..	—	ns	ns	*	**	***
83 ..	ns	—	ns	ns	**	***
99 ..	ns	ns	—	ns	**	***
2 ..	*	ns	ns	—	ns	***
55 ..	**	**	**	ns	—	**
1 ..	***	***	***	***	**	—
Copra per palm (kg) (out-crossed)	36.26	35.46	34.95	33.65	32.62	30.18
Inbreeding depression (%) ..	nil	nil	14.6	14.6	nil	12.4

Yield of copra per palm/yr is not significant between the three families 32, 83 and 99 : 32 has given significantly more copra than 2, 55 and 1; 83 more than 55 and 1. Families 32 and 83 do not show an inbreeding depression (see section 5.3). Further, amongst the best six exceptionally high yielding palms at Kima Atas (Table 4), two of them have been derived by crossing half sibs of 32 and 83. Therefore, the parental palms 32 and 83 could be broadly classified as having general combining ability, broadly because half sibs are involved in the study.

Inbreeding depression

If matings between half sibs are considered to be selfings, then the inbreeding depression could be calculated from the Kima Atas population (Table 2) as follows:

$$\text{Weight of copra of } \frac{\text{outcrossed-inbred}}{\text{outcrossed}} \text{(families)} \times 100$$

The inbreeding coefficient has varied from 0 to 15%. Inbreeding depression was shown in families 1, 2 and 99, but not in families 32, 55 and 83. It could be concluded that the high yield (copra) in the latter group is not due to heterosis effects, probably to the cumulative effect of additive genes.

The selfed and out-crossed progenies of families 32 and 83 have given 10% more copra than the population, but not 55% considering these factors, families 32 and 83 are composed of valuable genetic material, suitable for breeding for high yield of copra and they should be preserved.

The potential of progenies of 32 × 83

Fortunately, there are 24 progenies of the cross 32 f 11 × 83 g III in the Kima Atas population. They have given:

16 bunches per palm/yr

134 nuts ,,

38.95 kg copra ,,

291 g copra per nut

The above production amounts to 16,500 nuts/4,800 kg copra per ha/yr based on the density of 123 palms per ha. It could be assumed that with a larger density of palms, say 170 palms per ha, production will reach 19,500 nuts/5,600 kg copra per ha/yr, allowing a 15% drop in yield per palm due to the higher density.

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Appendix 1. *Planted July* 1957

Trial A I

Cross		*Palm Numbers*									
A 1 c II x 1 g III	—	2	3	4	5	6	7	8	9	10	
B 1 h IV x 2 h IVa	—	51	52	53	54	55	56	57	58	59	60
C 1 c II x 55 g IIa	—	101	102	104	105	107	108	110			
D 1 g III x 36 g IIa	—	151	152	155	156	158	159	153			
B 1 h IV x 2 h IVa	—	61	62	63	64	65	66	67	68	69	70
C 1 c II x 55 g IIa	—	112	113	114	115	117	118	119			
D 1 g III x 36 g IIa	—	161	164	165	166	167	169				
A 1 c II x 1 g III	—	11	12	13	14	15	16	17	18	19	20
C 1 c II x 55 g IIa	—	121	122	124	125	126	127	128	129	130	
D 1 g III x 36 g IIa	—	171	173	174	176	178					
A 1 c II x 1 g III	—	21	22	23	24	26	27	30			
B 1 h IV x 2 h IVa	—	71	72	73	74	75	76	78	80		
D 1 g III x 36 g IIa	—	182	189								
A 1 c II x 1 g III	—	33	35	38							
B 1 h IV x 2 h IVa	—	81	82	83	85	86	88	89			
C 1 c II x 55 g IIa	—	132	135	139							
A 1 c II x 1 g III	—	41	44	46	48	50					
B 1 h IV x 2 h IVa	—	95	99								
C 1 c II x 55 gb IIa	—	144	145	146	148						
D 1 g III x 36 g IIa	—	194									

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Trial A II

Cross		*Palm Numbers*								
A 55 f IVa x 55 g IIa	—	201	202	203	207	208	210			
B 55 e IIa x 55 g IIa	—	251	252	255	256	259	260	253		
C 55 c IIa x 99 i IIa	—	301	303	304	305	306	307	308	309	
D 55 e IIa x 83 f II	—	351	352	353	354	355	356	357	359	360
B 55 e IIa x 55 g IIa	—	261	262	263	264	269	270			
C 55 c IIa x 99 i IIa	—	311	312	314	315	316	317	318	320	
D 55 e IIa x 83 f II	—	361	364	365	366					
A 55 f IVa x 55 g IIa	—	211	215	217						
C 55 c IIa x 99 i IIa	—	321	322	324	335	326	327	329		
D 55 e IIa x 83 f II	—	371	375	376	377	378	380			
A 55 f IVa x 55 g IIa	—	221	222	223	224	225	230			
B 55 e IIa x 55 g IIa	—	271	273	274	276	277	279	280		
D 55 e IIa x 83 f II	—	382	383	385	388	390				
A 55 f IVa x 55 g IIa	—	240								
B 55 c IIa x 55 g IIa	—	281	282	283	285	288	290			
C 55 c IIa x 99 i IIa	—	331	333	334	335	336	337	339	340	
A 55 f IVa x 55 g IIa	—	249	250							
B 55 e IIa x 55 g IIa	—	295	296	297	299	300				
C 55 c IIa x 99 i IIa	—	342	343	344	345	346	347	348	349	
D 55 e IIa x 83 f II	—	391	392	393	394	395	396	398	399	400

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Trial B I

Cross			*Palm Numbers*							
A 83 c II	x 83 g III	—	401	402	405	407	409			
B 83 f II	x 83 f IV	—	451	456	457					
C 83 f IV	x 55 c II	—	501	502	504	508	509			
A 83 c II	x 83 g III	—	414	415	417	419				
C 83 f IV	x 55 c III	—	511	513	514	516	517	519		
B 83 f II	x 83 f IV	—	462	463	470					
A 83 c II	x 83 g III	—	421	422	423	424	425	427	429	430
B 83 f II	x 83 f IV	—	472	474	478	480				
C 83 f IV	x 55 c IIa	—	521	522	523	524	526	527	529	
B 83 f II	x 83 f IV	—	481	482	483	485	487	490		
C 83 f IV	x 55 c IIa	—	533	535	536	537	540			
A 83 c II	x 83 g III	—	431	432	434	435	436	437	440	
C 83 f IV	x 55 c IIa	—	543	544	546	547	548	549		
A 83 c II	x 83 g III	—	443	444	445	446	447	450		
B 83 f II	x 83 f IV	—	491	493	495	499	500			

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Trial B II

Cross			*Palm Numbers*								
A 80 b IIIa	x 80 c IIa	—	552	554	555	557	558	559			
B 80 c IIa	x 80 b IIIa	—	603	605	606	607	609	610			
A 80 b IIIa	x 80 c IIa	—	564	565	566	567	568	569			
A 80 c IIa	x 80 b IIIa	—	611	612	613	615	616	617	618	619	620
A 80 b IIIa	x 80 c IIa	—	572	577	578	579	580				
B 80 c IIa	x 80 c IIIa	—	621	622	623	626	628	629	630		
A 80 b IIIa	x 80 c IIa	—	583	586	587	598					
B 80 c IIa	x 80 c IIIa	—	631	633	634	636	638	640			
A 80 b IIIa	x 80 c IIa	—	591	592	595	596	598	600			
B 80 c IIa	x 80 b IIIa	—	642	645	649	650					

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Trial B III

Cross			*Palm Numbers*					
A 82 f IIa	x 82 h IIa	—	631	632	633	635	636	638
B 82 h IIa	x 82 f IIa	—	710	706				
A 82 f IIa	x 82 h IIa	—	661	662	663	666	670	
B 82 h IIa	x 82 f IIa	—	714	720				
A 82 f IIa	x 82 h IIa	—	673	675	676	680	674	
B 82 h IIa	x 82 f IIa	—	726	728	729	730		
A 82 f IIa	x 82 h IIa	—	682	684	685	687	690	
B 82 h IIa	x 82 f IIa	—	732	736	740	739		
A 82 f IIa	x 82 h IIa	—	693	696	698	699		
B 82 h IIa	x 82 f IIa	—	741	744	746	747	750	

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Trial C I

	Cross		*Palm Numbers*									
A	99 i IIa x 2 h IVa	—	851	852	853	854	855	857	858			
B	99 f IVa x 99 g IIIa	—	901	902	903	904	908	909	910			
C	99 f IIa x 99 h IIa	—	951	952	954	959	960					
D	99 f IIa x 36 g IIa	—	1001	1008	1009							
E	99 f IVa x 2 d IIIa	—	1054	1055	1057	1058	1060					
F	99 i IIa x 99 f IVa	—	1101	1102	1106	1108	1109					
E	99 f IVa x 2 d IIIa	—	1061	1063	1068							
D	99 f IIa x 36 g IIa	—	1011	1014	1016	1019						
F	99 i IIa x 99 f IVa	—	1114	1115	1119	1120						
B	99 f IVa x 99 g IIIa	—	911	912	913	914	916	917	918	919	920	
C	99 f IIa x 99 h IIa	—	961	962								
A	99 i IIa x 2 h IVa	—	861	863	864	865	866	867	868	869		
C	99 f IIa x 99 h IIa	—	972	973	974	975	977	978				
A	99 i IIa x 2 h IVa	—	871	872	873	874	875	876	877	878	880	
B	99 f IVa x 99 g IIIa	—	925	927	930							
E	99 f IVa x 2 d IIIa	—	1071	1075	1076	1079						
F	99 i IIa x 99 f IVa	—	1122	1123	1124	1125	1126	1127	1128	1129	1130	
D	99 f IVa x 36 g IIa	—	1022	1023	1024	1027	1028	1029	1030			
F	99 i IIa x 99 f IVa	—	1140									
E	99 f IVa x 2 d IIIa	—	1083	1085	1086	1087	1089	1090				
D	99 f IIa x 36 g IIa	—	1031	1033	1034	1037	1039	1040				
C	99 f IIa x 99 h IIa	—	982	984	986	989						
B	99 f IVa x 99 g IIIa	—	934	938								
A	99 i IIa x 2 h IVa	—	881	884	885							
B	99 f IVa x 99 g IIIa	—	945	946	947							
F	99 i IIa x 99 f IVa	—	1148									
C	99 f IIa x 99 h IIa	—	991	993	996	997	998	999	1000			
E	99 f IVa x 2 d IIIa	—	1091	1095	1098	1099	1100					
A	99 i IIa x 2 h IVa	—	892	894								
D	99 f IIa x 36 g IIa	—	1042	1045	1046	1049	1050					

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Trial C II

	Cross		*Palm Numbers*									
A	2 d IIIa x 2 h IVa	—	1153	1155	1156	1157	1158	1160				
B	2 c IIa x 2 h IIa	—	1208	1209	1210							
C	2 d IIIa x 1 h IV	—	1252	1254	1256	1258	1259	1260				
D	2 h IVa x 99 g IIIa	—	1301	1302	1304	1306	1308					
E	2 h IIa x 1 g III	—	1357									
B	2 c IIa x 2 h IIa	—	1213	1216	1218	1219						
C	2 d IIIa x 1 h IV	—	1261	1262	1263	1264	1265	1266	1267	1268	1269	
D	2 h IVa x 99 g IIIa	—	1311	1314								
E	2 h IIa x 1 g III	—	Pohon belajar berbuah									
A	2 d IIIa x 2 h IVa	—	1164									
C	2 d IIIa x 1 h IV	—	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280
D	2 h IVa x 99 g IIIa	—	1322	1323								
E	2 h IIa x 1 g III	—	1377									
A	2 d IIIa x 2 h IVa	—	—									
B	2 c IIa x 2 h IIa	—	1222	1224	1226	1229						
D	2 h IVa x 99 g IIIa	—	1333	1335	1336	1337	1339					
E	2 h IIa x 1 g III	—	1381									
A	2 d IIIa x 2 h IVa	—	Tak ada tanaman									
B	2 c IIa x 2 h IIa	—	1233	1235								
C	2 d IIIa x 1 h IV	—	1282	1285	1286	1287	1288					
E	2 h IIa x 1 g III	—	1399									
A	2 d IIIa x 2 h IVa	—	1193	1194	1198	1200						
B	2 c IIa x 2 h IIa	—	1243	1247								
C	2 d IIIa x 1 h IV	—	1291									
D	2 h IVa x 99 g IIIa	—	—									

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Trial D I

Cross				Palm Numbers								
A	31 a Ia	x 31 f IV	—	—								
B	31 f IV	x 83 f II	—	1452	1454	1455	1457	1458	1499			
C	31 a Ia	x 1 c II	—	1501	1502	1503	1506	1507	1509	1510		
D	31 f IV	x 55 g IIa	—	1552	1553	1555	1556	1557	1558	1559		
B	31 f IV	x 83 f II	—	1461	1462	1463	1364	1365	1466			
C	31 a Ia	x 1 c II	—	1511	1513	1514	1516	1515	1517	1518	1519	1520
D	31 f IV	x 55 g IIa	—	1561	1564	1565	1566	1567	1568	1569	1570	
A	31 a Ia	x 31 f IV	—	1418	1419	1420						
C	31 a Ia	x 1 c II	—	1522	1523	1524	1525					
D	31 f IV	x 55 g IIa	—	1575	1579							
A	31 a Ia	x 31 f IV	—	—								
B	31 f IV	x 83 f II	—	—								

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Trial D II

Cross				Palm Numbers							
A	32 g II	x 32 i IV	—	—							
B	32 g II	x 83 g III	—	1656	1658	1659					
C	32 g II	x 2 h IV	—	1701	1702	1705	1709				
D	32 i IV	x 99 f IIa	—	1751	1753	1754	1755	1758	1759		
B	32 g II	x 83 g III	—	1661	1662	1663	1664	1665	1668		
C	32 g II	x 2 h IV	—	1713	1714	1715					
D	32 i IV	x 99 f IIa	—	1761	1762	1764	1765	1770			
A	32 g II	x 32 i IV	—	1616							
C	32 g II	x 2 h IV	—	—							
D	32 i IV	x 99 f IIa	—	1771	1772	1775					
A	32 g II	x 32 i IV	—	1621	1624						
B	32 g II	x 83 g III	—	1671	1672	1673	1674	1676	1679		
D	32 i IV	x 99 f IIa	—	1781	1787						
A	32 g II	x 32 i IIa	—	1631	1632	1634	1637	1640			
B	32 g II	x 83 g III	—	1681	1682	1683	1684	1686	1687	1688	1689
C	32 g II	x 2 h IV	—	—							
A	32 g II	x 32 i IV	—	1646	1648	1650					
B	32 g II	x 83 g III	—	1691	1692	1694					
C	32 g II	x 2 h IV	—	—							
D	32 i IV	x 99 f IIa	—	1791	1794	1796	1799	1800			

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Trial E I

Cross		*Palm Numbers*
A 3163 XXXII x 3165 XXXII	—	1802 1805 1807 1808 1809 1810 1811 1812 1814
		1815 1816 1817 1818 1821 1822 1823
B 3181 XXXII x 3183 XXXII	—	1856 1858 1859 1862 1863 1868 1869 1871 1874
C 3181 XXXII x 1171 XXXIII	—	1908 1909 1912 1916 1923 1924
D 3163 XXXII x 1231 XXXII	—	1960 1963 1964 1965 1966 1971 1972 1973 1975
		1978 1979 1980
E 3183 XXXII x 1922 XXXII	—	2008 2010 2011 2012 2014 2015 2017 2019 2022
		2028
F 3165 XXXII x 31 a Ia	—	2061 2063 2065 2066 2070 2072 2073 2074 2075
		2077 2078 2079 2081 2082
G 3183 XXXII x 31 a Ia	—	2120 2124 2129 2131 2132
H 3163 XXXII x 32 g II	—	—
B 3181 XXXII x 3183 XXXII	—	1878 1879 1880 1881 1886 1888 1889 1890 1891
		1894
C 3181 XXXII x 1171 XXXIII	—	1931 1932 1934 1935 1938 1939 1940 1941 1943
		1944 1948
D 3163 XXXII x 1231 XXXIII	—	1983
F 3165 XXXII x 31 a Ia	—	2086 2087 2088 2090 2091 2092
G 3183 XXXII x 31 a Ia	—	2138 2143 (2140 hampir roboh)
E 3163 XXXII x 32 g II	—	—
A 3163 XXXII x 3165 XXXII	—	1824 1826 1829 1831 1833
E 3183 XXXII x 1922 XXXII	—	—

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Trial F I

Cross		*Palm Numbers*
A 1205 XXXIII x 1231 XXXIII	—	2323 2324 2330 2332
B 1205 XXXIII x 1230 XXXIII	—	2366 2369 2371 2372 2373 2374 2375 2376 2377
		2378
C 1231 XXXIII x 3163 XXXII	—	2413 2415 2417 2419 2421 2422
D 1922 XXXIII x 3183 XXXII	—	2456 2461 2465 2466 2467 2468 2462
E 1922 XXXIII x 1171 XXXIII	—	2499 2506 2508 2513
F 628 XXXIII x 1990 XXXIII	—	2545 2547 2548 2549 2553
G 1171 XXXIII x 32 g II	—	2591 2592 2593 2595
B 1205 XXXIII x 1230 XXXIII	—	2379 2382 2383 2384 2390 2392
C 1231 XXXIII x 3163 XXXII	—	2425 2428 2430 2432 2433 2434 2435 2436 2438
D 1922 XXXIII x 3183 XXXII	—	2477 2478 2479
E 1922 XXXIII x 1171 XXXIII	—	2515 2516 2517 2521 2522 2523 2524 2525 2526
		2528
F 628 XXXIII x 1990 XXXIII	—	2561 2566 2569
G 1171 XXXIII x 32 g II	—	2604 2605
A 1205 XXXIII x 1231 XXXIII	—	2334 2336 2337 2338 2339 2340 2341 2345 2346
		2347
C 1231 XXXIII x 3163 XXXII	—	2443 2444 2446 2447
D 1922 XXXIII x 3183 XXXII	—	2484 2485 2489 2490 2491 2492
E 1922 XXXIII x 1171 XXXIII	—	2530
F 628 XXXIII x 1990 XXXIII	—	—
G 1171 XXXIII x 32 g II	—	—
A 1205 XXXIII x 1231 XXXIII	—	—
B 1205 XXXIII x 1230 XXXIII	—	—