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農業研究

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內　容

微量元素對水稻苗床之影響
第一報　單獨施用微量元素對水稻幼苗生育之效果…… 徐　水　泉…… 1
猪蛔蟲驅除試驗（第四報）…… 陳耀錕・李永基……16
本所甘藷新育成種在北部試作成績…… 繆進三・林清秀・彭武勳……22
白色來航第一產卵年卵之增重研究…… 李　登　元……37
稻系統發生的分化
Ⅱ. 品種間什種不稔性之關係（英文）…… 岡　彥　一……50

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微量元素對水稻苗床之影響

第一報　單獨施用微量元素對水稻幼苗生育之效果

徐　水　泉

一、緒　言

近來許多學者研究結果(117)，證明某些元素，其量雖微少，但對於植物——至少對於某種植物，仍絕對必要的，倘此等元素缺如或不足時，植物則不能正常發育或營養遭受阻碍(1～7)，因而發生特殊病徵(8～21)。又據許多學者報告，適當施用此等元素，不但使植物生長良好，而且能達增收之目的(22～98)。

此等元素原來在植物體內之含有量極微，故稱爲『微量元素』，又因其效用有如 Vitamin、Hormon、Enzyme 等之作用，故又稱爲『觸媒元素』(99)。此等微量元素之中，以B、Cu、Mn、Zn等四元素之效果最堪注目，且實際上施用此等元素，已獲相當效果(100～105)，如硼素對甜菜之效果，即爲顯著之例證(106)。

目前微量元素對植物生育效果之研究，實不僅在純粹科學立場上爲重要，而且對栽培者及肥料製造者間亦爲急待明瞭之問題。因此研討微量元素對某種作物之效果，並進而將所得結果作實際應用，實爲現今肥料學上新課題之一。關於此等微量元素對水稻生育之效果，過去雖有試驗報告(107～116)，但其試驗所用微量元素皆施用於本田，至於將微量元素施於秧田時對水稻生育及收量之效果如何，則尚欠明瞭，仍待試驗研究，假如施用於秧田之效果，能與本田者相同，則經費及勞力均可節省，而其利用價值亦愈大。

本試驗之目的，乃爲闡明單獨施用微量元素於秧田時，如何影響水稻幼苗之生育。茲就下列兩項加以探討。

(1) 對水稻幼苗生育之效果；(2) 揷秧後對水稻生育及收量之效果。

本試驗在民國33年舉行，當時因情形特殊，所以試驗調查多項未盡理想，故所得之結果難免不無粗雜之感，然微量元素效用問題，近來各方咸認爲極關重要，爰將各項試驗結果加以整理，爲文發表，以供參考。當舉行本研究時，蒙前臺北帝大農學部教授德岡松先生（現任日本名古屋大學農學部教授）的指導，附此誌謝。

茲將其所得結果報告於下：

二、實　驗　之　部

本試驗於民國33年第一、二兩期作先後兩次以盆栽試驗方法舉行，供試微量元素爲 Mn、Cu、

B、Zn等四元素，土壤爲第三紀砂岩頁岩質，稻種爲臺中65號。

實驗一

本試驗於民國33年第一期作舉行，微量元素之種類及其用量如第1表：

第1表　微量元素種類及其用量

種類	用量 p.p.m.							
Mn	—	—	1	5	10	—	20	50
Cu	—	0.5	1	5	10	15	—	—
B	0.1	0.5	1	5	10	—	—	—
Zn	—	—	1	5	10	—	20	50

Mn……$MnSO_4 \cdot 7H_2O$　　Cu……$CuSO_4 \cdot 5H_2O$

B……$Na_2B_4O_7 \cdot 10H_2O$　　Zn……$ZnSO_4 \cdot 7H_2O$

每盆盛土壤 (pH=6.3)5kg 作爲苗床，不加肥料，然後分別加入第一表所列之各種微量元素，於民國33年2月4日播種，3月10日將各用量區之幼苗移植於另一盆中，每3枝爲一株，移植後經常觀察生育狀況並調查產量，又移植時就各用量區採取幼苗100枝舉行下列各項調查，其結果如下：

1. 對幼苗生育之效果：

爲明瞭施用微量元素對水稻幼苗生育之效果如何，將上述各苗床中採集一個月之幼苗 100枝，分別調查株高、葉數、根長、根數、稈長及生體重等項，其結果如第 2 表(表中數字係平均值)：

第2表　幼苗生育調查

元素	用量 (p.p.m.)	株高 (cm.)	葉數	根長 (cm.)	根數	生體量(g.)
Mn 區	1	20.6	3.0	3.6	6.0	0.20
	5	19.8	3.0	5.8	7.4	0.15
	10	17.5	3.5	6.2	14.0	0.24
	20	20.3	5.0	8.2	14.0	0.44
	50	22.2	4.1	4.2	14.0	0.29
Cu 區	0.5	22.9	4.0	4.0	5.0	0.17
	1	15.7	4.0	2.0	9.0	0.18
	5	19.2	4.0	4.5	7.0	0.20
	10	16.7	4.0	4.0	10.0	0.24
	15	17.5	3.9	6.2	10.0	0.25
B 區	0.1	19.0	3.5	4.8	6.0	0.20
	0.5	19.2	3.2	8.0	9.0	0.19
	1	17.0	4.0	6.1	14.0	0.29
	5	19.0	3.5	4.8	5.9	0.22

	10	9.4	3.1	2.9	4.4	0.10
Zn 區	1	17.0	3.1	2.6	6.0	0.19
	5	17.5	3.2	4.7	11.0	0.19
	10	26.0	5.0	4.0	9.0	0.19
	20	19.4	4.3	7.2	10.0	0.29
	50	18.0	4.0	4.9	7.0	0.29
標準區		17.0	4.1	3.3	9.0	0.21

據上列結果，可知 Mn10、20、50，Cu 10、15， B 1、5 及 Zn 20、50等區，其生體量均比標準區優良，株高有 Mn 20、50，Cu 0.5、1.5，B 5，Zn10、20、50 等區，除Cu施用區外，所有生體量及株高兩項之結果，大致有相同之傾向，葉數與生體量大體相同，根長除 Cu 1、B 10、Zn、20 等三區外，其他各區均比標準區長，根數除 Mn.10、20、50等區外，大致與標準區同。

總之，施用微量元素確能促進水稻幼苗之生育，但其程度與施用量多寡，並無平行關係。

Ⅱ. 對插秧後水稻生育及收量之效果：

爲明瞭施用微量元素於苗床，對於插秧後幼苗之生育及收量之效果如何，使用上述之幼苗實行以下之盆栽試驗。

1. 土　　壤：第三紀砂岩頁岩質細壤土， pH=6.3，每盆5g.。
2. 肥　　料：硫酸鋅3.5714g.，過磷酸石灰（19.5%）3.2257g.。
   硫酸鉀(48%) 0.925g. 等與每盆之土壤混和。
3. 移　　植：民國33年3月10日每叢植苗3枝。
4. 管理及收穫：試驗爲 2重複，放置於玻璃室內，經常注意灌水、除草及防除病蟲害，生育期中進行調查，8月20日收穫。

茲將試驗結果摘錄如下：

(a) 生育調查結果：

第3表 生 育 調 查 (一)

元素	用量 (p.p.m.)	4月10日		4月20日		5月3日		5月17日		5月31日	
		株高 (cm.)	分蘖	株高 (cm.)	分蘖	株高 (cm.)	分蘖	株高 (cm.)	分蘖	株高 (cm.)	分蘖
Mn 區	1	31.2	3	44.7	3.5	64.7	8.0	85.8	17.0	102.7	20.0
	5	26.8	3	40.3	3.0	60.3	6.5	72.2	12.5	93	17.5
	10	34.2	3	43.5	4.0	65.3	8.5	80.2	20.5	93.6	23.0
	20	40.7	3	50.8	4.5	73.5	8.0	84.5	21.5	102.5	24.5
	50	44.6	3	54.9	9.0	79.5	12.5	83.6	26.0	100.7	27.5
Cu 區	0.5	30.9	3	42.5	4.0	67.8	7.5	86.4	18.0	10.5	21.0
	1	31.7	3	43.1	4.0	69.2	8.5	89.1	20.5	109.3	24.5

	5	41.2	3	53.7	7.5	81.0	11.5	92.9	24.0	107.0	25.0
	10	41.3	3	50.8	7.0	75.2	10.5	99.2	26.0	104.5	28.5
	15	41.9	3	52.8	9.0	76.8	13.0	86.2	27.5	100.0	28.5
B 區	0.1	28.7	3	41.2	3.0	65.7	8.0	84.5	19.0	102.0	20.0
	0.5	35.4	3	44.5	3.0	67.5	7.0	80.0	18.0	100.0	22.5
	1	37.3	3	47.1	7.0	70.1	11.5	82.3	28.0	100.5	29.5
	5	16.9	3	27.8	1.0	48.9	2.0	58.4	6.5	77.1	7.0
	10	3月16日枯死		—	—	—	—	—	—	—	—
Zn 區	1	29.0	3	41.9	4.0	58.8	7.5	80.8	18.5	94.3	21.5
	5	30.1	3	41.8	3.5	61.0	6.5	82.0	17.5	98.7	19.5
	10	38.5	3	49.8	8.0	72.0	11.0	80.2	24.0	99.8	25.0
	20	40.1	3	52.0	7.0	79.8	12.0	89.5	25.4	107.0	26.5
	50	38.6	3	52.8	8.5	74.0	11.0	84.1	25.0	105.6	27.0
標準區		42.5	3	54.8	10.5	82.1	15.0	90.0	24.5	100.1	25.0

第3表 生育調查（二）

元素	用量 (p.p.m.)	6月14日			6月28日			7月12日			8月2日			出穗期
		株高 (cm.)	分蘖	出穗	株高 (cm.)	分蘖	出穗	株高 (cm.)	分蘖	出穗	株高 (cm.)	分蘖	出穗	
Mn 區	1	109.2	20.0	0	115.7	17.0	5.5	117.2	20.0	18.0	117.5	20.0	18.5	6月26日
	5	114.7	18.5	0	113.0	19.0	0	119.4	21.0	10.0	124.0	19.0	17.0	7月5日
	10	103.2	22.5	0.5	114.2	22.0	17.0	115.0	22.5	22.0	115.0	23.0	22.0	6月19日
	20	114.5	23.5	4.5	114.8	23.0	19.0	115.5	26.0	24.0	114.5	26.0	24.0	6月4日
	50	113.0	26.5	8.5	115.2	25.5	25.0	115.4	27.0	26.0	116.0	27.0	26.0	6月3日
Cu 區	0.5	109.8	20.5	0	113.7	19.0	6.0	119.0	21.0	18.0	119.0	28.0	18.0	6月24日
	1	125.0	24.0	0.5	128.8	21.5	3.0	127.5	22.5	15.0	123.0	23.0	15.0	6月8日
	5	117.9	23.5	8.5	122.0	24.0	22.0	116.7	24.0	21.0	119.0	23.0	21.0	6月4日
	10	119.5	26.5	5.0	121.8	25.5	20.0	119.3	26.0	22.0	122.3	27.0	26.0	6月7日
	15	112.5	28.0	8.5	112.6	29.5	24.0	116.0	29.5	25.0	112.2	29.5	25.0	6月4日
B 區	0.1	109.0	22.5	0	119.5	20.5	6.0	116.3	21.0	19.0	121.3	22.0	19.0	6月20日
	0.5	109.7	20.5	0	114.3	19.5	5.0	117.7	20.0	18.0	116.0	20.0	18.0	6月26日
	1	113.9	28.5	2.5	115.7	27.0	17.0	115.5	28.0	27.0	115.5	28.0	27.5	6月12日
	5	94.0	7.5	0	104.5	10.5	3.0	115.4	15.0	9.0	116.0	15.0	9.0	6月22日
	10	—	—	—	—	—	—	—	—	—	—	—	—	—
Zn 區	1	105.0	22.0	0	112.0	20.5	0	116.6	20.5	19.0	115.0	20.5	17.0	7月2日
	5	106.5	19.5	0	113.2	16.0	2.0	116.0	17.5	17.0	115.5	17.5	17.5	6月20日

	10	109.2	25.0	3.0	115.4	19.0	12.0	116.5	23.5	22.0	116.5	23.5	22.0	6 月 5日
	20	121.6	23.0	5.0	116.0	17.5	15.0	115.8	18.0	17.0	115.5	18.0	17.0	6 月 5日
	50	112.7	25.5	7.5	113.9	25.0	24.0	114.4	26.5	25.0	113.5	26.5	25.0	6 月 5日
標準區		114.8	20.5	11.0	115.7	20.5	20.0	115.2	22.5	21.0	115.0	22.5	21.0	6 月 7日

依收穫當日所調查之結果，Mn10、20、50， Cu 10、15，B 1，Zn 10、50 等之收量比標準區顯著優良，出穗期除 Mn 1、5、10，Cu 0.5，B 0、1、1.5，Zn1、5 等區外，大體與標準區相同。

(b) 收穫物調查：

收穫物調查之結果，如第4表及第5表：

第 4 表

元素	用量 (p.p.m.)	地上部 (g.)			地下部(g.)	總計(g.)	地上部/地下部	根長(cm.)
		穗	藁	計	根			
Mn 區	1	27.8	38.5	66.3	28.0	94.3	2.36	34.1
	5	24.5	42.0	66.5	30.1	96.6	2.21	35.6
	10	28.2	43.0	71.2	31.8	103.0	2.23	33.4
	20	28.3	41.5	69.8	28.0	97.8	2.49	29.1
	50	30.0	49.5	79.5	31.0	110.5	2.56	31.5
Cu 區	0.5	28.0	43.5	71.5	26.5	98.0	2.69	30.0
	1	26.0	42.1	68.1	28.9	97.0	2.35	31.0
	5	28.3	46.5	74.8	31.5	106.3	2.37	32.7
	10	29.4	51.0	80.4	36.5	116.9	2.20	33.8
	15	28.5	49.0	77.5	39.0	116.5	1.98	30.1
B 區	0.1	25.6	39.5	65.1	32.3	97.4	2.01	31.0
	0.5	33.3	44.5	77.8	28.5	106.3	2.72	39.3
	1	37.2	51.0	88.2	31.5	119.7	2.80	38.5
	5	18.1	21.0	39.1	15.6	54.7	2.50	20.0
	10	枯死						
Zn 區	1	35.2	45.0	80.2	34.0	114.2	2.35	31.4
	5	34.6	47.0	81.2	32.0	113.6	2.55	40.0
	10	26.9	48.0	74.9	37.0	111.9	2.02	42.5
	20	24.9	37.0	61.9	32.0	93.9	1.93	31.6
	50	28.0	42.5	70.5	39.0	109.5	1.80	32.6
標準區		24.3	38.5	62.5	28.5	91.3	2.20	33.5

第 5 表

元素	用量 (p.p.m.)	有效分蘖	籾		糀		計（穀實）		每穗穀實	
			數	量(g.)	數	量(g.)	數	量(g.)	數	量(g.)
Mn 區	1	17	1,132	22.9	0	0	1,132	22.90	66	1.34
	5	17	1,388	21.5	0	0	1,388	21.50	81	1.26
	10	22	9,940	21.8	104	0.55	1,098	22.35	49	1.02
	20	24	1,202	23.8	0	0	1,202	23.80	50	0.99
	50	24	1,182	28.2	0	0	1,182	28.20	49	1.17
Cu 區	0.5	19	1,220	22.7	0	0	1,220	22.70	64	1.19
	1	16	892	22.7	103	0.69	990	23.39	62	1.46
	5	20	1,346	24.4	43	0.05	1,389	24.09	69	1.20
	10	27	1,352	25.6	32	0.25	1,384	25.85	51	0.95
	15	21	1,253	25.1	0	0	1,253	25.10	59	1.19
B 區	0.1	20	1,065	20.3	0	0	1,065	20.30	53	1.01
	0.5	19	1,282	24.5	97	0.70	1,379	25.20	72	1.32
	1	29	1,479	29.5	31	0.10	1,510	29.60	52	1.02
	5	9	484	10.8	352	2.20	0,836	13.60	92	1.44
	10	枯死	—	—	—	—	—	—	—	—
Zn 區	1	20	1,409	29.5	70	0.75	1,479	30.25	74	1.51
	5	20	1,376	31.0	122	0.90	1,498	31.90	75	1.59
	10	22	1,170	25.0	0	0	1,170	25.00	53	1.13
	20	17	904	22.0	221	1.50	1,125	23.50	66	1.38
	50	22	1,135	25.8	101	0.50	1,236	26.30	56	1.19
標準區		17	1,059	22.5	0	0	1,059	22.50	62	1.32

據收量調查結果，可知穗重方面除 B：5施用區外，其他比標準區優良，而 Mn 20、50，Cu 10、15，B 0.5、1 及 Zn 1、5 等施用區之成績尤爲卓著，略與生育調查之結果，有平行之關係。

稻葉方面除 B 5、Zn：20外，其他均比標準區良好，根重除 Mn 1、Cu 0.5及 B 5 之施用區外，其他均比標準區優良，穀實數量以 B 5及 Zn 20 之施用區較高，籾方面則難見出其關係，但大體言之，穀於籾重顯示平行關係。

若以上述結果，予以論斷，實嫌過早，不過由此可知施用微量元素對幼苗有優良之影響，即施用 Mn1~50p. p. m. 及 Cu0.5~15p. p. m. 等範圍內，其效果程度的差異較少，B0.1~10p. p. m. 範圍內，以較少量時爲良好，超過 5 p. p. m. 則效果不良，10 p. p. m. 時則枯死；Zn 之效果據本報告所列之用量時，其差異不顯著。

Ⅱ. 苗床土壤反應

苗床土壤pH值用銻電極法測定之，其結果如第6表：

第 6 表　苗床土壤pH值

	用量 p. p. m.	KCl 處理液	H_2O處理液
Mn 區	1	5.4	6.4
	5	5.5	6.6
	10	5.5	6.7
	20	5.6	6.5
	50	5.4	6.4
Cu 區	0.5	5.3	6.3
	1	5.2	6.4
	5	5.3	6.5
	10	5.4	6.6
	15	5.5	6.7
B 區	0.1	5.6	6.6
	0.5	5.6	6.2
	1	5.5	6.3
	5	5.7	6.4
	10	5.4	6.5
Zn 區	1	5.1	6.4
	5	5.2	6.5
	10	5.5	6.3
	20	5.6	6.4
	50	5.4	6.5
標準區		5.5	6.3

如以上之施用量對 pH 之變化，極少影響。

實　驗　二

爲謀充分明瞭實驗一之結果，在民國33年第二期舉行本試驗，試驗方法與前次實驗所不同之處，乃在田間觀察插秧後之影響及變更微量元素之施用量(如第7表)。

第 7 表

種	類		用量 p. p. m.			
Mn	—	—	—	—	20	50
Cu	—	—	10	15	—	—
B	1	—	—	—	—	—
Zn	1	5	—	—	—	—

註：各種微量元素之使用形態與實驗一相同。

苗床之準備與實驗一相同，即係加入上列各種微量元素與用量而不施肥料。

民國33年7月26日以臺中65稻種播種，同年8月10日每株移植3枝秧苗，此次田間試驗在臺大農場舉行，每試驗區面積爲5坪，2區制，每區挿植216株，9月18日除草，同年11月28日收穫，至於田間每區施用之肥料種類及用量則如下：

硫酸錳0.629kg.，過燐酸石灰0·709kg.，過燐酸石灰0.709kg.，硫酸鉀0.278kg.。

施肥方法除對照區按慣行方法表層施用外，其他皆依全層施用法在挿秧前使用之，田間試驗爲2區制。

1．對幼苗之影響：

民國33年8月7日自各區苗床幼苗100枝分別調查其成績如下：

第8表　幼苗生育調查平均結果

區別		株高 (cm.)	葉數	根長 (cm.)	根數	生體量(g.)
Mn 區	20	25.2	4.0	5.1	16.0	0.20
	50	29.2	3.7	7.0	15.0	0.20
Cu 區	10	29.0	4.0	8.0	12.0	0.20
	15	26.0	4.0	7.8	11.0	0.30
B 區	7	27.6	4.0	8.2	14.0	0.20
Zn 區	1	29.0	3.0	6.4	12.0	0.20
	5	28.0	4.0	11.0	20.0	0.30
標準區		25.8	4.0	10.6	11.0	0.15

由上表結果，可知施用微量元素區之幼苗，其生育情形大概比標準區優良。

Ⅱ．挿秧後之影響：

自上項各苗床所採之幼苗，按前述之條件舉行田間試驗，其所得結果如第9表第10表：

第9表

區別		每株收量 (g.) 藁	粒	穗數	每穗穀粒(g.)
Mn 區	20	25	23.2	12.4	1.87
	50	25	21.1	14.4	1.46
Cu 區	10	27.5	20.9	12.9	1.62
	15	26	23.2	13.4	1.73
B	1	32.5	23.9	14.7	1.62
Zn	1	24	17.9	11.9	1.50
	5	25	19.0	12.4	1.53
慣行標準區		30	18.4	12.8	1.44
全層標準區		27	18.9	12.9	1.47
無肥區		16	13.5	6.7	2.01

第10表　每區全收量

區別		藁 (kg)	籾(kg)	(比較數)
Mn 區	20	3.95	2.74	(105)
	50	4.62	2.67	(100)
Cu 區	10	4.15	2.97	(112)
	15	4.93	3.23	(121)
B 區	7	5.85	3.90	(147)
Zn 區	1	3.54	2.68	(101)
	5	4.30	2.84	(107)
慣行標準區		5.40	2.33	(87.6)
全層標準區		5.10	2.66	(100)
無肥區		1.92	1.87	(70.3)

依第9表結果而言，穀之產量除 Zn 1 p. p. m. 外，其他各區均比標準區優良，由第10表之全收量觀之，大致與第 9 表之結果有平行關係，因此可知施用微量元素於苗床，其幼苗移植於田間後，皆有促進生育及增加收量之效果。

Ⅲ. 苗床土壤之反應：

苗床土壤之pH值用銻電極法測定，其結果如第11表：

第11表　苗床土壤 pH 值

區別		KCl 處理液	H_2O處理液
Mn 區	20	5.1	6.8
	50	5.3	6.2
Cu 區	10	5.4	6.5
	15	5.5	6.3
B 區	1	5.3	6.2
Zn 區	20	5.6	6.4
	50	5.2	6.8
慣行標準區		5.4	6.4

由上述結果觀之，施用各種不同微量之元素區或不同用量之同一微量元素區之土壤，其 pH 值之差異均極少。

Ⅳ. 實地觀察：

田間試驗施行中，曾爲實地調查生育情形，並將肉眼觀察加以記載。茲將其所得結果摘錄於下，以供參考。

第一次觀察(民國33年9月9日)。

除無肥料區外，其優劣之差異，似難覺察，概其株高葉色，彼此間大致相同。

第二次觀察(民國33年10月9日)。

本次觀察結果，各區間之差異稍爲顯著，其生育情形：無肥料區最劣，B區最優，Cu、Mn 區次之，而以標準區比較，則各施用區之葉色濃，株高長，祇有 Zn區比標準區稍劣。又按施肥方法比較，則慣行法之對照區比全層施肥對照區株高較低，葉色略淡，而除少數例外，大體本次調查時各區均有出穗整齊之感。

第三次觀察(民國33年11月9日)。

各區穀實已相當充實，無肥區生育最衰弱，B區良好，其他各區大致相同，至本次調查爲止，各區均已齊穗。

三、檢　討

本文乃單獨施用微量元素對水稻生育之影響之試驗報告，檢討內容分：(1)對稻幼苗生育之效果；(2)對幼苗移植後生育及收量之效果。本試驗舉行兩次。

第一次用盆栽法，第二次爲田間試驗法。

綜合以上各表所列之結果，除極少特殊情形外，大體言之，凡單獨施用微量元素，對水稻幼苗不論在揷秧前後之生育狀況及穀實之產量，均有優良之效果，如實驗一及實驗二皆表現有平行關係，不過本試驗之進行，因設備困難，既如前述，故此項資料僅爲豫備試驗之結果，至於精密之重複試驗，當有待今後繼續舉行，關於苗床土壤性質之檢討，僅調查 pH 值之變化一項，此外均未舉辦，本試驗中所用之各微量元素施用量對作物生育上最重要之 pH 值，均無顯著變化，尤其對作物生育上極少有致命之影響，但是連用微量元素情形之下，對土壤 pH 值之變化如何，此點尚未有明確瞭解，仍有待日後詳細探討；至於施用微量元素何以有此優良效果一節，僅就本試驗中之調查數字仍欠明瞭，此項問題自有檢討之必要，現在繼續試驗中，容日後再爲文發表。

四、摘　要

本試驗之主要結果茲摘錄如下：

(1) 單獨施用微量元素對幼苗揷秧前後生育及穀實收量均有顯著優良效果，其適量範圍爲：Mn 20~50p. p. m.，Cu 10—15p. p. m.，B 1 p. p. m.，Zn 1—5 p. P. m.。

(2) 穀實收量之效果，茲以百分率比較其結果，按標準爲100時，Mn 20 P. P. m. 施用區爲105，50p. p. m. 區爲101，Cu 10 p. p. m. 區爲 112，15p. p. m. 區爲 121，B I p. p. m. 區爲147，Zn 1 p. p. m. 區爲 101，5 p. p. m. 區爲107。

(3) 苗床土壤反應就上述施用量範圍內，影響極小。

EFFECTS OF SOME MINOR ELEMENTS ON THE NURSERY BED OF RICE PLANTS

I. Effects of its single application on the growth of rice seedlings

By
S. C. Shyu

Summary

This paper is intended to acertain the effectibility of some minor elements which were separately applied in the soil on the growth of young rice seedlings. There are two sections of this experiment being concerned: (1) the effectibility on the young seedlings after application of the minor elements; (2) the effectibility on the paddy rice after transplantation from the nursery. The experimental results were briefly stated as follows:

(1) It is obviously significant that after a separately single application of different minor elements the young seedlings have grown much better than the check area either in the nursery bed or in the paddy field. Moreover, better yields could also be obtained rather than that of the untreated area. The available amounts of the minor elements applied in this experiment were Mn 20-50 p.p.m., Cu 10-50 p.p.m., B 1 p.p.m., Zn 1-5 p.p.m. respectively.

(2) Among the different treatments the results as compared with the untreated area (assume the index in the untreated area being 100%) were: 105% and 101% yields in the Mn of 20 p.p.m. and 50 p.p.m. respectively. At the same time, 112% and 121% of Cu with 10 p.p.m. and 15 p.p.m.; 147% of B with 1 p.p.m.; 101% and 107% of Zn with 1 p.p.m. and 5 p.p.m. being obtained.

(3) The minor elements which have been applied as above amounts, were studied of very little reaction on the soil of the nursery bed. (From the Laboratory of Soils and Fertilizers, Taiwan University.)

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猪蛔蟲驅除試驗(第四報)

陳　耀　錕　　李　永　基

(一) 緒　言

猪蛔蟲成爲養猪業者一大威脅，衆所週知，而氟化鈉具有驅蛔卓越效力，亦係確固之事實。本藥試用以爲猪之驅蛔，獲有良好成績，始於 Miller (1944)、Habermann(1945)兩氏後美國對此一藥復作進一步研究，知其驅蟲效力曾達90%。若據 Allen (1945)、Morgan(1947)及 Turk & Fred(1948)諸氏試用方法，乃於乾燥混合飼料內加入1%之氟化鈉，經24小時自由採食，未見何等副作用，並得90—100%之驅蟲率。

惟東方各國，如日本等，養猪給飼方法與美國迥不相同，美國爲乾燥飼料，日本爲水溶性者，按氟化鈉見水立溶，可使毒力增加，若依照美國方法，難合實用，故於1949年有伊藤等氏將美國方法改爲適合日本習尙，以仔猪體重每 kg 給與氟化鈉0.08gm 成猪每 kg 給與0.05gm，混於練餌內，連續四次投與，驅蛔成績亦甚佳良。筆者等曾以本省中國獸醫藥物廠出品之甲號畜蟲散，內含純氟化鈉70%提供試驗，知其成績不亞外來，且有使用方便之優點（請參閱臺灣畜牧獸醫第一卷第一二期猪蛔蟲之驅除試驗）。

但以該藥散須與練餌混同合用，不甚適合本省一般養猪習，尙經與中國獸醫藥物廠洽商，製成一種於水難溶，於胃液可以溶解，適與水溶性飼料混用而無練餌之麻煩，卽所謂「乙號畜蟲散」者，提供試驗，知其確具上列性能，但驅蟲效力稍遜（請參閱猪蛔蟲驅除試驗第三報　農業研究　第二卷第三期），嗣再告知該廠，經其再度改良，乃於最近製成一種效力較完全之畜蟲散提供筆者就各級猪隻加以試驗結果，方稍滿意，而成績亦頗優良，用特提出報告如下。

(二) 試驗材料及方法

(A) 試驗材料：

(1)供試之猪隻係農業試驗所飼育中之仔猪成猪姙娠及哺乳母猪各種。

(2)供試藥品係中國獸醫藥物廠所製造之畜蟲散（主成份爲氟化鈉 Sodium Fluoride 純含量15%）。

(B) 試驗方法：

(1)首先檢查糞便中之蟲卵(塗抹法)，將檢有蛔蟲卵之成猪（50kg以上者）分成三組，仔猪

(50kg以下) 分成二組，妊娠與哺奶母猪各一組。

(2)投藥前以不絕食與亦不減食爲原則，投藥後亦無須用瀉劑。

(3)投藥量成猪體重每kg每次藥量分爲0.04gm、0.05gm及0.06gm等三組，仔猪分爲0.07gm及0.0975gm兩組，妊娠及哺奶母猪爲0.05gm各一組，上述各組除成猪部分用0.04gm一組連續投藥五次外，其餘全部均爲連續投藥四次者。

(4)投藥方法以平日喂用之水溶性飼料，取其沈澱較濃部分一杓，混入上藥給與，待其混藥之飼料吃完爲止，再將其餘者全部給食，如是連用四次或五次，每次間隔時間與平日喂飼之時間同。

(5)投藥後第七天及第十四天分兩次檢查其糞便，有無蟲卵及驅出蟲數，依其結果計算其效力。

(三) 試驗成績

(A) 乙號畜蟲散對成猪蛔蟲驅除試驗成績

供試成猪14頭，分成三組，每組按各猪體重每Kg每次給與氟化鈉量計第一組 0.04 gm，第二組 0.05gm，第三組 0.06gm，獨第一組投藥次數爲五次，其目的在求其副作用之輕減，故將每次投藥量減低而代之爲增加其投藥次數，但其總投藥量仍與第二組同，其試驗成績如第一表。

第一表　畜蟲散對成猪蛔蟲驅除試驗成績 (1951)

猪別	體重每公斤每次投氟化鈉量	投藥次數	驅蟲後之排出蟲數						驅蟲後之蟲卵檢查		副作用	驅蟲效力
			第一天	第二天	第三天	第四天	第五天	合計	七天後	十四天後		
B 257 ♀	0.04gm	5		1	2	4	4	11	無	無	無	
B 973 ♀	〃	〃			4			4	〃	〃	〃	
B 2072 ♀	〃	〃			3	1		4	〃	〃	〃	
B 2905 ♀	〃	〃		5	23			28	〃	〃	〃	
B 2937 ♀	〃	〃	1	3	1	2		7	〃	〃	〃	100%
B 152 ♂	0.05	4			3	3		6	〃	〃	〃	
B 239 ♀	〃	〃			9	5		14	〃	〃	〃	
B 3076 ♀	〃	〃		3	3			6	〃	〃	〃	
○ 389 ♀	〃	〃			4	2		6	〃	〃	〃	
B 2982 ♀	〃	〃			8	6		14	〃	〃	〃	100%
B 190 ♂	0.06	〃		2	4			6	〃	〃	〃	
B 393 ♂	〃	〃		2	4	1		7	〃	〃	〃	
Y 2 ♀	〃	〃			2	2		4	〃	〃	嘔吐一回	
B 1507 ♀	〃	〃		4	4			8	〃	〃	無	100%

註：(1)猪別欄內(B)代表盛克夏猪，(什)代表什種猪，(Y)代表約克夏猪。
(2)其中有一頭曾發生嘔吐一次，但未發生何等副作用，想係該猪敏感之故。

根據上表每次投藥量每kg定爲0.05gm，經連續四次投與，既未發生何等副作用，且具100%之驅蟲效力，故認成猪之驅蛔自以採用該組之份量爲適當。

(B) 畜蟲散對仔猪蛔蟲驅除試驗成績

以患有蛔蟲症之仔猪9頭，分成兩組，其中一組體重每kg每次給與氟化鈉量爲0.075gm，經四次連續投與，但驅蟲效力不過 60%；另一組則以氟化鈉含量每kg投與 0.0975gm，所得效力曾達100%，，其成績如第二表。

第二表　畜蟲散對仔猪蛔蟲驅除試驗成績 (1951)

猪別	體重每公斤每次投氟化鈉量	投藥次數	驅蟲後之排出蟲數						驅蟲後之蟲卵檢查		副作用	驅蟲效力
			第一天	第二天	第三天	第四天	第五天	合計	七天後	十四天後		
什 178 ♀	0.075gm	4		6	21	1		31	無	有	無	
〃 183 ♂	〃	〃		8	1	2		11	〃	無	〃	
〃 184 ♂	〃	〃		12	4	2		18	〃	〃	〃	
〃 185 ♂	〃	〃		1	3	1		5	有	有	〃	
〃 186 ♂	〃	〃			4			4	無	無	〃	60%
〃 178 ♀	0.0975	〃		1				1	無	無	〃	
〃 180 ♀	〃	〃		8	1			9	〃	〃	〃	
〃 182 ♀	〃	〃		8				8	〃	〃	〃	
〃 185 ♂	〃	〃		2	1			3	〃	〃	〃	100%

若據第二表每次投藥量猪體重每kg可用氟化鈉0.0975gm，經連續四次投與，知有100%之驅蟲效力，同時對仔猪並無何等副作用。

(C) 畜蟲散對妊娠及哺乳中母猪之蛔蟲驅除試驗成績

一般養猪業者向視妊娠以及哺乳中母猪等同珍寶，故對可否使用驅蟲藥劑均存畏懼心理，茲次經筆者等試以用於成猪之驅蛔藥量，應用於上述猪隻，成績尚稱滿意，所得結果如第三表。

第三表　畜蟲散對妊娠及哺乳母猪之蛔蟲驅除試驗成績 (1951)

猪別		體重每公斤每次投氟化鈉量	投藥次數	驅蟲後之排出蟲數						驅蟲後之蟲卵檢查		副作用	驅蟲效力
				第一天	第二天	第三天	第四天	第五天	合計	七天後	十四天後		
妊娠猪	Y 2 ♀	0.05gm	4		2	2			4	無	無	無	
	B 81 ♀	〃	〃		4	1			5	〃	〃	〃	
	B119 ♀	〃	〃		4		2		6	〃	〃	〃	100%
哺乳母猪	桃101 ♀	〃	〃		2	1			3	〃	〃	〃	
	海144 ♀	〃	〃		2	3			5	〃	〃	嘔吐一次	100%

註：(1)(B)(Y)同第一表(桃)代表桃園種猪(海)代表海南島種猪。
(2)其中有嘔吐者一頭係一時敏感作用並無其他副作用發生。

若照第三表知妊娠及哺乳母猪以成猪驅蟲藥量與方法並無何等副作用，且具100％，驅蟲效率但，以例數不多，不無遺憾，然若能善爲注意，予以應用，對斷絕生產仔猪感染源一端認爲有益無害，頗有採用之價值。

(D) 畜蟲散對各級種猪隻之蛔蟲驅除有效量

依據第一第二第三各表成績，特將仔猪成猪妊娠及哺乳母猪之最小完全驅蟲藥量簡列如下表：

第四表　畜蟲散對各級各種猪隻之猪蛔蟲驅除最小有效量　1951

猪別	體重每公斤每次所需之氯化鈉 (gm)	畜蟲散1粒每次可用之猪體重 (kg)	投藥次數	副作用	驅蟲效果
成猪(50公斤以上)	0.05	3.0	4	無	100%
仔猪(50公斤以下)	0.0975	1.54	〃	〃	〃
妊娠猪	0.05	3.00	〃	〃	〃
哺乳母猪	0.05	3.00	〃	〃	〃

照第四表成猪(50kg以上)體重每Kg每次給與氟化鈉量爲0.05gm，妊娠哺乳母猪用量亦相同，仔猪(50kg以下)爲0.0975gm，給與方法乃以平日喂用之水溶性飼料取其沈澱較濃部份一杓，與上藥混合給食，視其吃完爲止，然後再將其餘之未食全部飼料繼續給與，如是連用四次，可得驅蟲藥效100％，但本藥使用時偶有發生一過性(一時性)下痢者，實際上與猪體毫無妨碍，而且稍瞬即止，蓋此作用不獨有助排蟲，甚至有後下劑作用，唯妊娠與哺乳母猪使用該藥時應特加注意，若論其成效亦可到達100％，同時有斷絕生產仔猪感染源之優點，然對其他寄生蟲則無效，併此附及。

(四) 考　察

猪蛔蟲之驅除試驗爲筆者等過去三年間之接續工作。茲將其前後所發表各報加以總括，並將各種藥品對猪蛔蟲驅除優劣略加比較，以爲檢討，其情形如下表：

第五表　猪蛔蟲驅除各種藥品之優劣與價格比較(以猪體重30kg爲標準)

藥品別	每次投藥量	投藥次數	投藥需要日數	後下劑之種類及總量	驅蟲效力	所要費用	備考
乾燥檳榔子	9gm	3	8	野生喇叭花(アサガホ)之生花 720gm	80%	不要	投藥方法不便且須相當忍耐但在臺灣年可採收兩次而又到處可以取得只要農家青花時間無須破費金錢可得相當驅蟲效果
山道年 Santonin	0.2gm	2	2	硫酸鎂 60gm	100%	9.0元	本藥原可稱爲驅除蛔蟲之王座但以投藥不便投藥前既須絕食投藥後又須下劑即小量亦不易購入
氟化鈉 Sodium Fenoride	2.4gm	4	2	不要	100%	4.5元	所費雖低但不能與含水之飼料混同使用對臺灣一般養猪法不能適用
畜蟲散	3.0gm 20粒	4	2	不要	100%	6.7元	費用低，使用簡便，可與水溶性飼料相混與即對妊娠哺乳各猪亦能應用

註：(1) 表中所列費用一欄係按民國40年12月市價計算者。

(2) 其他記錄係依據筆者等前後所作猪蛔蟲驅除試驗第一、二、三、四各報告節略而來者。

如就第五表所示各種驅蛔藥品之優劣檢討時，畜蟲散之於臺灣養豬業者堪稱使用最簡便成本頗輕而效力頗優之藥品，惟農民若能不惜勞力節省金錢轉而採用土產之檳榔子及野生鮮喇叭花（野生アサガホ）以供驅蟲之用，亦可得80%之驅蛔效力，若山道年及氟化鈉因有使用不便及不經濟等關係，已詳諸備考欄內，實對臺灣養豬飼養法不甚適合，不無缺點，認爲無採用價值。

（五）結　　論

使用氟化鈉發端於美國，改換投藥法於日本，再改善於臺灣，知其效力極佳，總以本省養豬習尚均用水溶性飼料，欲達實用理想地域，非加改善不可，茲次屢經改革，乃有一種理想之畜蟲散，經試驗於各豬，知有簡便與經濟及效果等優點，用將其結果綜錄如下：

(1) 成豬(包括姙娠及哺乳母豬)體重每Kg每次使用氟化鈉含量爲 0.05gm 換算畜蟲散粒數，即每3kg體重用一粒，仔豬體重每Kg每次使用氟化鈉含量爲0.0975gm，即每體重1.54kg使用畜蟲散一粒。

(2) 投藥方法係以平日喂用之水溶性飼料，取其中沈澱較濃部分一杓滲入上述藥量混與給食，視其吃完爲止，再將其餘應飼之全料，繼續給食，如是連續四次，可獲驅蟲藥效 100%，至取其較濃部分，目的在使豬喜食濃料之故，且可減失無謂損耗，期達藥效之完全量，但對其他寄生蟲並不奏效，併此附及。

(3) 副作用方面，僅於投藥中偶有一二頭發生一過性(即一時性)下痢者，且稍俟即止，並無其他妨碍，與健康更絲毫無損，又此作用不獨有助排蟲，並有後下劑之好處。

(4) 姙娠以及哺乳母豬使用是藥應加細心注意，但結果亦至佳良，驅蟲成績亦可達 100%，且對生產之仔豬有斷絕感染源之優點。

(5) 投藥前無須絕食或減食，投藥後亦無須下劑。

(6) 投藥所需費用與手續包括下劑等均較山道年等爲廉便，對於臺灣養豬喂飼習慣尚稱適合。

（六）參 考 文 獻

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STUDIES ON THE MEDICAL TREATMENT OF ROUNDWORM IN PIGS

No. 4

Y. K. Cheng By Y. C. Lee

Summary

Soldium flouride was first adopted in America, then making an improvement in Japan and Taiwan with the Anti - Pigworm powder as its excellent result. By the preceding test, it not only has an extraordinary effects but also convenient and economic.

(1) Dose

For pigs, conceived or suckled, it is 0.05 gm. of soldium flouride per kg. of its own weight, or one tablet of anti- pigworm- powder per 3 kgs. of its own weight in equivalence. As for young pigs, it is 0.0975 -gm. per or one tablet per 1.54 kgs.

(2) Administration

Take a little thicker portion from the soluble feed, mixing with a certain dose as stated above for feed, then furnish the remainder. After four times successive administrations, it gains a hundred percent effect in expelling the worms.

(3) Reaction

No evidence of reactions except a slight diarrhea which does not effect the health condition and causes no damage. This slight diarrhea is more beneficial to the expelling of wormeggs.

(4) Summary

(a) Highly careful should be required for fhe administration to the conceived or suckled pigs, and their infants can no longer be injected.

(b) Pigs should be fed as usual before administration and requires no purgative after administration.

(c) It is more convenient and economic in comparison with santonin.

本所甘藷新育成種在北部試作成績

繆進三　林清秀　彭武勳

一、**緒言**：臺灣甘藷爲次于米及甘蔗之重要農作物，甘藷育種，自民國11年開始，本以農試所嘉義分所爲中心，在民國17年有新育成種發表，謂之臺農種，其後迄民國25年，普及仍甚遲緩，改良種甘藷，不過佔全省甘藷總栽培面積 14.75％，據光復前本所日籍技士大崎忠一估計，其普及程度平均20－30％，各地區之普及率如下所示：

高雄區20％，臺南區60％，臺中區20％，新竹區10％，臺北區５％，但據嘉義分所民國37年發表各地區之普及率如下：

臺農種栽培面積平均佔全省甘藷田57.40％，其中臺北縣佔25.3％，新竹縣佔26％，臺南縣佔78％，高雄縣佔57％，花蓮縣佔72.9％，臺東縣佔68.4％，澎湖縣佔 42.7％，全產量約爲30億臺斤。臺農種雖有其優點，即澱粉量較高，收量亦豐，但以生育期間較長，不耐瘠薄土地，以及貯藏中易于腐敗，在本省北部甘藷多植于丘陵地，土地瘠薄，晚熟種一二月間收穫時，適值雨季，不適于製簽，生藷貯藏，臺農種較易變質(據農民口述)，故限制其在北部普及之程度，觀上列數字，臺北及新竹僅達25％左右，可爲例證。

甘藷栽培，在本省各區所佔耕地總面積比率如次：

高雄區	19.3％	臺南區	37.5％	臺中區	14.0％
新竹區	15.3％	臺北區	10.0％	其　他	4.7％

依據以上耕地面積，甘藷生產地帶分爲三個區域，如下所示：

區域	包含範圍	栽培品種名
北部地區	臺北區及新竹區	臺農3號，9號，17號，31號，七十日早，鐵線藤，
中部地區	臺中區及臺南區北部	臺農3號，9號，17號，31號，五斤種，白和蘭，
南部地區	臺南區南部及高雄區	臺農3號，9號，17號，31號，番種，嘉義種，

北部地方，風土不同，臺農種並未十分普及，故農家仍多植在來種，而以鐵線藤爲最廣。光復以後，36年開始，本所甘藷育種着重適應北部地方之品種，以在來種、美國種及臺農種爲什交父母本，希望就在來種予以改良，經選擇結果，有數品種較對照種爲優，爰于40年秋分區舉行適應性試驗，以期測定各品種在各地之生產力及適應性。

二、**試驗進行情形**

試驗地點：臺北在臺灣省農業試驗所，桃園在省立桃園農校，新竹在新竹區農林改良場，關西在縣立關西農校，苗栗在省立苗栗農校。

試驗品種：(1) P13*（臺農27號×美國黃皮） (2) P21*（臺農27號×鐵線藤）

(3) P30*（臺農47號×鐵線藤） (4) P46*（臺農44號×美國黃皮）

(5) 臺農10號 (6) 臺農31號 (7) 本地種

* 記號者爲光復後本所新育成種。

P 爲 Provincial 之代號

試驗方法：每小區面積60平方尺，行長20市尺，行距3市尺。株距1市尺，每品種單行區，重複4次，採用隨機排列，每試驗連保護行共5公畝，每小區施肥量如下：

肥料種類	基肥	追肥
堆肥	12kg.	0
硫酸鉀	40 g.	40 g.
過磷酸石灰	66 g.	0
硫酸鉀	34 g.	34 g.

化學肥料由本所供應，堆肥由合作機關自籌。插植後10天補苗，插植後1個月除草。將畦之兩邊掘開，曝晒1天，施用追肥後再行培土，恢復畦之原來高度爲止。

插植後6個月收穫，本試驗以臺農種及本地種爲標準種，試驗期間自民國40年8月中旬迄41年2月中旬。本地種參加試驗者，臺北、苗栗用鐵線藤，桃園、關西用五斤種，新竹用七十日早，臺農種參加試驗者，爲適應性最强之臺農31號，以及過去認爲在南部最豐產之臺農10號。

三、各地區試驗結果

試驗記錄表（1）臺北省農試所

		每小區生莖葉重 (kg)	收穫株數 (株)	每小區大塊根數 (個)	每小區小塊根數 (個)	每小區總塊根數 (個)	每小區大塊根重 (kg)	每小區小塊根重 (kg)	每小區總塊根重 (kg)	備考
第一重複	P13	7.870	19	16	107	123	2.300	3.300	5.600	
	P21	8.520	14	15	34	49	5.630	2.170	7.800	
	P30	5.340	18	47	33	80	16.570	1.570	18.140	
	P46	7.110	17	38	68	106	8.980	3.830	12.810	
	臺農10號	5.970	18	24	55	79	4.630	2.170	6.800	
	臺農31號	7.940	20	51	42	93	14.190	3.050	17.240	
	鐵線藤	5.300	20	41	70	111	11.740	3.740	15.480	
第二重複	P13	8.030	17	14	55	69	1.990	1.480	3.470	
	P21	6.590	18	15	36	51	3.770	1.540	5.310	
	P30	6.360	18	44	46	90	14.100	2.780	16.880	
	P46	7.750	19	36	80	116	6.900	3.090	9.990	
	臺農10號	9.990	18	15	46	61	2.670	2.450	5.120	
	臺農31號	7.730	20	43	80	123	10.950	4.380	15.330	
	鐵線藤	5.640	18	52	46	98	10.950	2.680	13.630	

第三重複	P13	9.320	19	4	102	106	0.690	3.750	4.440	
	P21	11.400	17	31	70	101	8.290	3.990	12.280	
	P30	4.700	20	45	48	93	14.580	2.260	16.840	
	P46	7.290	19	42	68	110	8.260	3.630	11.890	
	臺農10號	5.120	19	20	72	92	3.470	3.270	6.740	
	臺農31號	8.000	18	44	74	118	12.350	3.540	15.890	
	鐵線藤	5.080	20	59	63	122	14.740	2.740	17.480	
第四重複	P13	7.500	20	23	56	79	3.010	2.540	5.550	
	P21	10.740	20	34	59	93	8.220	3.540	11.760	
	P30	7.310	20	49	33	82	16.240	1.240	17.480	
	P46	7.960	20	61	51	112	11.290	1.440	12.730	
	臺農10號	10.000	20	33	47	80	4.670	2.020	6.690	
	臺農31號	10.860	20	44	43	87	12.600	2.800	15.400	
	鐵線藤	6.910	19	49	54	103	11.110	2.390	13.500	
四重複合計	P13	32.720	75	57	320	377	7.990	11.070	19.060	
	P21	37.250	69	95	199	294	25.910	11.240	37.150	
	P30	23.710	76	185	160	345	61.490	7.850	69.340	
	P46	30.110	75	177	267	444	35.430	11.990	47.420	
	臺農10號	31.080	75	92	220	312	15.440	9.910	25.350	
	臺農31號	34.530	78	182	239	421	50.090	13.770	63.860	
	鐵線藤	22.930	77	201	233	434	48.540	11.500	60.090	

臺北本所產量分析表

(一) 產量表(每小區公斤數)

品種名 \ 重複	I	II	III	IV	品種總和	平均數
P13	5.600	3.470	4.440	5.550	19.060	4.77
P21	7.800	5.310	12.280	11.760	37.150	9.29
P30	18.140	16.880	16.840	17.480	69.340	17.34
P46	12.810	9.990	11.890	12.730	47.420	11.86
臺農10號	6.800	5.120	6.740	6.690	25.350	6.34
臺農31號	17.240	15.330	15.890	15.400	63.860	15.97
鐵線藤	15.480	13.630	17.480	13.500	60.090	15.02
區組總和	83.870	69.730	85.560	83.110	總和=322.270	

(二) 變量分析表

變因	自由度	平方和	變量	F值	5%F	1%F
區組間	3	22.82	7.61	3.98*	3.16	5.09
品種間	6	573.70	95.62	49.80**	2.66	4.01
機誤	18	34.50	1.92			
總和	27	631.02				

*差異顯著　**差異十分顯著

(三) 差異比較表

品種		P 30	臺農31號	鐵線藤	P 46	P 21	臺農10號
	產量	17.34	15.97	15.02	11.86	9.29	6.34
臺農31號	15.97	1.37					
鐵線藤	15.02	2.32	0.95				
P 46	11.86	5.48	4.11	3.16			
P 21	9.29	8.05	6.68	5.73	2.57		
臺農10號	6.34	11.00	9.63	8.68	5.52	2.95	
P 13	4.77	12.57	11.20	10.25	7.09	4.52	1.57

----------差異達 5%平準 (2.06)

~~~~~~~~差異達 1%平準 (2.76)

臺北區情形，以P30產量最高，與臺農31號相比，差異不顯著。但 P30優于在來種鐵線藤，差異顯著。優于臺農10號，差異十分顯著。

試驗記錄表（II）桃園農校

		每小區生薯葉重 (kg.)	收穫株數 (株)	每小區大塊根數 (個)	每小區小塊根數 (個)	每小區總塊根數 (個)	每小區大塊根重 (kg.)	每小區小塊根重 (kg.)	每小區總塊根重 (kg.)	備考
第一重複	P13	17.100	—	0	120	120	0	2.186	2.186	
	P21	14.400	—	19	120	139	4.325	5.706	10.032	
	P30	10.200	—	24	114	138	7.541	4.156	11.697	
	P46	13.800	—	15	33	148	3.306	5.101	8.407	
	臺農10號	10.800	—	3	97	100	0.441	3.766	4.207	
	臺農31號	15.600	—	14	163	177	2.286	6.936	9.222	
	五斤種	10.800	—	8	97	105	2.373	2.876	5.249	
第二重複	P13	13.650	—	0	207	207	0	4.351	4.351	
	P21	13.200	—	5	115	120	1.016	5.751	6.767	
	P30	10.500	—	45	85	130	14.625	3.141	17.767	
	P46	10.500	—	14	150	164	3.066	5.776	8.842	
	臺農10號	13.500	—	3	91	94	0.591	3.186	3.777	
	臺農31號	13.200	—	16	165	181	3.426	7.206	10.632	
	五斤種	8.850	—	21	60	81	5.761	2.171	7.932	
第三重複	P13	8.100	—	3	135	138	0.446	3.306	3.752	
	P21	12.600	—	11	83	94	2.496	3.161	5.657	
	P30	3.978	—	21	67	88	5.776	2.846	8.622	
	P46	9.000	—	16	123	139	2.956	4.361	7.317	
	臺農10號	6.900	—	8	78	86	1.026	2.021	3.047	
	臺農31號	13.500	—	20	171	191	3.136	5.646	8.782	
	五斤種	7.500	—	9	61	70	2.916	2.116	5.032	
~~~~~~~~

第四重複	P13	13.800	—	5	208	213	0.526	3.746	4.272	
	P21	13.200	—	13	82	95	1.726	1.906	3.632	
	P30	9.300	—	30	113	143	11.056	4.031	15.087	
	P46	13.050	—	3	161	164	0.106	3.381	3.492	
	臺農10號	12.600	—	2	85	87	0.306	2.491	2.797	
	臺農31號	14.100	—	11	154	165	2.201	5.616	7.817	
	五斤種	10.800	—	16	63	79	4.216	2.086	6.302	
四重複合計	P13	52.650	—	8	670	678	0.972	13.589	14.561	
	P21	53.400	—	48	400	448	9.564	16.524	26.088	
	P30	33.978	—	120	379	499	38.999	14.174	53.173	
	P46	46.350	—	48	567	615	9.434	18.624	28.058	
	臺農10號	43.800	—	16	351	367	2.364	11.464	13.828	
	臺農31號	56.400	—	61	653	714	11.049	25.404	36.453	
	五斤種	37.950	—	54	281	335	15.266	9.249	28.515	

桃園農校產量分析表

(一) 產量表(每小區公斤數)

品種名 \ 重複	I	II	III	IV	品種總和	平均數
P13	2.19	4.35	3.75	4.27	14.56	3.64
P21	10.03	6.77	5.66	3.63	26.09	6.52
P30	11.70	17.77	8.62	15.09	53.18	13.30
P46	8.41	8.84	7.32	3.49	28.06	7.02
臺農10號	4.21	3.78	3.05	2.80	13.84	3.46
臺農31號	9.22	10.63	8.78	7.82	36.45	9.11
五斤種	5.25	7.93	5.03	6.30	24.51	6.13
區組總和	51.01	60.07	42.21	43.40	總和=196.69	

(二) 變量分析表

變因	自由度	平方和	變量	F 值	5%F	1%F
區組間	3	29.13	9.71	2.4	3.16	5.09
品種間	6	275.58	45.93	11.57**	2.66	4.01
機誤總和	18	71.42	3.97			
總和	27	376.13				

*差異顯著　　**差異十分顯著

(三) 差異比較表

品種		P30	臺農31號	P46	P21	五斤種	P13
	產量	13.3	9.11	7.02	6.52	6.13	3.64
臺農31號	9.11	4.19					
P46	7.02	6.28	2.09				
P21	6.52	6.78	2.59	0.50			
五斤種	6.13	7.17	2.98	0.89	0.39		
P13	3.64	9.66	5.47	3.38	2.88	2.49	
臺農10號	3.46	9.84	5.65	3.56	3.06	2.67	0.18

……差異達5%平準(2.96)
～～～差異達1%平準(4.06)

桃園區情形，以P30產量爲最高，與臺農31號相比差異十分顯著，且P30塊根較大而整齊，臺農31號則屑諸甚多，P30與在來種，五斤種，及臺農10號相比，差異十分顯著。

試驗記錄表(Ⅲ)新竹區農林場

		每小區生薯葉重(kg)	收穫株數(株)	每小區大塊根數(個)	每小區小塊根數(個)	每小區總塊根數(個)	每小區大塊根重(1g.)	每小區小塊根重(1g.)	每小區總塊根重(kg.)	備考
第一重複	P13	10.500	20	25	64	89	4.600	3.300	7.900	
	P21	7.000	16	27	31	58	8.500	2.700	11.200	
	P30	5.200	18	65	46	111	19.300	3.000	22.300	
	P46	7.600	18	39	69	108	9.700	3.500	13.200	
	臺農10號	7.600	16	35	45	80	7.300	2.200	9.500	
	臺農31號	20.500	20	65	32	97	19.000	1.800	20.800	
	七十日早	6.500	20	38	27	65	11.800	1.300	13.100	
第二重複	P13	7.500	17	26	46	72	5.300	3.200	8.500	
	P21	10.500	17	26	39	65	8.500	3.000	11.500	
	P30	5.000	18	51	20	71	16.000	1.700	17.700	
	P46	7.500	18	27	47	74	6.000	3.700	9.700	
	臺農10號	8.600	19	28	39	67	5.000	2.000	7.000	
	臺農31號	9.500	20	55	62	117	15.400	4.000	19.400	
	七十日早	4.000	17	42	14	56	12.500	0.700	13.200	
第三重複	P13	9.000	19	33	22	55	7.500	1.600	9.100	
	P21	2.500	11	18	22	40	4.400	1.700	6.100	
	P30	3.000	20	63	45	108	18.000	2.300	20.300	
	P46	6.000	18	44	72	116	9.300	4.200	13.500	
	臺農10號	5.000	19	47	42	89	7.600	1.700	9.300	
	臺農31號	7.000	20	56	40	96	18.000	3.200	21.200	
	七十日早	5.000	19	49	21	70	14.000	1.700	15.700	

第四重複	P13	7.000	19	30	51	81	6.300	2.800	9.100	
	P21	9.000	18	35	30	65	12.800	2.300	15.100	
	P30	4.000	19	74	31	105	17.000	1.500	18.500	
	P46	6.000	20	51	46	97	11.000	2.200	13.200	
	臺農10號	5.000	19	36	23	59	7.300	1.500	8.800	
	臺農31號	7.500	20	72	42	114	19.500	2.500	22.000	
	七十日早	4.000	20	40	30	70	11.800	2.200	14.000	
四重複合計	P13	34.000	75	114	183	297	23.700	10.800	34.600	
	P21	29.000	62	106	122	228	34.200	9.700	43.900	
	P30	17.200	75	253	142	395	70.300	8.500	78.800	
	P46	26.100	74	161	234	395	36.000	13.600	49.600	
	臺農10號	26.200	73	146	149	295	27.200	7.400	34.600	
	臺農31號	44.500	80	248	176	424	71.900	11.500	83.400	
	七十日早	19.500	76	169	92	261	50.100	5.900	56.000	

新竹農林場產量分析表

(一) 產量表(每小區公斤數)

品種名 \ 重複	I	II	III	IV	品種總和	平均數
P13	7.900	8.500	9.100	9.100	34.600	8.65
P21	11.200	11.500	6.100	15.100	43.900	10.98
P30	22.300	17.700	20.300	18.500	78.800	19.70
P46	13.200	9.700	13.500	13.200	49.600	12.40
臺農10號	9.500	7.000	9.300	8.800	34.600	8.65
臺農31號	20.800	19.400	21.200	22.000	83.400	20.85
七十日早	13.100	13.200	15.700	14.000	56.000	14.00
區組總和	98.000	87.000	95.200	100.700	總和=380.900	

(二) 變量分析表

變因	自由度	平方和	變量	F值	5%F	1%F
區組間	3	15.05	5.02			
品種間	6	589.07	98.18	28.88**	2.66	4.01
機誤	18	61.17	3.40			
總和	27	665.29				

*差異顯著　　**差異十分顯著

(三) 差異比較表

品種		臺農31號	P30	七十日早	P46	P21	臺農10號
	產量	20.85	19.70	14.00	12.40	10.98	8.65
P30	19.70	1.15					
七十日早	14.00	6.85	5.70				
P46	12.40	8.45	7.30	1.60			
P21	10.98	9.87	8.72	3.02	1.42		
臺農10號	8.65	12.20	11.05	5.35	3.75	2.33	
P13	8.65	12.20	11.05	5.35	3.75	2.33	0

..... 差異達5%平準(2.74)

~~~~~ 差異達1%平準(3.75)

新竹區情形，以臺農31號產量最高，但與P30相比，差異不顯著，而P30優于七十日早，及臺農10號差異十分顯著。

試驗記錄表(IV)關西農校

		每小區生產葉重(kg.)	收穫株數(株)	每小區大塊根數(個)	每小區小塊根數(個)	每小區總塊根數(個)	每小區大塊根重(kg.)	每小區小塊根重(kg.)	每小區總塊根重(kg.)	備考
第一重複	P13	7.900	20	23	51	74	5.000	2.700	7.700	
	P21	5.000	19	31	38	69	13.700	2.300	16.000	
	P30	4.000	20	55	31	86	16.600	1.500	18.100	
	P46	5.700	20	36	54	90	11.600	3.000	14.600	
	臺農10號	7.000	20	31	88	119	6.200	3.800	10.000	
	臺農31號	8.300	20	56	34	90	19.400	2.000	21.400	
	五斤種	8.000	20	36	72	108	8.200	3.500	11.700	
第二重複	P13	6.500	20	27	46	73	5.200	2.400	7.600	
	P21	5.800	19	34	25	59	11.300	1.300	12.600	
	P30	4.400	20	44	50	94	14.000	3.600	17.600	
	P46	5.000	20	38	70	108	8.000	3.800	11.800	
	臺農10號	7.800	20	30	64	94	6.400	3.000	9.400	
	臺農31號	4.700	20	48	35	83	15.500	1.800	17.300	
	五斤種	7.000	20	40	58	98	9.200	2.000	11.200	
第三重複	P13	6.500	20	30	39	69	6.500	1.900	8.400	
	P21	5.200	19	26	54	80	8.200	4.300	12.500	
	P30	2.900	20	60	29	89	16.900	1.400	18.300	
	P46	5.000	20	40	64	104	10.600	2.900	13.500	
	臺農10號	5.100	20	33	31	64	6.600	2.200	8.800	
	臺農31號	7.700	20	51	49	100	18.700	3.300	22.000	
	五斤種	8.000	19	31	29	60	11.400	2.400	13.800	
~~~~~

第四重複	P13	8.700	20	24	45	69	6.500	2.900	9.400	
	P21	7.000	19	22	45	67	8.200	3.000	11.200	
	P30	2.800	19	41	30	71	12.300	1.600	13.900	
	P46	4.700	20	36	59	95	7.800	3.400	11.200	
	臺農10號	6.700	20	40	36	76	9.000	2.300	11.300	
	臺農31號	5.400	20	46	35	81	13.300	2.200	15.500	
	五斤種	9.700	17	22	53	75	6.000	3.700	9.700	
四重複合計	P13	29.600	80	104	181	285	23.200	9.900	33.100	
	P21	23.000	76	113	162	275	41.400	10.900	52.300	
	P30	14.100	79	200	140	340	59.800	8.100	67.900	
	P46	20.400	80	150	247	397	38.000	13.100	51.100	
	臺農10號	26.600	80	134	219	353	28.200	11.300	39.500	
	臺農31號	26.100	80	201	153	354	66.900	9.300	76.200	
	五斤種	32.700	76	129	212	341	34.800	11.600	46.400	

關西農校產量分析表

(一) 產量表(每小區公斤數)

重 / 品種名	I	II	III	IV	品種總和	平均數
P13	7.700	7.600	8.400	9.400	33.100	8.38
P21	16.000	12.600	12.500	11.200	52.300	13.08
P30	18.100	17.600	18.300	13.900	67.900	16.98
P46	14.600	11.800	13.500	11.200	51.100	12.78
臺農10號	10.000	9.400	8.800	11.300	39.500	9.88
臺農31號	21.400	17.300	22.000	15.500	76.200	19.05
五斤種	11.700	11.200	13.800	9.700	46.400	11.60
區組總和	99.500	87.500	97.300	82.200	總和=366.50	

(二) 變量分析表

變因	自由度	平方和	變量	F值	5%F	1%F
區組間	3	28.58	9.527			
品種間	6	345.82	57.637	21.52**	2.66	4.01
機誤	18	48.21	2.678			
總和	27	422.61				

*差異顯著　　**差異十分顯著

(三) 差異比較表

品種		臺農31號	P30	P21	P46	五斤種	臺農10號
	產量	19.05	16.98	13.08	12.78	11.60	9.88
P30	16.98	2.07					
P21	13.08	5.97	3.90				
P46	12.78	6.27	4.20	0.30			
五斤種	11.60	7.45	5.38	1.48	1.18		
臺農10號	9.88	9.17	7.10	3.20	2.90	1.72	
P13	8.28	10.77	8.70	4.80	4.50	3.32	1.60

.....差異達5%平準(2.43)

~~~~~差異達1%平準(3.33)

關西區情形，以臺農31號產量最高，但與P30相比，差異不顯著，P30優于在來種五斤種及臺農10號差異十分顯著。

試驗記錄表(V)苗栗農校

		每小區生薯葉重(kg.)	收穫株數(株)	每小區大塊根數(個)	每小區小塊根數(個)	每小區總塊根數(個)	每小區大塊根重(kg.)	每小區小塊根重(kg.)	每小區總塊根重(kg.)	備考
第一重複	P13	12.660	20	26	72	98	4.050	2.430	6.480	
	P21	16.560	18	42	45	87	10.410	1.500	11.910	
	P30	7.350	20	52	22	74	15.850	0.810	16.660	
	P46	10.075	20	40	52	92	7.460	1.550	9.010	
	臺農10號	6.670	20	40	40	80	8.500	1.660	10.160	
	臺農31號	13.350	20	60	55	115	17.280	2.660	19.940	
	鐵線藤	6.700	20	42	50	92	9.920	1.930	11.850	
第二重複	P13	10.100	18	26	54	80	4.020	2.190	6.210	
	P21	13.950	17	44	75	119	10.110	3.780	13.890	
	P30	5.950	20	53	35	88	15.300	1.520	16.820	
	P46	9.950	20	46	50	96	9.500	2.130	11.630	
	臺農10號	3.350	19	45	50	95	8.590	2.060	10.650	
	臺農31號	10.200	20	51	30	81	17.580	1.400	18.980	
	鐵線藤	3.400	20	50	60	110	13.430	2.750	16.180	
第三重複	P13	14.350	20	33	92	125	4.230	1.950	6.180	
	P21	17.980	17	46	50	96	11.070	1.890	12.960	
	P30	8.450	19	52	56	108	16.160	1.830	17.990	
	P46	13.300	20	37	45	82	8.730	1.550	10.280	
	臺農10號	3.830	19	37	34	71	6.980	1.460	8.440	
	臺農31號	4.1480	20	43	60	103	13.620	3.280	16.900	
	鐵線藤	9.250	20	65	44	109	12.690	1.990	14.680	
~~~~~

第四重複	P13	11.050	14	23	38	61	2.130	1.120	3.250	
	P21	11.950	15	28	19	47	7.390	0.730	8.120	
	P30	7.820	19	62	28	90	7.760	0.860	18.620	
	P46	13.710	20	45	50	95	8.380	1.350	9.730	
	臺農10號	7.500	20	46	45	91	9.410	1.210	10.620	
	臺農31號	13.600	20	59	50	109	16.160	1.510	17.670	
	鐵線藤	8.100	19	57	23	80	13.720	0.870	14.590	
四重複合計	P13	48.160	72	108	256	364	14.430	7.690	22.120	
	P21	60.440	67	160	189	349	38.980	7.900	46.880	
	P30	29.570	78	219	141	360	65.070	5.020	70.090	
	P46	47.035	80	168	197	365	34.070	6.580	40.650	
	臺農10號	21.350	78	168	169	337	33.480	6.390	39.870	
	臺農31號	51.630	80	213	195	408	64.640	8.850	73.490	
	鐵線藤	27.450	79	214	177	391	49.670	7.540	57.300	

苗栗農校產量分析表

(一) 產量表(每小區公斤數)

品種＼重複	I	II	III	IV	品種總和	平均數
P13	6.480	6.210	6.180	3.250	22.120	5.53
P21	11.910	13.890	12.960	8.120	46.880	11.72
P30	16.660	16.820	17.990	18.620	70.090	17.52
P46	9.010	11.630	10.280	9.730	40.650	10.16
臺農10號	10.160	10.650	8.440	10.620	39.870	9.97
臺農31號	19.940	18.980	16.900	17.670	73.490	18.37
鐵線藤	11.850	16.180	14.680	14.590	57.300	14.33
區組總和	86.010	94.360	87.430	82.600	總和＝350.400	

(二) 變量分析表

變因	自由度	平方和	變量	F值	5%F	1%F
區組間	3	10.46	3.487			
品種間	6	496.43	82.738	35.653**	2.66	4.01
機誤	18	40.62	2.257			
總和	27	547.51				

*差異顯著　　**差異十分顯著

(三) 差異比較表

品種	名稱	臺農31號	P30	鐵線藤	P21	P46	臺農10號
名稱	產量	18.37	17.52	14.33	11.72	10.16	9.97
P30	17.52	0.85					
鐵線藤	14.33	4.04	3.19				
P21	11.72	6.65	5.80	2.61			
P46	10.16	8.21	7.36	4.17	1.56		
臺農10號	9.97	8.40	7.55	4.37	1.75	0.19	
P13	5.53	12.84	11.99	8.80	6.19	4.63	4.44

.....差異達5%平準(2.23)

~~~~~差異達1%平準(3.06)

苗栗情形，臺農31號產量最高，但與P30相比差異不顯著，P30優于在來種鐵線藤及臺農10號，差異十分顯著。

五場產量綜合分析表

(一) 產量表

品種＼場所	本所	桃園	新竹	關西	苗栗	品種總和	化算公斤/公頃
P13	19.06	14.56	34.60	33.10	22.12	123.44	9,258.00
P21	37.15	26.09	43.90	52.30	46.88	206.32	15,474.00
P30	69.34	53.18	78.80	67.90	70.09	339.31	25,448.25
P46	47.42	28.08	49.60	51.10	40.65	216.83	16,262.25
臺農10號	25.35	13.84	34.60	39.50	39.87	153.16	11,487.00
臺農31號	63.86	36.45	83.40	76.20	73.49	333.40	25,005.00
場地總和	262.18	712.18	324.90	320.10	293.10		

(二) 變量分析表

變異原因	自由度	平方和	變量	F值	5%F	1%F
試驗場	4	649.45	162.36	53.58**	2.50	3.60
品種	5	2,031.22	406.24	134.07**	2.35	3.29
品種×場	20	161.65	8.08	2.67**	1.67	2.07
區組	15	95.25	6.42	2.12*	1.87	2.45
機誤	75	227.24	3.03			
總和	119	3,165.81				

*差異顯著　　**差異十分顯著
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(三) 差異比較表

品種		P30	臺農31號	P46	P21	臺農10號
	產量 公斤/公頃	25,448.25	25,005.00	16,262.25	15,474.00	11,487.00
臺農31號	25,005.00	443.25				
P46	16,262.25	9,186.00	8,742.75			
P21	15,474.00	9,974.25	9,531.00	788.25		
臺農10號	11,487.00	13,961.25	13,518.00	4,975.25	3,987.00	
P13	9,258.00	16,190.25	15,747.00	7,004.25	6,216.00	2,229.00

~~~~~~差異達1%平準(2,186.25)

.....差異達5%平準(1,646.25)

五場合併分析結果，P30最爲豐產，產量高出于臺農31號，但差異不顯著，P30、P46在北部優于臺農10號，差異十分顯著。P46爲品質甚佳之新品種，P30則爲耐瘠早熟豐產之新品種。

品種×場之交叉差異：爲明瞭每品種之適應能力起見，故算出每品種在每場之交叉差異（Cross difference）列成下表：

品種＼場地	本所	桃園	新竹	關西	苗栗
P13	—4.48	8.65	1.89	1.01	—7.09
P21	—2.58	2.34	—7.21	4.29	3.14
P30	4.41	2.96	3.17	—9.45	—1.10
P46	7.63	2.18	—2.73	0.17	—7.28
臺農10號	—4.04	0.32	—5.54	1.58	7.67
臺農31號	—0.97	—16.48	10.40	2.40	4.63

二交叉差異比較顯著所需差數＝10.967

由上表，新品種P30、P46似最適應于臺北，P13、P30在桃園最適應，臺農31號在新竹苗栗爲最適應，P21及臺農31號在關西爲最適應，P30在本所、桃園、新竹有相似之反應，故對於本省北部之適應力大。

製簽率之比較(以臺北爲代表)

每品種取生藷1000g，製簽後晒乾，其製簽率如下：

P13……36.25%　　臺農10號……36.50%

P21……18.75%　　臺農31號……29.00%

P30……26.00%　　鐵線藤……25.75%

P46……36.50%
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P30 產量優于在來種鐵線藤而製簽率亦稍高。

P46 製簽率與臺農10號相倣，且食味較佳，產量亦高。

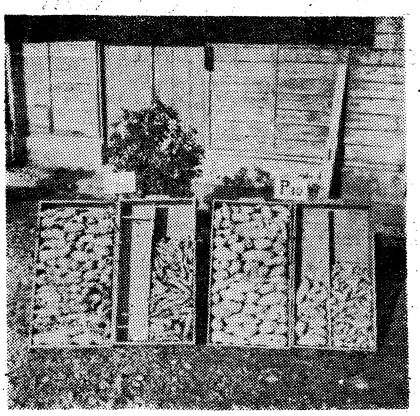
P30 之優點爲早熟，豐產，耐瘠，塊根整齊，屑諸少，各地平均產量已超過臺農31號雖製簽率較差，但其產量及製簽率已較鐵線藤前進一步。在北部丘陵地栽培粗放之情形下，可以代替鐵線藤而爲推廣材料。莖葉外觀與鐵線藤相似，但較爲粗大，生活力較旺盛，挿植初期對乾旱之抵抗力較强，故缺株較少。

P46 之優點爲塊根中等而整齊，食味佳，製簽率與臺農10號相倣，在北部情形，產量高出於臺農0號，甚爲顯著。

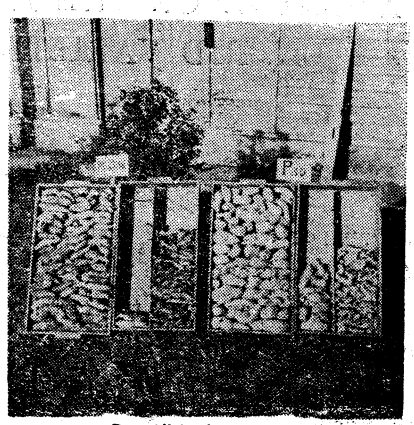
P13 製簽率雖高，但產量低，P21 產量雖高，但製簽率過低，均予淘汰，據更換兩個其他新育成品種，繼續試驗。P30 、P46 則在育苗大量繁殖中。

本試驗之進行初期，由前本所張技正佩英主持，又後期承梁技佐廷勳技工周定等協助工作，特此附載，以爲紀念。

附圖表示臺北桃園兩地P30豐產情形(40年8月—41年2月)



1. 臺農31號比 P30

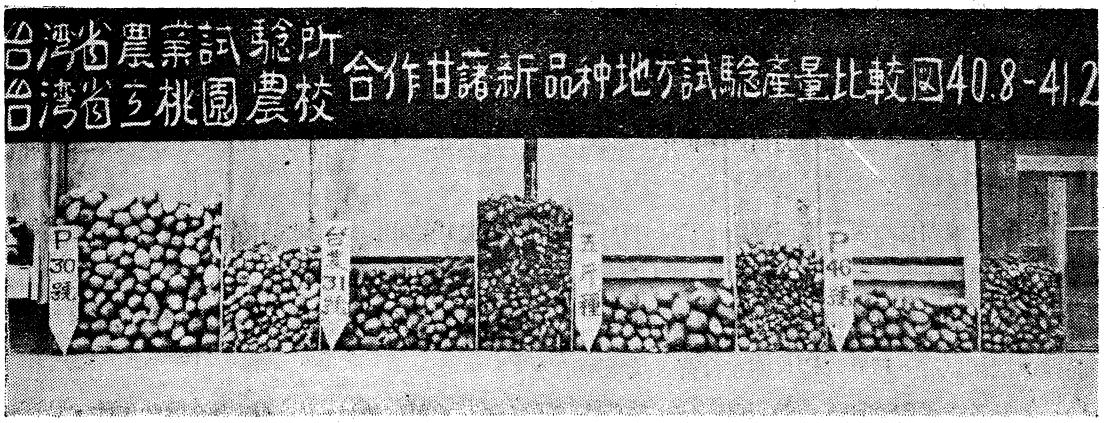


2. 鐵線藤比 P30



3. 臺農10號比 P30

(臺北本所四重複總產量比較)



(桃園農校四重複總產量比較)

A REPORT ON THE ADAPTATION TEST OF NEW HYBRID VARIETIES OF SWEET POTATO

T. S. Mou

Summary

1. Four new varieties of sweet potato p13, p21, p30, and p46 were bred from 1947 to 1948, in Taipei. and were tested for adaptation at five localities in 1951.

2. Variety p30 appeared to be the highest in yield, and variety p46 appeared to be the best in quality, among all the other experimental varieties.

3. p13 and p21 are in no respect than the check so far as the useful characteristics are concerned.

4. It is therefore concluded that the substitution of p30 and p46 for native varieties through extension in northern part of Taiwan is rather promising.

白色來航第一產卵年卵之增重研究

李 登 元

一、引　言

本研究之目的，在分析產卵鷄第一產卵年卵重之遞增情形，以爲根據卵重選擇鷄隻之根據，求能在短期內觀察其生產情形，先行淘汰不合要求者，以符合飼養經濟之原則。關於鷄群全年產卵量之擇選，多產者固屬重要，但其全年卵之平均重量亦不可忽視，卵之平均重量，能達市場之標準，則經營者亦可增加收益。

據 Jull (1924)報告：產卵鷄在一年之中，卵重均有變異，卵各部份之變化，由於生理發生變化所引起。Atwoop (1925)稱：鷄隻卵重隨其歲數增加而逐漸遞減。Waters (1937)報告稱：產卵鷄第一產卵年卵重之變異，在第十一個月至第十八月之間爲最少。該氏(1941)又稱：卵重遺傳與親代母系關係較大，母系卵大者則其女卵亦大，與親代父系關係則較少，有如性之連鎖遺傳然。但據Hays (1941)稱：卵之大小，父母之遺傳能力兩者相等而同樣重要。總之，卵之大小與遺傳有關則毫無疑問，但卵重除遺傳關係外，亦受生理、飼養管理及環境等因子之影響。茲將來航產卵鷄在同一飼養管理環境之下，研究分析其第一產卵年卵重增加之結果，分述如後，以供參考。

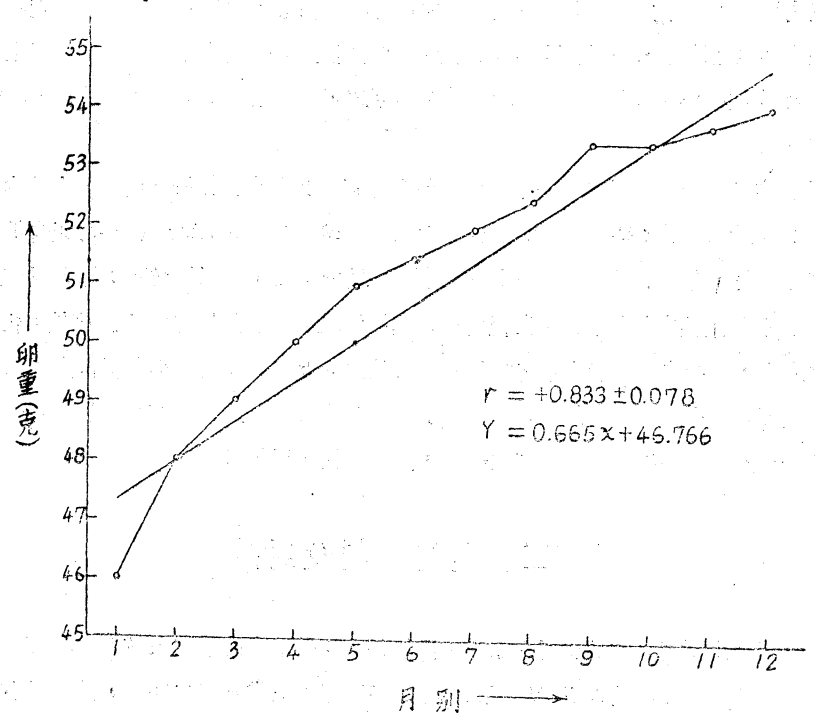
二、研究資料及討論

本研究資料爲臺灣省農業試驗所養鷄場，自1945—1950年白色單冠來航第一產卵年之產卵記錄。其第一產卵年之卵數在 100 枚以下者均不加計算。每天卵重係當日下午稱之，稱重至小數點一位。統計資料計來航 163 隻，其卵數共計 26,452 枚，其第一產卵年每隻產卵平均爲162.227±2.687枚，其開始產卵最早128天，最遲 337 天，平均天數爲192.583±3.323天。逐月卵之平均增重情形如表(一)，其增重之速度則以指數（即以第一個月卵重平均爲100）示之。其遞增之趨向則如圖(一)，卵之增重與開始產卵後年齡(月數)之相關係數爲r＝＋0.833±0.078，此即表示第一產卵年卵之增重與年齡成正比例，據 Waters(1937) 稱：測最大卵重則約在成熟期年齡之第十個月，以後其增減則不顯著。在圖(一)之曲線亦可看出增重之速度亦隨年齡(月數)之增加而漸緩。

表(一) 163白色來航第一產卵年逐月卵之平均增重(克)

月別 / 平均及指數	第一月	第二月	第三月	第四月	第五月	第六月
卵重平均	46.075±0.387	48.117±0.353	49.172±0.35	50.071±0.448	50.926±0.373	51.443±0.310
指數	100	104.431	106.721	108.672	110.523	111.650
月別 / 平均及指數	第七月	第八月	第九月	第十月	第十一月	第十二月
卵重平均	51.914±0.360	52.447±0.309	53.556±0.286	53.435±0.348	53.735±0.356	54.058±0.342
指數	112.803	113.829	116.019	115.973	116.625	117.326

圖(一)：163隻來航第一產卵年逐月平均卵重圖



第一個月產卵平均重量(小數點以四去五入法計算之)之範圍爲33—59克，其平均爲46.075±0.387克，依其第一個月不同之平均卵重分別列表分析其增重情形如表(二)，同時亦以其增重指數分別製圖(二)，以示第一個月各種不同之平均卵重逐月增重之速度，除第一個月平均卵重33, 36, 55, 58, 及59克因變員數(隻數)太少，未予製圖外，其餘各種卵重之增加指數直線方程計算如下：

第一月平均卵重	直線方程式	第一月平均卵重	直線方程式	第一月平均卵重	直線方程式
37(克)：	Y=2.446x+111.184	44(克)：	Y=1.786x+104.641	51(克)：	Y=1.074x+ 99.092
38(〃)：	Y=1.637x+115.193	45(〃)：	Y=1.510x+ 99.601	52(〃)：	Y=0.774x+ 99.469
39(〃)：	Y=2.543x+105.637	46(〃)：	Y=1.592x+ 99.402	53(〃)：	Y=0.024x+101.437
40(〃)：	Y=2.405x+102.867	47(〃)：	Y=0.432x+104.442	54(〃)：	Y=0.387x+ 97.318

41(ク)： Y=2.729x+103.762　48(ク)： Y=0.552x+105.833　57(ク)： Y=0.069x+ 98.833
42(ク)： Y=1.900x+104.550　49(ク)： Y=0.417x+104.456
43(ク)： Y=2.201x+101.944　50(ク)： Y=1.008x+100.780

在圖(二)，可以看出第一月平均卵重較輕者，其直線傾斜度較大，而表示增重速度較快，第一月平均卵重次第加重則其直線傾斜度有隨之漸減之趨勢，尤以47克以上之增重速度遽減至爲明顯。同時在該圖可以找出，第一個月平均卵重愈重者，其增減之變化亦愈大，在52克以上者，其平均卵重之增減，有較第一個月爲輕，增重亦頗不齊一。由於以上情形觀之，選擇第一個月之平均重量以其中數較爲適當，過大或過小，均所不宜。

初生卵重之大小與成熟年齡遲早有關，按 Jull(1924)報告稱；開始產卵年齡愈早則其開始十個卵之平均重量亦愈輕；同時其產卵總平均亦較輕，據 William. H. Lippincott (1925)稱：開始產卵之年齡，爲第一產卵年卵重季節性之分佈之重要因素。該氏(1921)所得來航初產期愈遲則其初生十個蛋之平均重量與年齡之相關係數爲 +0.7139±0.0293， 本研究所分析之結果其相關係數爲 r = +0.616±0.078至於其第一個月卵重平均與全年卵重之總平均重量之相關係數 r=+0.913±9.079 相關至爲明顯。茲 依初生年齡與卵之增重情形分別列表(三)及製圖(三)， 爲初生年齡計算便利計，以月數爲單位(120－136天爲四個月；136－165天爲五個月，依次類推)，其各別增重直線方程如下：

四個月： Y=2.957x+103.613　八個月： Y=0.365x+102.583
五個月： Y=1.976x+102·989　九個月： Y=0.534x+104.279
六個月： Y=1.796x+101.326　十個月： Y=0.152x+ 99.512
七個月： Y=0.964x+103.984　十一個月： Y=0.019x+ 98.731

初生卵重與年齡關係爲正相關，故在圖(三)所示之情形與第一個月卵重平均大小各別增重情形相似不另多贅。成熟期早爲選擇育種條件之一，過早有卵輕之弊，故選擇應注意早熟且卵重。遲熟期第一個月卵雖重但不合經濟原則在所不宜。

依其開始產卵月份不同之增重情形分別列表繪圖如表(四)及圖(四)，其增重速度以指數計算之直線方程如下：

一 月： Y=1.827x+ 97 703　五 月： Y=1.779x+ 98.020　九 月： Y=0.794x+111.172
二 月： Y=1.973x+ 98.592　六 月： Y=1.710x+105.468　十 月： Y=0.446x+106.351
三 月： Y=1.181x+105.659　七 月： Y=1.599x+105.690　十一月： Y=0.110x+101.548
四 月： Y=2.829x+102.023　八 月： Y=1.667x+107.915　十二月： Y=0.435x+ 99.239

據 D. C. Warren 1933)報告：溫度可影響卵之重量，又按李登元(1948)報告：夏秋兩季之卵重較之春冬兩季之卵重爲輕，來航減輕3.64克或6.393%洛島紅減輕0.946克或 1.72%，名古屋減輕 1.409克或 2.616 %，夏秋兩季卵之所以減輕，因該兩季節之氣溫較春冬兩季者爲高之故也。在表(四)開始第一個月平均卵重，在春冬兩季者較夏秋兩季者爲重，此卽開始產卵之季節氣溫之不同而影響卵之輕重也。圖(四)之曲線表示，除一、二兩月份開始產卵，其第一產卵年之增重情形一直向上外，從三月份以後開始產卵者則其增重情形由產卵第十個月起次第提前一個月減輕蛋重之趨勢，尤其以 11. 12兩月份開始產卵者第三個月(卽當夏季開始之時)以後卽行減輕卵重，且有逐漸減輕較初生卵重爲輕之現象，直至暑季過後約八月間才漸向上增重，此爲冬季開始產卵雖較重而受氣候影響亦較顯著所致。在春季產卵之鷄隻除初生卵重影響全年平均卵重亦較重外，同時其增重較爲正常，第一產卵年所受氣溫之影響變化不大。換句話說卽秋雛之飼育頗有其價值也。

表(二) 第一個月卵產平均重量別及其逐月增重(克)

開始卵重	平均及指數 / 月別	第一月	第二月	第三月	第四月	第五月	第六月
33	1	33.36 100	36.795 110.296	40.117 120.434	44.000 131.894	41.625 124.775	46.652 139.844
36	2	35.832±0.329 100	38.181±7.487 106.572	43.164±1.701 120.462	42.879±0.879 119.666	43.650 121.818	50.950 142.191
37	3	37.233±0.017 100	42.853±0.218 114.939	43.341±1.209 116.251	45.504±4.754 122.050	51.189±0.368 137.298	50.208±1.008 134.667
38	3	38.261±0.212 100	43.863±0.755 114.641	48.291±0.930 126.214	49.658±0.825 129.552	49.810±1.690 130.184	50.904±1.874 133.044
39	6	38.983±0.235 100	42.427±0.841 108.834	44.777±1.326 114.862	46.443±1.749 119.136	47.381±2.101 121.545	49.047±1.661 125.816
40	8	40.014±0.325 100	43.251±0.582 108.089	44.641±0.466 111.563	44.971±0.999 112.388	46.346±0.685 115.824	48.223±0.880 120.515
41	11	40.958±0.314 100	44.629±0.904 108.962	45.388±0.873 110.815	46.876±1.362 114.448	48.660±1.381 118.804	50.906±1.187 124.288
42	18	42.368±0.124 100	45.671±0.454 107.795	47.139±0.615 111.250	47.745±0.744 112.691	50.103±0.840 118.256	50.854±0.896 120.029
43	8	42.923±0.215 100	45.870±0.746 106.865	45.918±0.792 106.977	47.452±1.286 110.551	49.761±0.809 115.930	50.375±1.334 117.361
44	12	44.130±0.212 100	47.984±0.869 108.733	48.452±0.602 109.793	49.617±0.698 112.433	51.219±1.489 116.063	51.871±1.663 117.541
45	19	45.006±0.142 100	46.843±0.306 104.081	46.501±0.801 103.321	47.476±1.127 105.488	47.911±1.042 106.454	49.272±1.158 109.478
46	11	46.033±0.211 100	46.979±0.516 102.121	47.843±0.655 103.999	49.033±1.079 106.517	49.273±0.909 107.038	49.929±0.823 108.463
47	5	47.059±0.103 100	48.449±0.400 102.953	50.596±0.812 107.516	51.469±2.629 109.371	51.306±2.714 109.024	51.655±2.088 109.766
48	16	48.145±0.114 100	49.906±0.502 103.657	50.606±0.701 105.111	50.891±0.806 105.683	51.383±1.188 106.725	50.486±1.333 104.856
49	11	48.828±0.206 100	49.632±1.682 101.646	50.113±1.628 102.631	51.604±1.077 105.685	51.377±0.951 105.220	52.153±1.291 106.809
50	11	50.109±0.124 100	51.979±1.226 103.731	53.005±0.774 105.779	53.261±0.960 106.290	53.287±1.211 106.342	52.884±1.325 105.537
51	8	50.938±0.015 100	51.684±0.864 101.466	52.905±1.807 103.861	53.492±0.971 105.013	53.859±1.056 105.734	53.198±0.925 104.436
52	7	51.919±0.058 100	51 442±0.669 99.081	53.250±0.808 102.503	53.230±1.491 102.525	54.323±1.452 104.630	53.714±1.605 103.457
53	4	52.832±0.117 100	52.636±0.408 99.629	52.919±0.578 100.164	54.513±1.855 103.181	54.710±1.471 103.546	54.846±1.224 103.812
54	3	53.652±0 210 100	52.448±1.764 97.755	54.536±0.666 101.647	53.078±1.000 98.930	52.721±1.321 98.264	53.037±1.201 98.853
55	2	54.951±0.379 100	60.065±5.595 109.306	56.341±2.351 102.529	56.170±3.572 102.218	54.546±2.273 99.295	55.091±4.532 100.254
56	1	56.131 100	57.800 102,973	60·010 106.910	61.100 108.852	59.355 105.743	60.636 108.025
57	3	56.873±0.128 100	56.034±1.521 98.524	57.382±0.473 100.894	56.494±2.374 99.331	56.005±3.000 98.473	55.303±2.666 97.239
58	2	58.113±0.067 100	57.253±0.310 98.520	57.731±0.016 99.342	59.982±0.418 103.216	59.089±0.242 101.679	59.327±0.141 102.089
59	1	59.200 100	57.629 97.346	58.335 98.538	59.540 100.574	60.5 102.195	60.500 102.195

* 休 產

（續）

開始非重	月卵 平均及指數 變數	第七月	第八月	第九月	第十月	第十一月	第十二月	全年卵重總平均
33	1	47.000 140.887	*	51.505 154.391	51.852 155.431	51.742 155.101	52.084 156.127	46.035±2.665
36	2	52.776 147.287	51.407 143.466	50.728 141.571	51.895±0.355 144.828	49.355±0.120 137.340	49.555±0.160 138.298	46.902±2.176
37	3	50.499±1.519 135.447	51.122±2.594 137.118	48.661±1.477 130.517	48.509±2.376 130.110	51.419±1.267 137.915	47.739±1.039 128.044	48.220±2.320
38	3	50.237±2.736 131.300	49.552±3.125 129.518	48.868±4.017 127.722	48.350±4.784 126.368	47.808±1.492 124.952	52.488±0 137.184	48.432±3.322
39	6	49.110±1.851 125.977	49.610±1 964 127.234	49.652±0.979 127.371	50.239±1.356 128.874	51.147±1.196 131.203	52.755±0.872 135.328	46.678±1.625
40	8	48.067±0.948 120.125	48.598±0.846 121.452	51.321±1.560 128.257	50.922±0.893 127.260	51.588±1.172 128.912	51.061±1.693 127.607	46.094±2.645
41	11	52.327±1.016 127.757	53.110±0.966 129.669	53.546±0.974 130.733	53 517±0.579 130.663	53.525±0.615 130.682	52.987±0.670 129.369	49.874±1.094
42	18	50.888±0.884 126.109	51.267±0.663 121.004	51.415±0.927 121.353	52.502±0.826 123.918	52.206±0.913 123.220	53.092±1.108 125.311	49.375±0.588
43	8	51.527±1.824 120.045	52.086±1.129 121.349	51.623±1.431 120.273	53.582±1.003 124.832	54 047±1.255 125.916	53.495±0.974 124.630	48.894±0.789
44	12	52.603±1.430 119.200	53.476±1.397 121.178	54.307±1.032 123.061	54.299±0.912 123.043	54 157±0.679 122.721	53 213±0.750 120.582	51.486±1.014
45	19	50.802±1.492 112.878	50.409±1.645 112.005	50.637±1.376 112.511	52.059±1.033 115.671	52.202±1.987 115.988	52.128±0.840 115.824	48.832±0.680
46	11	50.569±1.170 109.853	52.427±0.942 113.890	54.136±1.159 117.602	52.965±1.426 115.058	52.329±0.719 113.677	54.519±0.756 118.434	50.721±0.714
47	5	50.835±2.089 108.023	50.646±2.011 107.622	50.339±2.286 106.969	51.304±2.969 109.020	50.728±2.926 107.796	50 850±2.121 108.055	50.154±1.318
48	16	51.259±1.023 106.467	50.638±0.494 105.178	51.388±1.087 106.735	51.465±1.111 106.895	51.835±0.995 107.664	52.880±0.906 109.834	50.733±0.696
49	11	51.960±1.406 106.414	52.752±1.252 108.036	51.250±2.063 104.966	56.511±1.998 115.734	55.970±1.789 114.626	54.971±1.271 112.580	52.241±0.776
50	11	53.355±1.504 106.477	54.152±1.181 108.068	53.525±0.977 106.817	54.432±1.268 108.627	57.173±0.428 114.097	58.174±0.644 116.094	53.560±0.789
51	8	53.215±1.271 104.470	53.521±1.000 105.070	54.410±1.400 106.816	56.806±1.121 111.519	57.073±1 370 112.044	58.073±0.927 114.007	53.784±0.868
52	7	55.166±1.281 106.253	54.554±1.586 105.075	54.850±1.040 105.645	55.881±1.189 107.642	55.352±1.214 106.612	56.434±1.306 108.696	54.161±0.737
53	4	53.759±1.201 101.754	53.642±1.418 101.533	55.705±1.479 105.437	54.025±1.080 102.252	49.768±2.729 94.200	54.553±0.325 103.257	53.528±0.408
54	3	50.851±0.520 94.779	51.920±0 236 96.771	53.438±1.855 99.601	52.634±0.610 98.102	53.867±0.267 100.400	54.444±0.874 111.476	52.544±0.332
55	2	57.384±4.666 104.427	58.302±5.447 106.098	52.744±0 95.983	54.100±0 94.451	66.681±0 121.357	67.755±0 123.300	57.192±0.972
56	1	58.227 103.734	55.837 99.476	*	55.500 98.875	*	59.828± 106.586	57,677±
57	3	55.830±2.645 98.166	56.173±1.526 98.769	55.980±1.290 98.429	54.778±1.391 96.316	57.761±3.179 101.561	56.479±2.061 99.307	55.004±1.146
58	2	59.261±0.295 101.975	59.045±1.013 101.603	60.094±0.353 103.408	62.412±0.775 107.397	61.933±3.733 106.593	64.712±1.038 111.358	61.271±1.024
59	1	*	64.842 109.530	64.741 109.359	62.000 104.729	64.008 108.121	62.300 105.236	61.280±0.000

表(三)　開始產卵年齡(月數)之卵重逐月增重(克)

月數	隻數	第一月	第二月	第三月	第四月	第五月	第六月
4	2	38.233±4.872 100	42.022±5.227 109.910	40.177±0 105.084	47.357±3.358 123.864	45.862±5.238 119.953	48.770±2.118 127.559
5	38	42.953±0.755 100	45.341±0.735 105.559	46.233±0.668 107.636	47.543±0.818 110.686	49.731±0.917 115.780	51.072±0 878 118.762
6	60	45.434±0.510 100	47.766±0.572 105.132	48.621±0.506 107.014	49.749±0.578 109.497	50.557±0.469 111.275	51.514±0.491 113.382
7	35	47.270±0.756 100	49.621±0.668 104.973	51.441±0.648 108.823	51.782±0.794 109.545	53.104±1.105 112.341	52.684±0.788 111.453
8	15	49.019±0.724 100	49.713±0.641 101.415	50.673±0.830 103.374	51.219±0.824 104.488	50.486±0 960 102.992	49.708±1.082 101.405
9	3	50.055±3.535 100	51 694±1.775 103.274	51.627±2.767 103.140	55.124±0.882 110.126	56.590±1.462 113.055	55.910±2.013 111.697
10	5	53.063±2.028 100	52.403±1.777 98.756	53.356±1.624 100.540	52.308±2.067 98.577	51.746±2.251 97.518	48.77±81.030 91.924
11	4	54.136±1.108 100	54.177±1.080 100.075	53.884±0.957 99.534	53.120±1.547 98.123	53.145±2.121 98.169	52.049±2.159 96.144

表(四)　開始產卵月份別及其逐月增重(克)

月份	隻數	第一月	第二月	第三月	第四月	第五月	第六月
1	15	46.965±1.261 100	48.444±1.234 103.149	49.242±1.205 104.848	49.843±1.275 106.127	49.599±1.223 105.608	50.045±1.102 106.558
2	38	45.887±0.692 100	47.688±0.764 103.924	47.655±0.666 103.852	48.372±0.712 105.393	45.400±0.678 105.476	49.252±0.700 107.333
3	8	45.590±0.731 100	45.493±2.427 99.787	46.558±1.919 102.123	47.773±2.327 104.788	48.898±1.810 107.255	51.332±2.014 112.594
4	8	41.479±1.252 100	44.549±1.232 107.401	46.553±1.087 112.231	47.833±1.032 115.318	48.388±1.408 116.656	49.672±0.748 119.752
5	4	47.807±1.314 100	47.810±0.556 100.006	48.717±0.947 101.903	48.259±0.407 100.945	50.754±1.154 106.164	52.319±0.881 109.431
6	8	44.486±2.202 100	47.371±1.995 106.485	47.905±1.826 107.685	50.091±2.823 112.599	53.906±2.409 121.175	53.389±1.174 120.013
7	14	43.641±1.278 100	45.292±0.525 105.173	46.985±0.638 109.105	47.627±1.018 110.595	51.956±0.941 120.648	52.907±0.905 122.856
8	10	44.396±1.946 100	47.229±1.645 106.381	51.026±1.525 114.933	52.289±2.035 117.850	54.736±0.980 123.290	55.318±0.996 124.601
9	17	44.158±1.014 100	48.263±0.868 109.296	50.612±0.904 114.655	52.534±0.767 118.968	54.692±1.104 123.855	54.207±1.012 122.756
10	12	48.808±0.810 100	51.560±0.801 105.638	53.956±0.6861 110.547	5'.847±0.736 112.372	55.247±0.891 113.895	53.714±0.970 110.051
11	15	49.760±0.869 100	50.582±0.867 101.651	51.312±0.944 103.118	50.994±1.440 102.479	51.210±0.857 102.913	50.291±1.192 101.067
12	10	50.118±1.412 100	51.262±0.907 102.382	51.916±0.759 103.587	51,000±0.997 101.763	50.609±1.056 100.979	49.331±1.317 98.429

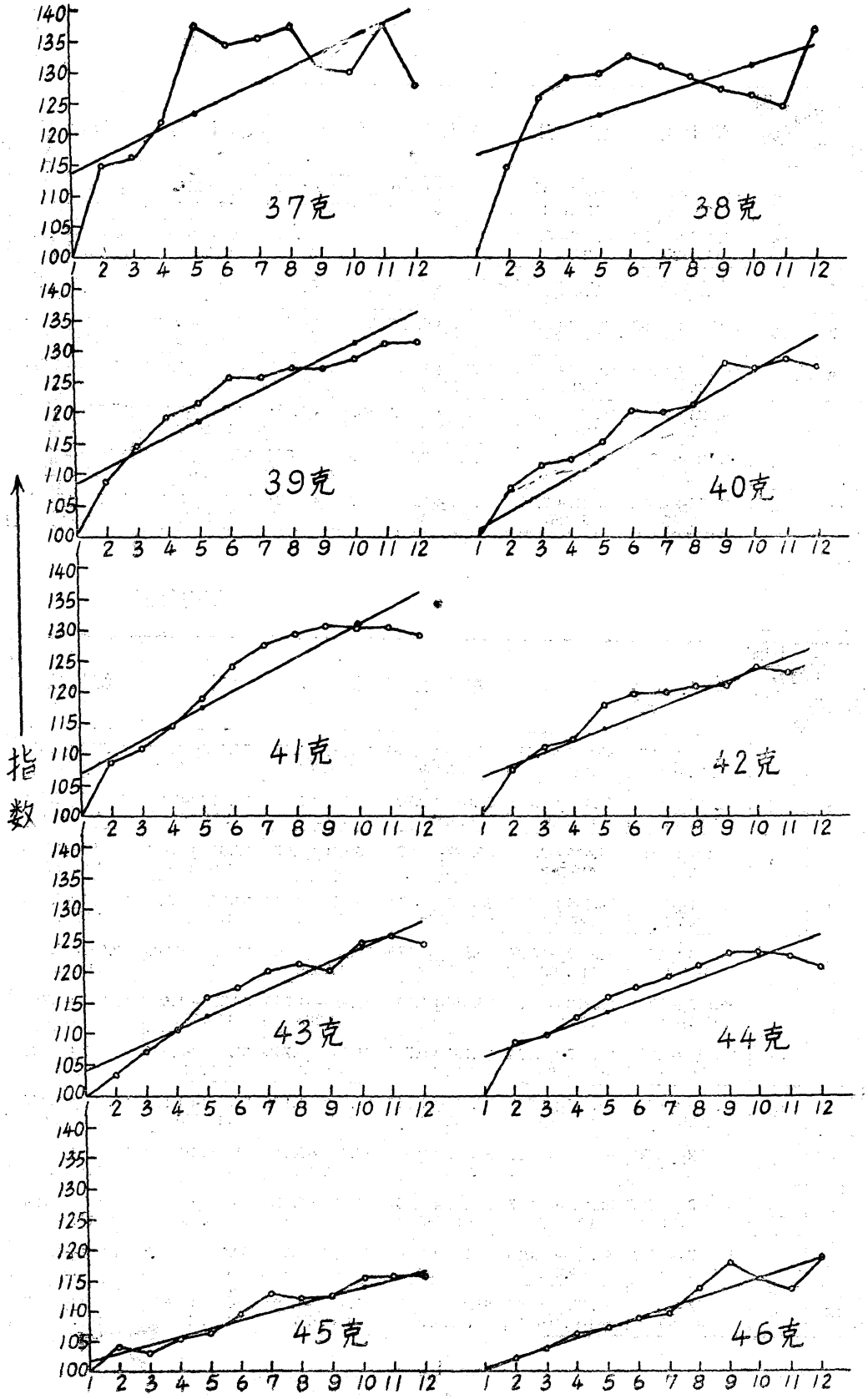
續表(三)

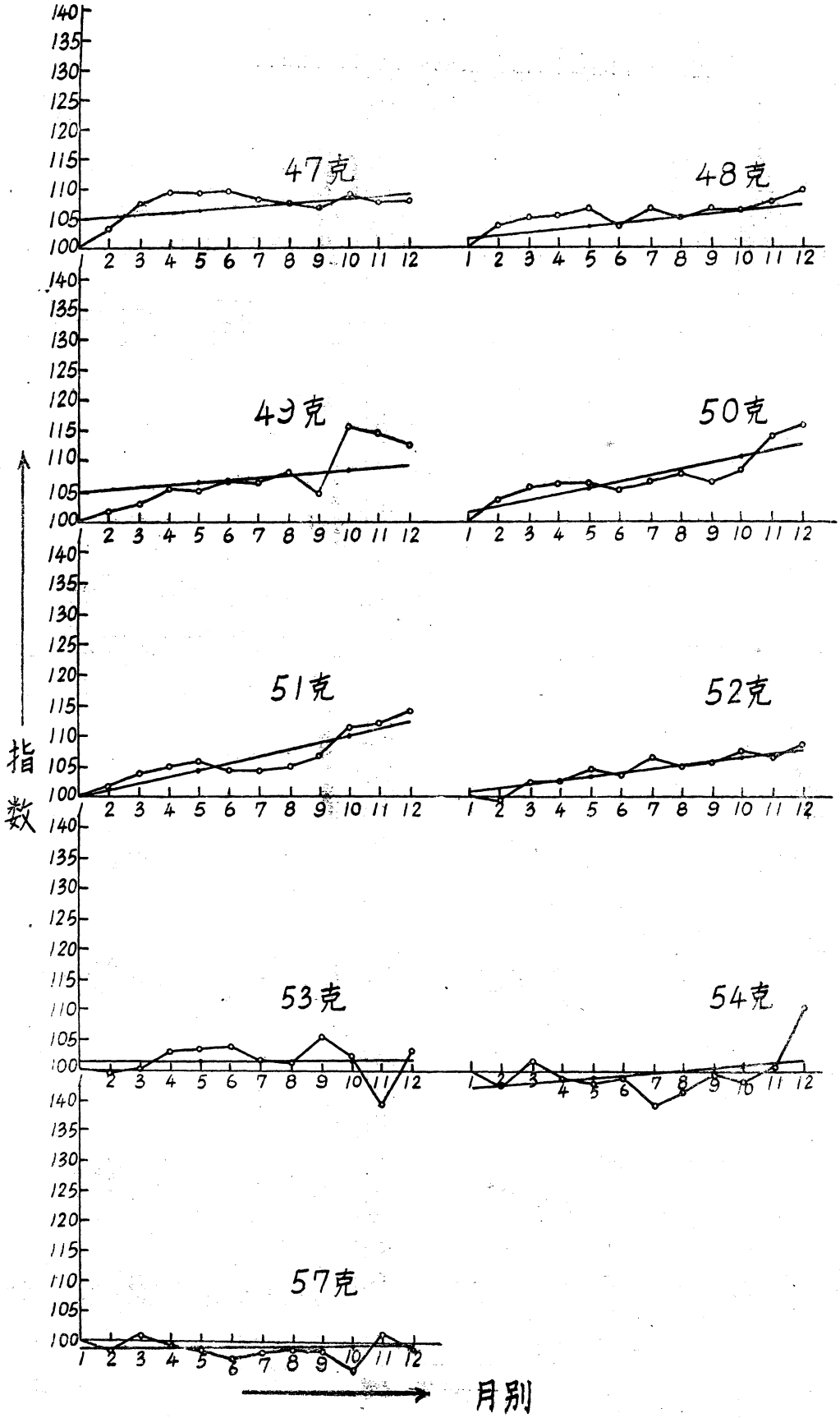
月別及平均售數 / 月數		第七月	第八月	第九月	第十月	第十一月	第十二月
4	2	48.537±3.075 126.950	49.008±0 128.182	50.143±1.362 131.151	50.709±1.143 132.631	51.942±0 135.856	50.860±1.221 133.025
5	38	51.298±0.780 119.428	51.913±0.716 120.860	52.376±0.719 121.937	52.884±0.628 123.120	52.530±0.623 122.296	52.845±0.643 123.029
6	60	52.269±0.574 115.043	53.163±0.488 117.911	53.541±0.464 117.843	54.399±0.485 119.731	54.321±0.547 119.560	55.253±0.546 121.633
7	35	52.578±0.783 111.229	52.812±0.676 111.724	52.553±0.776 111.176	53.577±0.848 113.342	53.925±0.734 114.080	54.520±0.755 115.337
8	15	50.156±1.032 102.319	50.168±0.962 102.343	50.033±1.008 102.068	49.866±0.971 101.727	50.412±1.402 102.841	52.880±1.377 101.876
9	3	54.725±2.013 109.329	54.517±1.462 108.914	54.990±1.462 109.859	55.053±1.597 109.985	51.361±5.166 102.609	55.550±1.650 110.977
10	5	52.129±4.308 98.239	51.464±3.310 96.986	52.573±3.130 99.076	54.473±6.388 102.657	58.570±1.677 110.378	58.519±2.088 110.282
11	4	52.752±2.652 97.443	52.126±2.349 96.287	54.577±1.351 100.814	52.819±0.729 97.567	55.503±3.242 102.525	53.275±1.125 98.409

續表(四)

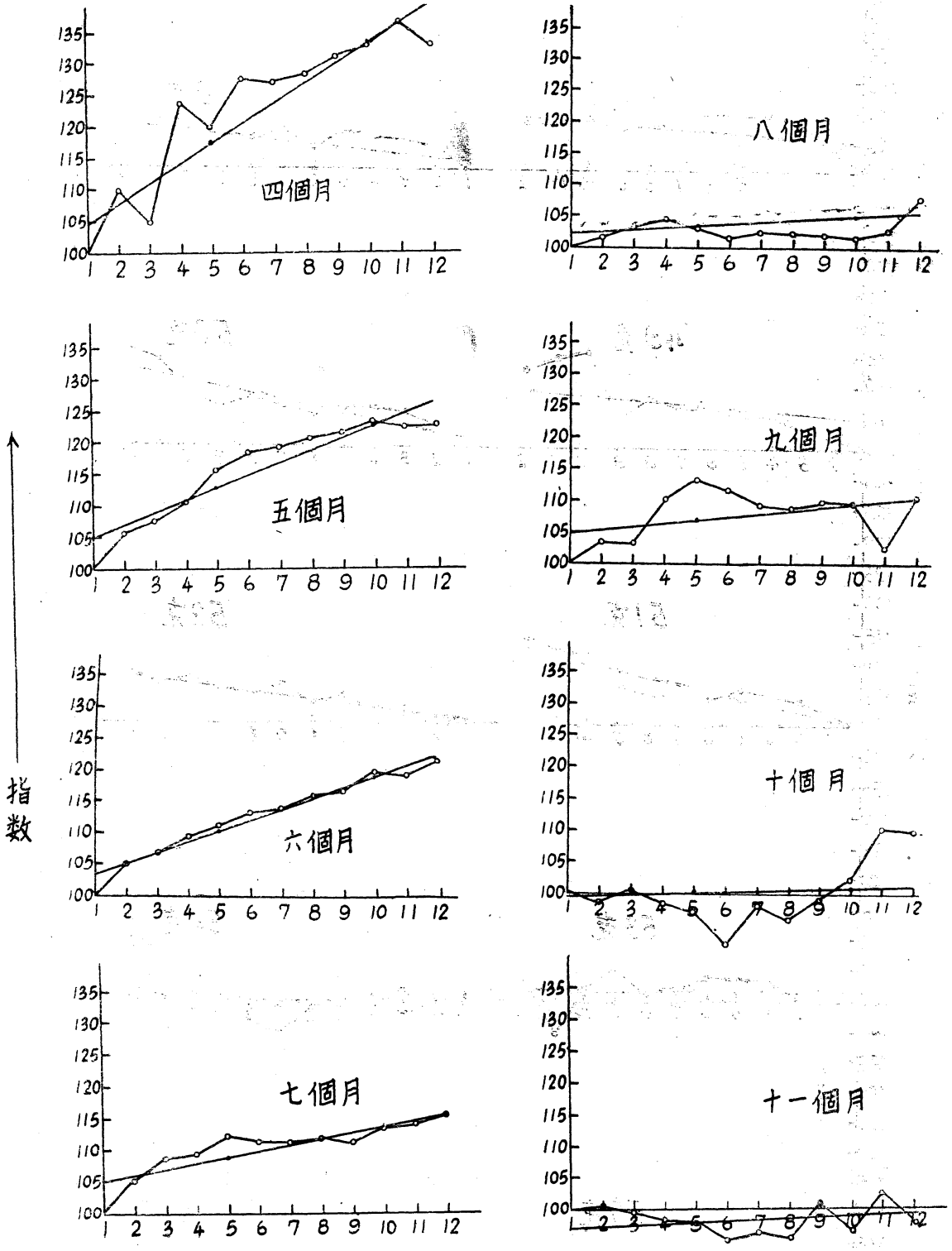
月別及平均售數 / 月份		第七月	第八月	第九月	第十月	第十一月	第十二月
1	15	49.980±1.378 106.419	50.966±1.298 108.519	52.746±1.190 112.309	55.889±1.651 119.001	56.613±1.335 120.542	56.700±0.884 120.728
2	38	50.134±0.783 109.257	52.406±0.795 114.206	53.070±0.704 115.653	55.161±1.529 120.210	55.110±0.732 120.099	55.973±0.651 121.980
3	8	54.181±1.600 118.844	54.486±2.056 119.513	56.127±2.000 123.112	56.881±0.978 124.766	56.061±1.711 122.967	55.884±1.558 122.579
4	8	50.051±1.030 120.677	52.845±1.470 127.401	53.398±1.477 128.735	55.645±0.752 134.152	55.177±0.523 133.023	54.094±0.766 130.412
5	4	55.698±0.722 116.505	55.649±1.207 116.403	56.356±0.676 117.882	55.962±0.763 117.058	55.291±0.500 115.564	53.891±0.816 112.726
6	8	55.137±1.711 123.942	55.213±1.719 124.143	54.354±1.996 122.182	53.954±1.750 121.283	53.208±1.684 119.606	53.352±1.780 119.929
7	14	53.098±0.907 123.300	52.617±0.694 122.183	52.151±0.745 121.181	51.643±0.745 119.921	51.858±0.906 120.920	50.857±0.903 118.096
8	10	55.739±0.770 125.549	55.855±1.000 125.810	54.864±1.059 123.578	54.068±1.161 121.785	52.412±1.122 118.066	54.558±1.277 122.889
9	17	53.492±0.928 121.137	52.272±0.955 118.374	51.697±0.992 117.072	52.078±0.411 117.935	51.062±1.488 115.634	51.169±0.771 115.877
10	12	54.622±0.987 111.911	53.136±0.877 108.867	52.607±1.157 107.783	53.932±0.673 110.498	53.845±0.911 110.320	54.213±1.109 111.074
11	15	50.367±0.895 101.219	49.370±1.014 99.216	48.780±1.145 98.030	48.797±0.992 98.064	49.980±1.120 100.442	51.655±1.318 103.808
12	10	49.497±1.212 98.760	50.477±1.156 100.716	51.458±1.379 102.673	50.457±1.087 100.676	54.366±3.844 108.475	53.910±0.727 107.566

圖(二) 第一個月卵之平均重量別及其各月平均增重圖

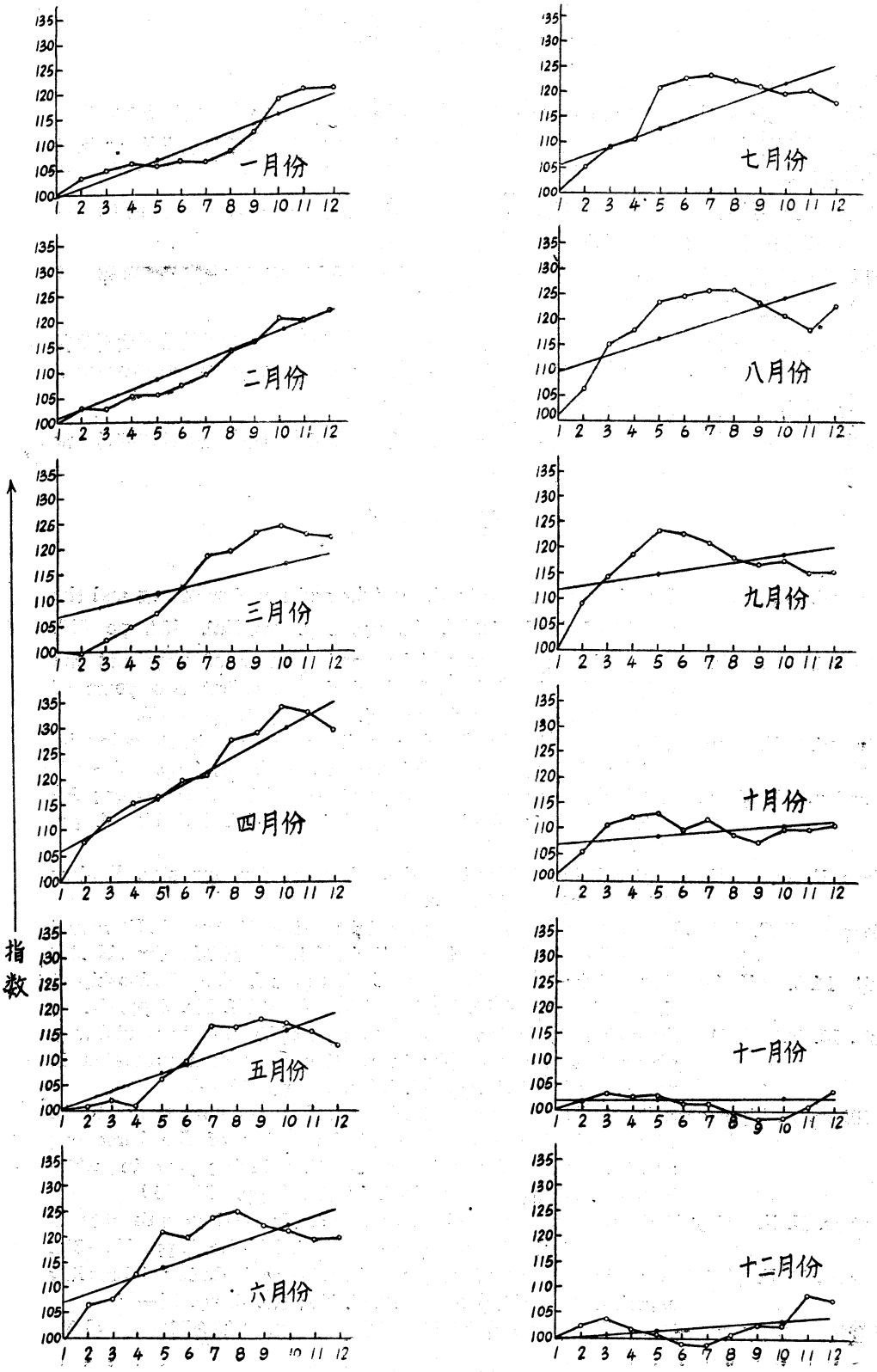



47克
48克
49克
50克
51克
52克
53克
54克
57克
指数
月別

圖(三)　開始產卵年齡(月數)別逐月卵之平均增重圖



圖(四)開始產卵之月份不同逐月卵之平均增重圖



三、結 果 摘 要

1. 開始產卵其第一個月卵重平均較輕者，其第一產卵年期內之增重較快，重者則反是。同時其增重之速度隨(年齡)月數之增加而漸減，第一個月平均卵重愈重者，其增重愈不齊一，且有反輕之現象。
2. 初產卵重與年齡成正比，成熟期愈早則其初產卵亦愈輕。初產第一個月平均卵重與年齡（月數）之相關係數 $r=+0.616\pm0.078$
3. 初產第一個月平均卵重與全年卵重之相關係數 $r=+0.913\pm0.079$ 表示第一個月平均卵重者，全年卵重總平均亦較重，甚爲明顯。
4. 開始產卵之月份別，因氣溫不同之影響，春、冬兩季之第一個產卵月平均重量較夏秋兩季者爲重，但冬季開始產卵者，至翌年卵重受氣溫之影響較大；春季開始產卵者其卵重受氣溫之影響則較小，故秋雛之飼育頗有其價值。
5. 開始產卵年齡之選擇在5－6個月爲宜，其第一個月平均卵重，似接近中數左右選擇較爲正常。

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STUDIES ON THE INCREASE OF EGG-WEIGHT DURING THE FIRST LAYING YEAR IN W. S. C. LEGHORNS

By

T. Y. Lee

Summary

During the years 1945—1950 all eggs at the poultry farm were weighed daily on the day following production to 0.5 gm. The records of 163 W. S. C. leghorns Were chosen for this study, only, birds that had produced 100 eggs or more during the first laying year were used. The mean number of eggs per bird was 162±2.687, the mean days of first egg laying was 192.583±3.323. The data were placed on a monthly basis. The mean monthly egg size was obtained from the varied age of first laying egg, from the different month the bird beginning laying and from the different egg size of beginning laying, for determing what effect the various factors named have on egg size. The data gives the following results:

1. The smaller the mean of the first month egg size, the greater the rate of increrase egg size in successive laying. But the rate slowly decreased analogous to increase in age.
2. The later laying commences the higher the mean weight of the first month eggs laid. The correlation between the later laying and the first month eggs mean weight is highly significant($r=+0.616\pm0.078$)
3. The higher the mean weight of the first month egg laid, the greater the average weight of total egg weight in first laying year. The correlation is highly significant ($r=+0.913\pm0.078$)
4. The average egg size of first month of the winter-spring laying commenced is more greater than that of summer-autum laying. It is due to the effect of seasonal weather. But the egg size of winter laying commenced was effected by the warm weather more serious than that of other seasons in which laymg commenced. The hens were laying hatching out at autum should possess of resistance to the warm weather during next. ycar.
5. It is suggested that the seletion of the time of first egg laymg of bird should be about 5 to 6 months of age, and that the egg size should be chosen the mean weight of normal distridution of the first month egg size for breeding stock.

PHYLOGENETIC DIFFERENTIATION OF THE CULTIVATED RICE PLANT

II. Intervarietal Hybrid Sterility

Hikoichi OKA

Introduction

Intervarietal hybrid sterility in the rice plant, which has been familiar with rice breeders in Formosa from the earliest time, has arisen the interest of agronomists since Kato (1) dealt with it as a basis of his Japonica-Indica classification. And it has been once believed that the sterility shows itself in the hybrid between Japonica and Indica types, but does not witnin a same type.

However, a scepticism about this conception was put forward by Terao and Mizushima (7, 8), demonstrating the intricacy of mutual relations of varieties in this hybrid sterility. While they suggested several inter-sterile variety groups, Mizushima (3, 4) pointed out lately, after observing the hybrids of several dozens of varieties of Japan, Java and America with definite analysing varieties, that the reaction type (which analysing variety and a given variety show sterility in their hybrid) varied among the varieties continuously.

On the other hand, the author pointed out in the preceding paper(5), on the ground of discontinous variation of various characters and a definite tendency in their combinations, that rice varieties were to be divided into Continental and Insular variety groups, and the Insular group further into two minor groups, named as Tropical and Temperate.

As a continuation of this foregoing work, variation of the reaction type of hybrid sterility was investigated by using definite analysing varieties, and was compared with the differentiation of variety groups. The present paper is a report of those results. The method of investigation was as a rule similar with Mr. Mizushima's method, however, a somewhat different conclusion was reached, probably owing to the difference in the materials as well as in the method of arranging observation results. Namely, the reaction types of various varieties were fo und to be classified into two main groups, I and II, corresponding respectively to Continental and Insular variety groups. In addition to these, some foundamental nature of this hybrid sterility as observed in parallel with the differentiation of reaction types will be mentioned in the present paper.

The present study was carried out in the Taiwan Provincial College of Agriculture from 1944 to 1950. The author express his hearty thanks to the college authorities for their kind support, and also to the staffs of the laboratory for their enthusiastic cooperation.

Materials and Methods

Some one hundred and twenty varieties taken out nearly randomly from diverse varieties of Eastern Asia were used as the materials. Before using in the present study, they were inbred repeatedly for two to several generations. Other detailed explanations of these varieties will be omitted here, as they are same to those used in the preceding study.

Seven varieties were picked out from them as the analysing varieties. Name and some characters of these analysing varieties are given in Table 1. They were chosen as representatives of the varieties of India, Indochina, Formosa, Celebes, Philippine, and Japan; additionally, a glutinous variety having glumes of dark color, 563, was partly for the purpose of gene analyses.

Table 1. Name, origin and some characters of analysing varieties.

No. or vara.	Name	Origin	Varielal group	Color Ap.	St.	Response to day length
*1	70a som cau	Indochina	Continental	—	—	sensible
108	Peh-ku	Formosa	〃	—	—	insensible
219	Garumbalay	Philippine	Insular (tropical)	+	—	〃
414	P. T. B. 10	India	Continental	—	—	sensible
521	Kisshin	Japan	Insular (temperate)	—	—	〃
563	Kinoshita-mochi	〃	〃	+	±	insensible
617	Padi ase banda	Celebes	〃	—	—	〃

Each of these seven varieties were pollinated with the pollen from the above mentioned 120 varieties respectively, and F_1 hybrids about 800 in total number were obtained. These F_1s, two or three plants per cross, were cultured together with maternal and paternal varieties in the paddy field.

For measuring the hybrid sterility, the percentage of normal pollen was observed by the following method: To take 5-10 florets of one day before the openning, smear the anther and stain with iodine pottasium iodide solution, and observe under the microscope more than 1,000 pollen grains.

These observations were continued from 1945 to 1950; a same material was observed repeatedly when low temperatures below 23°C or a typhoon occured during two weeks before the heading.

Table 2. Tests of the difference between lines of a same variety in the percentage of normal pollen.

Lines Maternal	Paternal	1 x 219 (i)	(ii)	219 x 108 (i)	(ii)	219 x 414 (i)	(ii)	563 x 108 (i)	(ii)	563 x 219 (i)	(ii)
I	I	75	79	70	78	61	64	23	28	89	82
I	II	79	74	66	68	59	52	34	36	88	86
II	I	70	87	52	67	50	55	43	36	84	80
II	II	88	77	61	64	51	58	38	34	71	88

I, II. No. of lines in a same variety,
(i), (ii). No. of plants in a same cross.

Crosses		1 × 219		219 × 108		219 × 414		563 × 108		563 × 219	
Source of variation	D. F.	S. S.	M. S.	S. S.	M. S.	S. S.	M. S.	S. S.	M. S.	S. S.	M. S.
Total	7	270		289		179		262		248	
Lines	3	44	14.7	165	55.0	113	37.7	215	71.7	69	23.0
Maternal	1	28	28.0	136	136.0	60	60.0	112	112.0	60	60.0
Paternal	1	6	6.0	1	1.0	12	12.0	18	18.0	1	1.0
Interaction	1	10	10.0	28	28.0	41	41.0	85	85.0	8	8.0
Remainder	4	226	56.5	124	31.0	66	15.5	247	61.7	179	44.8

Remarks : D. F.:Degree of freedom, S. S.: Sum of squares,
M. S.: Mean square.

Analysis of variance as the whole.

Variation due to	D. F.	S. S.	M. S.	F (remarks)
Among crosses	4	12434	3109	87.2 (beyond 1%level)
Within crosses	35	1248	35.7	
Total	39	13682		

In 1949, seeds of several analysing varieties produced in different years were examined as to whether different seeds (or lines) of a same variety would give an identical reaction or not. And it was recognized, as seen in Table 2, that the varieties were pure enough to be free from significant differences between different lines of a same variety. In other few varieties, however, different results were found between crosses of a same parental combination, probably owing to the impurity of materials. Nevertheless, this seemed not to be so fatal as to disturb the interpretation of observation results.

Observation Results

(1) A general aspect of the hybid sterility.

Hybrid plants were generally vigorous in growth, and showed no deterioration in the sexual organs. And it was confirmed that the behavior of chromosomes was completely regular in the meiosis of a sterile hybrid. However, a sterile hybrid showed diverse kinds of abortive pollen grains, and they were found to originate from the degeneration of microspores during the course of development. Some observations on the development of microspore and embryosac will be reported in another paper.

Under the microscope, pollen grains were distinguished into three classes: (A) normal pollen, showing regular diameter and starchy content, (B) anormal or underdevelopped pollen, diameter being smaller and containing insufficient starch, and (C) inert or empty pollen, irregular in shape and without any content, but having a micropyre and two layers of envelopping membran.

It was found further, by comparing the plants of a same cross in different seasons,

that the percentage of normal pollen was affected little by outer conditions, while the percentage of fertile grain fluctuated on a wider range. The correlation between normal pollen percentage and fertile grain percentage is given in Table 3. The latter was in a greater part of hybrids similar with or lower than the former. The difference between these two kinds of percentages may be mainly due to the modification of the latter, but may possibly be due to, in a few cases, the difference between normal pollen percentage and normal embryosac percentage, as pointed out by Terao and Mizushima(7).

Table 3. Correlation between normal pollen percentage and fertile grain percentage.

% of normal Pollen	% of fertile grain 95	85	75	65	55	45	35	25	15	5	Totals
95	11	29	25	12	9	7	2				95
85	3	14	14	10	14	14	6	1	3	1	80
75	2	4	8	9	17	14	9	6	3	2	74
65		5	7	7	13	16	10	9	1		68
55		1	1	2	13	14	8	10	3		52
45					1	7	7	5	7	2	29
35		1	1		1			3	10	3	19
25						2		3	3	1	9
15								1	1	2	4
5									1	2	3
Totals	16	54	56	40	68	74	42	38	32	13	433

(2) Hybrid sterility among analysing varieties and the comparison of reciprocal crosses.

The percentages of normal pollen in mutual hybrids between the above mentioned analysing varieties are given in Table 4. While the hybrids between 1 and 108, 219 and 647, and, 521 and 563 were free from sterility, other crosses all showed sterility, and their normal pollen percentages were different with the combination of varieties.

At the same time, it will be recognized in Table 4, that reciprocal crosses are essentially equal to each other in normal pollen percentage.

Table 4. Normal pollen percentages in reciprocal crosses between analysing varieties.

Crosses	% of pollen (A)	(B)	(C)	Croases	% of pollan (A)	(B)	(C)
1 x 108	97.2	1.8	1.0	108 x 1	98.1	0.4	1.5
1 x 219	70.9	12.9	16.2	219 x 1	68.5	20.7	10.8
1 x 414	55.9	13.3	30.8	414 x 1	59.1	27.7	13.2
1 x 521	78.5	18.4	3.1	521 x 1	78.0	18.9	3.1
1 x 563	57.6	40.1	2.3	563 x 1	54.2	42.8	3.0

1	x	647	86.1	9.6	4.3	647	x	1	86.2	11.6	2.2
108	x	216	71.5	13.0	15.5	219	x	108	65.0	19.0	16.0
108	x	414	76.7	0.6	22.7	414	x	108	74.8	5.3	19.9
108	x	521	26.6	63.2	10.2	521	x	108	26.5	65.4	8.9
108	x	563	29.0	58.0	13.0	563	x	108	34.0	49.0	17.0
108	x	647	83.9	10.8	5.3	647	x	108	85.8	11.6	2.6
219	x	414	60.9	7.5	31.6	414	x	219	62.7	3.3	34.0
219	x	521	73.4	20.2	6.1	521	x	219	79.5	17.2	3.3
219	x	563	72.1	26.2	1.7	563	x	219	68.9	26.8	4.3
219	x	647	98.6	0.7	0.7	647	x	219	97.5	0.7	1.8
414	x	521	44.0	21.8	34.2	521	x	414	46.0	21.1	32.9
414	x	563	67.1	27.3	5.6	563	x	414	66.7	27.7	5.6
414	x	647	71.5	1.3	27.2	647	x	414	73.4	2.0	24.6
521	x	563	88.3	9.1	2.6	563	x	521	93.9	3.1	3.0
521	x	647	77.8	19.5	2.7	647	x	521	75.0	20.5	4.5
563	x	647	86.5	12.8	0.7	647	x	563	86.1	13.8	0.1

(A): normal pollen, (B): underdevelopped pollen,

(C): inert pollen; detailed explanation in text.

(3) Variation of normal pollen percentage among various hybrids.

Table 5. Variation of the percentage of normal pollen.

Anal. Vars.	100	95	90	85	80	75	70	65	60	55	50	45	40	30	20	10	0	Totals
1	11	28	20	10	11	7	7	5	7	4	3		3	1	1			118
100	10	25	9	20	13	7	7	5	3	3	6	4	2	2				116
219	17	16	10	17	12	6	10	6	4	3	4	3	3	1		1	1	114
414	5	3	2	4	9	6	12	15	15	14	13	9	5	3				115
521	3	17	8	8	11	9	5	14	7	4	8	5	13	3	4			119
563	6	11	16	12	8	7	5	4	10	6	7	4	7	8	2	2		115
647	10	26	18	15	14	7	9	5	5	5	1	1	2					118
Totals	62	126	83	86	78	49	55	54	52	39	42	26	35	17	7	3	1	815

Variation of normal pollen percentage among the hybrids between each of the analysing varieties and respective varieties is given in Table 5. Normal pollen percentage ranged roughly speaking from 100% to 0%, and relatively high percentages were larger in number. And they seemed to be grouped into several classes, such as 100%-90%, 85%-75%, 70%-55%, 55%-40% and so on.

Variation of the percentage of inert pollen among various hybrids was, as given in Table 6, seemingly continuous, and hybrids showing high percentages of inert pollen were relatively few with the exception of the hybrids with 414.

Table 6. Variation of the percentage of inert pollen.

Anal. Vars	0	5	10	15	20	25	30	35	40	45	50	60	100	Totals
1	31	40	26	6	6	3	2		2	1		1		118
108	28	53	17	13	2	2			1					116
219	42	31	14	12	6	3	2			3			1	114
414	8	7	21	18	18	11	10	11	8	2	1			115
521	28	61	19	6	2	2		1						119
563	26	44	20	8	9	3	3				2			115
647	31	59	15	2	2	3	1	2	2			1		118
Totals	194	295	131	66	45	27	18	14	13	6	3	2	1	815

Table 7. Correlation between normal pollen percentage (A) and inert pollen percentage (C).

C \ A	100	95	90	85	80	75	70	65	60	55	50	45	40	30	20	10	0	Totals
0	62	62	21	13	10	7	8	4	2	1	2	1	1					194
5		64	47	43	35	18	13	21	17	12	12	4	5	2	2			295
10			15	22	15	12	15	10	9	8	7	5	10	2	1			131
15				8	12	5	6	8	10	3	2	2	3	5	1	1		66
20					6	5	5	3	4	3	5	3	7	2	1	1		45
25						2	7	2	3	3	2	1	3	2	1	1		27
30							1	3	2	3	4	1	2	2				18
35								3	3	1	1	6						14
40									2	5	4	1	1					13
45											2		2	2				6
50											1	2						3
60													1		1			2
100																	1	1
Totals	62	126	83	86	78	49	55	54	52	39	42	26	35	17	7	3	1	815

Between normal pollen percentage and inert pollen percentage such a correlation as shown in Table 7 was found: The proportion of inert pollen (C) to under-developped pollen (B) was found to be different with the cross, even though normal pollen percentage being the same. Therefore, how to express the abnormality of pollen may be a problem. In the present study, the hybrids of more than 87.5% in normal pollen percentage were regarded conveniently as free from sterility, and those of less than 87.5% were divided into several classes in accordance with the relation of normal pollen percentage and inert pollen percentage. (vide Table 11)

Certain crosses between the analysing varieties, 1×108, 219×647, and 521×563, did

not show hybrid sterility as mentioned above. Whereas, there was found a number of such varieties as showing sterility in the hybrid with one of these analysing varieties, but not with the other. In other words, among three varieties, A, B, and C, A×B and B×C are free from sterility, while B×C is sterile. Having taken out such cases from the whole of the crosses observed in the present work, numerous cases as listed in Table 8 were found. In these cases, the percentage of normal pollen in A×C varied roughly speaking from 85% to 45%, and percentages round 70% were large in number. This phenomenon is found also in the results of Terao and Mizushima (7), and seems to be a characteristic of the intervarietal hybrid sterility in rice plant.

Table 8. List of varieties as giving fertile hybrid with one and sterile hybrid with the other of two analysing varieties which are fertile with each other (A×B and B×C are fertile, but A×C is sterile).

No.	Variety A	Variety B	Variety C (Nos. of varieties)	Num. of vars.
(1)	1	108	315, 325, 419, 440, 644, 716, and 721	7
(2)	108	1	109, 111, 221, 244, 417, 504, 546. 624. 655, 703, 706 710, 715, 734; 739, 757, 833, 871, and 1098	19
(3)	219	647	2, 51, 104, 115, 427, 445, 451, 538, 552, 566, 571, 701, 719, and 1091	14
(4)	647	219	220, 318, 321, 546, 708, 766, and 777	7
(5)	521	563	25, 33, 104, 115, 143, 259, 272, 325, 451, 501, 538, 644, 707, 712, 736, and 868	16
(6)	563	521	244, 319, 336, 655, and 757	5

(4) Differentiation of the reaction type of hybrid sterility among the varietieties of Eastern Asia.

The reaction type of hybrid sterility of a given variety will be represented to some extent by whether the variety would show sterility or not in the hybrids with definite analysing varieties respectively. Thus, denoting a hybrid of more than 87.5% in normal pollen percentage by a plus sign, and less than 87.5% by a minus sign, the reaction type of the variety will be represented by a combination of seven plus or minus signs. By using this method, to distinguish different reaction types $2^7=128$ in total number will be possible.

Having investigated the frequency of each of possible reaction types found actually among the used varieties, thirty-one kinds as given in Table 9 were found out.

Table 9. List of the reaction types found among the used varieties.

No.	1	108	219	414	521	563	647	Num. of vars.	No.	1	108	219	414	521	563	647	Num. of vars.
1	+	+	−	+	−	+	+	1	17	−	+	+	−	−	+	+	2
2	+	+	−	+	−	−	+	2	18	+	−	+	−	+	−	+	3
3	+	+	−	+	−	−	−	4	19	−	−	+	−	−	+	+	4
4	+	−	−	+	−	−	−	1	20	+	−	+	−	−	−	+	3
5	−	−	−	+	−	−	−	1	21	−	−	+	−	−	−	+	12
6	+	+	+	−	−	+	+	1	22	−	−	+	−	−	−	−	5
7	+	+	−	−	−	+	+	2	23	+	−	+	−	+	+	−	1
8	+	+	+	−	−	−	+	3	24	−	−	−	−	+	+	+	4
9	+	+	−	−	−	−	+	4	25	−	−	+	−	+	+	−	1
10	+	+	−	−	−	+	−	4	26	+	−	−	−	+	+	−	1
11	+	+	−	−	−	−	−	20	27	−	−	−	−	+	+	−	5
12	+	−	−	−	−	−	−	7	28	−	−	−	−	−	+	+	1
13	−	+	−	−	−	−	−	4	29	−	−	−	−	−	+	−	1
14	−	+	+	−	+	+	+	1	30	−	−	−	−	+	−	−	2
15	+	−	+	−	+	+	+	3	31	−	−	−	−	−	−	−	7
16	−	−	+	−	+	+	+	6									

These reaction types were placed in order in conformity with the number and position of plus or minus signs, and any two reaction types same to each other excepting one sign were connected by drawing a line. In other words, these reaction types were arranged in the order of their mutual similarity. And the result as given in Table 10 was obtained.

It will be seen in Table 10 that the reaction types of the used varieties are to be classified into two main groups, I and II, and each group is divided again, though a little less clearly, into two minor groups, a and b. However, a part of them in group II, as seemingly belonging to both of IIa and IIb, was grouped to be IIab. And a few varieties gave sterile hybrids with every analysing varieties, resulting a reaction type as consisting of seven minus signs. They could not be connected with any of the groups, and remained as "indistinct group".

The characteristics of these reaction type groups as shown by the pollen sterility in hybrids with respective analysing varietes are summarized in Table 11. Varieties belonging to group Ia all gave fertile hybrids with 414, and showed different percentages of normal pollen with other analysing vareties, expressing relatively high percentages of inert pollen. A greater part of varieties belonging to Ib group gave fertile hybrids with 1 and 108, and showed high percentages of inert pollen with 414. IIab produced fertile hybrids with 219, 521, 563, and 647. IIa were consisted of such varieties as producing fertile hybrids with 219 and 647, and IIb with 521 and 563.

Table 10. Reaction types of hybrid sterility arranged in comformity with their mutual similarity

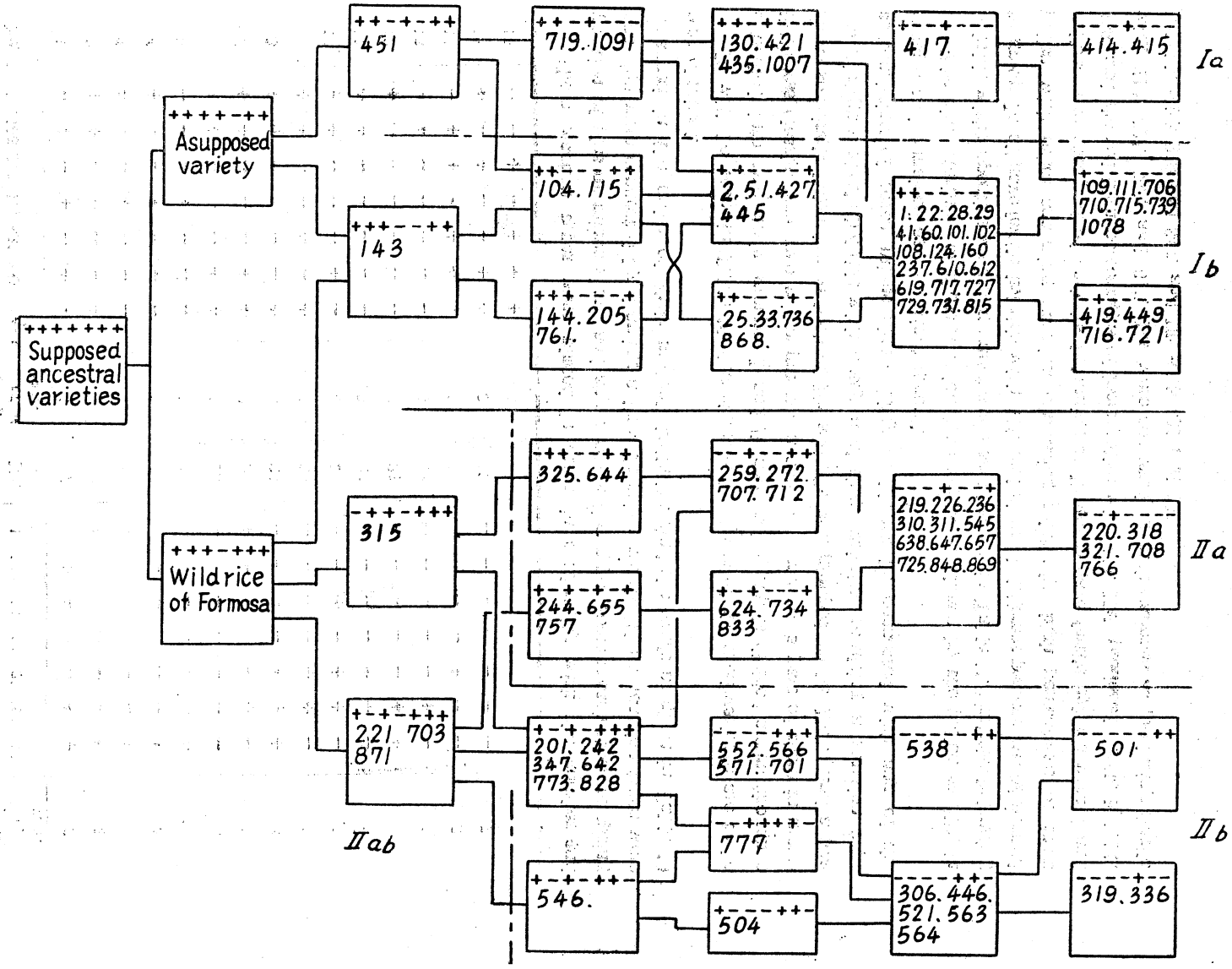


Table 11. Characteristics of pollen sterility of the reaction type groups.

Group Ia

	I	II	III	IV	V	VI
1	8			2		
108	7			3		
219		4	1	3	1	1
414	10					
521			6		4	
563	1	1	2	1	5	
647	3	3		4		

Group Ib

	I	II	III	IV	V	VI
1	41		1	3		
103	37	2	3	2	1	
218	4	9	7	18	7	
414		3	2	33	1	6
521		18	10		16	1
563	7	4	15	4	11	4
647	10	18	9	5	2	1

Group IIab

	I	II	III	IV	V	VI
1	3	2	2	1	2	
108	1	5	2	2		
219	10					
414			1	7		2
521	10					
563	10					
647	10					

Group IIa

	I	II	III	IV	V	VI
1	6	13	3	6	1	
108	2	15	7	3	1	1
219	29					
414		2	6	17		4
521	3	9	14		3	
563	6	13	7	1		2
647	24	3	2			

Group IIb

	I	II	III	IV	V	VI
1	2	3	6	4	1	
108		2	8		5	1
219	2	9	5			
414		2	5	5	2	2
521	14	1	1			
563	14	1			1	
647	5	6	5			

Remarks :

	Normal pollen (A)	Inart polleu (C)
I	Over87.5%	-
II	87.5-75.0	0-12.5
III	75.0-50.0	〃
IV	87.5-50.0	Over12.5
V	50.0- 0	0-25.0
VI	〃	Over25.0

(5) Geographical distribution of the reaction type groups and their relafion with Continental and Insular variety groups.

Geographical distribution of the above mentioned reaction type groups is given in Table 12. It will be seen in Table 12 that Group Ia is distributed over India and China Continent, Group IIb over India, Indochina, China and Formosa (native vars. of plain part), Groups IIa and IIab mainly. in Sunda Islands, Celebes, Philippine, Hai-Nan Island and Formosa (native vars. of mountain part) and Group IIb mainly in Japan. In shortwords, Group I will be found mainly in Asiatic Continent, and Group II in the islands of Western Pacific. Thus, a tendency analogous to the cases of various characters as mentioned in the preceding study is found, and an intimate relations will be inferred between the reaction types of hybrid sterility and Continental-Insular variety groups.

Table 13 gives the relation of the reaction type of hybrid sterility to the variety groups which were pointed out in the preceding study. Continental and Insular variety groups were found to be nearly equivalent to reaction type groups I and II respestively. And varieties belonging to Tropical Insular and Temperate Insular gronps were preponderant in Groups IIa and IIb respectively. It will be concluded, therefore, that the reactiontype groups of hybrid sterility are corresponding to Continental-Insnlar variety groups.

Table 12. Geographical distribution of the reaction type groups.

Districts	Reaction type groups Ia	Ib	IIa	IIab	IIb	Indistinct	Num. of varieties
Indochina		10					10
India & Siam	6	4			1	1	12
Formoss (plain part)	1	11			1		13
China Formosa (mountain part)	3	12	5	1	1	1	23
		2	3	2			7
Hai-Nan Island		1	2	1	1		5
Philippine		2	7	2		1	13
Cel,ebes		3	6	1			10
Sunda Islands			5	2	3	1	11
Japan (lowland vars.)			1		7		8
Jaqau (upland vars.)					2	3	5
Total	10	45	29	10	16	7	117

Table 13. Relation between the reaction type groups and Continental-Insular variety groups.

Variety groups	Reaction type groups Ia	Ib	IIa	IIab	IIb	Indistinct	Totals
Continental	10	42				2	54
Indistinct (Continental or Insular)		2	2	2	1	1	8
Insular (in total)			27	8	15	4	54
Tropical			20	5	5	3	33
Temperate			7	3	10	1	21
Totals	10	44	29	10	16	7	116

Discussion

Considerations on the genetical mechanism of intervarietal hybrid sterility in the rice plant will be mentioned in another paper, but some evidences on it will be in our hands now. It has been pointed out by Terao and Mizushima (7) and also by the author that the behavior of chromosomes is regular in the meiosis of a sterile hybrid. Therefore, the assortment of chromosomes must be numerically normal. Further, as no significant difference is found between reciprocal crosses, cytoplasmic differences seem to have no bearing on this hybrid sterility. And sterile gametes are produced in a proportion definite with the cross. It may be inferrable, therefore, that the gametes possessing a definite gene combination are degenerated. If it were necessary for the development of a gamete to possess at least one dominant allelomorph of duplicate factors X_1 and X_2, varietal cross $X_1x_2 \times x_1X_2$ would produce x_1x_2 gamete to be degenerated. Different percentages of normal pollen will be explainable by the duplicaton of such a

genetical mechanism. This assumption goes well in explaining the cases as among three varietics A, B, and C, A × B and B × C are fertile, while A × C is sterile. According to these thinkings, even if two given varieties did not show sterility in their mutual hybrid, they may not necessary be identical in the combination of gamete development factors. Nevertheless, the higher the sterility is, the larger will be the genic difference between the two parental varieties as a whole.

Table 10 was obtained, as mentioned in the observation results, by arranging various reaction types in conformity with their mutual similarity. In this table, generally speaking, gene combinations alike one another are placed on a same line, and with more dominant genes being on the lefter side. It will be inferred, therefore, assuming genic changes to go from dominant to recessive, and thus the ancestral varieties to have been dominant for a larger part of factors, that the varieties locating on the lefter hand in Table 10 will be nearer some unknown ancestral varieties from which the present ones have originated. And thus, the classification of reaction type groups in this table will be regarded as a sketch of the pattern of phylogenetic differentiaton of rice varieties.

It was known that various reaction types were to be divided into two main groups and each group again into two minor groups, and the groups were corresponding respectively to Continental, Tropical Insular, and Temperate Insular variety groups which had been established in the preceding study after some variation studies on diverse characters. Therefore, intervarietal hybrid sterility seems to be available as a basis of the classification of Continental and Insular variety groups, and also as an agent to point the direction of varietal differentiation.

Mizushima pointed out recently, after examining the reaction types of various varieties of Japan, Java and America, that the varieties varied continuously from those showing normal fertility with a larger part of analysing varieties to those showing normal fertility only with one or two analysing varieties of Japan or India. The results of the present study seems to be somewhat different from this, however, a conclusion similar with his will be obtained also by arranging the present data by his method.

Further, Table 10 will lead us to some imagination on the nature of wild rice varieties ancestral to the present ones. Such wild varieties, possibly having dominant allelomorphs for a larger part of gamete development factors, may produce fertile hybrids with every varieties as the supposed one shown at the leftest side of Table 10. It will be an interesting fact in this connection that the wild rice of Formosa has given fertile hybrids with all of the analysing varieties except 414, although this may be partly due to the heterozygous nature of the wild rice. (As when normal pollen percentage was different among the hybrid plants with the wild rice, the highest one was taken to be the representive of that cross.) This wild rice is seemingly only a relic form inhabiting in several narrowly limited area which are scattered along a stream. Nevertheless, noteworthy variatiors of characters are found within the colonies. Although such a variation may be partly due to natural hybridization with cultivated varieties,

the richness of variation may probably be an important characteristic of the wild rice in itself. For the purpose of researching the ancestor of rice plant, it seems necessary to advance genetical studies on the populations of the wild rice.

Summary

1. From 120 rice varieties of various districts of Eastern Asia, seven varieties were taken out as the analysing varieties, and were crossed with each of the 120 varieties, and thus each variety was examined as to which analysing varieties would present sterility in the hybrid with the variety, or as to the reaction type.

2. The percentage of normal pollen, by which the degree of sterility was represented, was found to be different with the combination of parental varieties ; and there was no difference between reciprocal crosses.

3. There was found a number of such cases as among three varieties, A, B, and C, A x B and B x C were not sterile, while A x C was sterile.

4. When normal pollen percentage was more than 87.5%, the cross was regarded as free from sterility, and was denoted by one plus sign. Thus, the reaction type of a variety was represented by seven signs (+ or -), where each sign stood for whether the variety was fertile or sterile in the hybrid with each of the seven analysing varieties.

5. Among 128 ($=2^7$) kinds of possible reaction types, only 31 kinds were found actually among the used varieties. These reaction types were arranged in conformity to the number and kinds of analysing varieties showing sterility, i. e. in conformity to their mutual similarity. And it was pointed out that they were to be classified into two groups, I and II, and each group seemed to be divided again into two minor groups, a and b.

6. Group I was found to be equivalent to "Continental" variety group, which had been established in the preceding study. Group IIa and IIb seemed also to be corresponding to "Tropical Insular" and "Temperate Insular" variety groups respectively.

7. It was pointed out, after some speculations on the genetical mechanism of intervarietal hybrid sterility that the classification of reaction types by their mutual similarity as the above mentioned one would serve as a sketch of phylogenetic differentiation of rice varieties.

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Appendix.

Variety no.	Original districts.
1 — 60	Indochina
110—160	Formosa (plain part)
201—272	Philippine
306—347	Sunda Islands
414—451	India & Siam
501—571	Japan
610—657	Celebes
701—739	China Continent
1001—1098	China Continent
828—871	Formosa (mountain part)

Vol. 3, No. 1 March, 1952

AGRICULTURAL RESEARCH

CONTENTS

Effects of Same Minor-elements on the Nursery Bed of Rice Plants

1. Effect of Its Simple Application on Growth of Rice Seedlings ..... S. C. Shyu... 1

Studies on the Medical Treatment of Roundworm in Pigs...Y. K. Cheng & Y. C. Lee...16

A Report on the Adaptation Test of New Hybrid Varieties of Sweet Potato..... T. S. Mou...22

Studies on the Increase of Egg-weight During the first Laying Year in W. S. C. Leghorns ..... T. Y. Lee...37

Phylogenetic Differentiation of the Cultivated Rice Plant

II. Intervarietal Hybrid Sterility..... Hikoicho OKA...50

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