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# 農業研究

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# EFFECTS OF SPLIT APPLICATION OF FERTILIZER AND PLANTING DENSITY ON YIELD, COMPONENTS OF YIELD, AND OTHER AGRONOMIC CHARACTERS OF RICE (III)

by

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Experimental results obtained at Chiayi Agricultural Experiment Station proved that split application of nitrogen and potash fertilizers was generally effective in increasing grain yield in both the first and the second crops of rice (Chang and Yang, 1964a, b). A favorable effect of split application of potash fertilizer on rice was also observed by Shen and Yuen (1964), and Hong and Kuo (1965). However, split application of phoshoric fertilizer did not show any significant increase in grain yield of rice (Chang and Yang, 1964b). Mitsui (1954) also concluded that sufficient amount of phosphoric fertilizer applied as a basal dressing would be enough to cover the need for a maximum yield production.

The efficiency of fertilizer utilization by the rice plant can be improved if the timing of fertilizer application concurs with the periods of maximum plant uptake. Combinations of split fertilization should, therefore, be tried to evaluate their relative efficiency in relation to increase in grain yield. The relationship between split application of fertilizer and planting density is also worthwhile to investigate, since planting density is an important factor affecting nitrogen response of the rice plant (Matsuo, 1965).

This report presents a summary of the experimental results obtained at Chiayi Agricultural Experiment Station with the hope that the above-mentioned subjects could be better understood.

## MATERIALS AND METHODS

Rice variety Chianung 242 was subjected to 4 applications of fertilizer as given in Table 1 and 2 planting densities, viz., 64 and 96 hills per 3.3 $m^2$. These were combined to make a factorial experiment with 8 treatments arranged in a randomized-block design with 4 replications. Ammonium sulphate, calcium superphosphate and potassium chloride were used as sources of N, $P_2O_5$, and $K_2O$, respectively. Application rates of fertilizers were 80, 40, and 40 for N, $P_2O_5$, and $K_2O$, respectively. Approximately 5 seedlings were transplanted for each hill. The distance between rows was 24 cm while that between hills within a row was 21.5 and 14.3 cm for 64 and 96 hills per 3.3 $m^2$, respectively. The plot was 2.5×4 m in

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Table 1. Treatments of fertilizer application*

| Treatment | Element | Basal dressing | First top-dressing | Second top-dressing | Third top-dressing |
|---|---|---|---|---|---|
| Conventional | N | 50 | 50 | — | — |
| | P | 100 | — | — | — |
| | K | 100 | — | — | — |
| Splitting 1 | N | 40 | 30 | 30 | — |
| | P | 100 | — | — | — |
| | K | 67 | — | 33 | — |
| Splitting 2 | N | 40 | 20 | 30 | 10 |
| | P | 100 | — | — | — |
| | K | 67 | — | 33 | — |
| Splitting 3 | N | 30 | 20 | 40 | 10 |
| | P | 100 | — | — | — |
| | K | 50 | — | 25 | 25 |

* Basal dressing: one day before transplanting.
First top-dressing: Maximum tillering stage or 20 days (2nd crop) and 30 days (1st crop) after transplanting.
Second top-dressing: Panicle initiation stage or 32 days (2nd crop) and 60 days (1st crop) after transplanting.
Third top-dressing: Heading stage or 50 days (2nd crop) and 90 days (1st crop) after transplanting.

size which was equivalent to 10 $m^2$ or 1/1,000 ha.

Data taken included heading date, plant height, weight of panicle, length of panicle, number of panicles per hill, weight of 1,000 grains, number of grains per panicle, grain yield per hectare, length of internodes, lodging, and blast occurrence. All data were subjected to analysis of variance.

This experiment was conducted at Chiayi Agricultural Experiment Station in the second crop of 1964 and the first crop of 1965.

## RESULTS AND DISCUSSION

### Effects of Application of Fertilizer and Planting Density on Yield and Components of Yield.

The average yield, components of yield, and F values from the analysis of variance are given in Table 2.

Table 2 shows that, although not statistically significant, split fertilizations generally yielded better than conventional one in both rice crops. Split Fertilization 3 produced 346 kg or 6.36% and 352 kg or 5.69% more grain yields per ha than conventional fertilization in the second and the first crops, respectively. The highest yield increases previously recorded for split fertilization were 6.75% in the second crop of 1963 (Chang and Yang, 1964a) and 10.75% in the first crop of 1964 (Chang and Yang, 1964b). It appears probable, therefore, that 5 to 6% yield increase could reasonably be expected in both crops when fertilizers are properly splitted.

Table 2. Means and F values of grain yield and components of yield of rice variety Chianung 242 subjected to methods of fertilization and planting densities

| Treatment | Grain yield (kg/ha) | | Number of panicles per hill | | Number of grains per panicle | | weight of 1,000 grains (g) | |
|---|---|---|---|---|---|---|---|---|
| | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 |
| Fertilization | | | | | | | | |
| Conventional | 5,437 | 6,177 | 9.9 | 11.5 | 153 | 121 | 29.8 | 30.8 |
| Splitting 1 | 5,599 | 6,527 | 9.8 | 11.9 | 170 | 128 | 28.7 | 31.4 |
| Splitting 2 | 5,561 | 6,364 | 9.6 | 10.1 | 176 | 130 | 29.1 | 31.9 |
| Splitting 3 | 5,783 | 6,529 | 9.1 | 10.5 | 179 | 131 | 29.0 | 31.3 |
| F value | 2.10 | 1.47 | 1.0 | 4.1* | 10.7** | 2.2 | 13.0** | 2.1 |
| LSD 5% | — | — | — | 1.3 | 10.5 | — | 0.4 | — |
| Planting density | | | | | | | | |
| 64 hills | 5,592 | 6,359 | 10.8 | 12.6 | 172 | 133 | 29.0 | 31.3 |
| 96 hills | 5,598 | 6,440 | 8.4 | 9.4 | 167 | 122 | 29.3 | 31.4 |
| F value | 0.01 | 0.35 | 49.8** | 57.5** | 1. | 11.1** | 8.9** | 0.1 |
| LSD 1% | — | — | 1.0 | 1.2 | — | 9 | 0.3 | - |
| Fertilization × planting density | | | | | | | | |
| F value | 3.11* | 1.10 | 1.78 | 0.47 | 0.9 | 1.7 | 1.7 | 1.7 |

* Difference significant at 5% level.
** Difference significant at 1% level.

Split Fertilization 1 yielded better than Split Fertilization 2 in both crops, indicating spltting ratio of 4:3:3 for nitrogen fertilizer in Split Fertilization 1 was more effective than that of 4:2:3:1 in Split Fertilization 2. Suzuki (1958) also reported that 4:3:3 splitting ratio for nitrogen fertilizer gave the best result. The higher productivity of Split Fertilization 1 may be attributable to the heavier dosage of nitrogen applied at first top-dressing or maximum tillering stage which eventually results in a larger number of panicles per hill.

Split Fertilization 3 outyielded Split Fertilization 1 in the second crop but both fertilization gave almot the same yield in the first one. The higher efficiency of the former may be due probably to heavier dosage of nitrogen applied at second top-dressing or panicle initiation stage. Smaller ratio of potash fertilizer used as basic dressing in Split Fertilization 3 may also have contributed to the increase of grain yield, as suggested by Hong and Kuo (1965). Chang and Yang (1964b) also found that for potash fertilizer, splitting ratio of 6:4 gave better grain yield than that of 6.7:3.3.

The analysis of yield components shows that split fertilizations substantially increased number of grains per panicle and weight of 1,000 grains which may be the factors responsible for the yield increase. The number of panicles per hill was considerably decreased by split applications of fertilizers except Split Fertilization 1 which appeared to have almost the same number of panicles per hill as that of conventional one.

High planting density consistently outyield low one in both rice crops, the percentage of yield increase being greater in the first crop. The yield increase of high planting density was caused largely by the increase of panicles per unit area. The results were similar to those of previous experiments (Chang and Yang, 1964a, b).

It was noted that conventional fertilization and Split Fertilization 1 gave high yield in low planting density while Split Fertilization 2 and 3 yielded better in high planting density in the second crop. In the first crop, the situation was just the opposite. The interaction between fertilization and planting density was significant at 5% level in the second crop but failed to reach a significant level in the first one. Since rice plant appeared to produce larger and heavier panicles with more grains per panicle in the second crop, third top-dressing of nitrogen at heading stage or so-called "grain fertilization" may be quite effective especially to plots of high planting density. The effect of nitrogen fertilization at milk ripe stage was also noted by Matsuwura (1962). In the first crop, however, heavier dosage of nitrogen applied at first top-dressing or maximum tillering stage seems necessary to prevent a drastic decline of effective tillers, especially in the plots of high planting density where competition for nitrogen may be more serious at the early stage of growth. Therefore, it seems reasonable to suggest that nitrogen splitted less than three times with heavier dosage applied at the early stage of growth may be more favorable in the first crop while in the second crop, nitrogen

Table 3. Means and F values of certain agronomic characters of rice variety Chianung 242 subjected to treatments of fertilization and planting density

| Treatment | Heading date (days) | | plant height (cm) | | Panicle weight (g) | | Panicle length (cm) | | leaf blast (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 |
| Fertilization | | | | | | | | | | |
| Conventional | 63 | 87 | 116 | 105 | 4.4 | 3.7 | 24.3 | 21.9 | 15.8 | 25.6 |
| Splitting 1 | 64 | 87 | 116 | 106 | 4.4 | 3.9 | 24.3 | 23.6 | 16.3 | 20.5 |
| Splitting 2 | 64 | 87 | 118 | 106 | 4.9 | 4.1 | 24.9 | 24.0 | 17.6 | 18.4 |
| Splitting 3 | 63 | 87 | 118 | 105 | 4.8 | 4.0 | 25.2 | 24.1 | 14.7 | 18.4 |
| F value | 0.7 | 0.5 | 1.7 | 0.1 | 3.5* | 3.5* | 3.7* | 14.0** | 1.2 | 15.0** |
| LSD 5% | — | — | — | — | 0.4 | 0.3 | 0.7 | 0.8 | — | 2.6 |
| Planting density | | | | | | | | | | |
| 64 hills | 63 | 88 | 119 | 107 | 4.6 | 4.1 | 24.3 | 23.6 | 14.2 | 20.5 |
| 96 hills | 63 | 87 | 116 | 104 | 4.6 | 3.8 | 25.0 | 23.2 | 18.0 | 21.0 |
| F value | 0 | 11.0** | 14.1** | 9.3** | 0 | 11.5** | 6.9* | 2.6 | 11.5** | 0.34 |
| LSD 1% | — | 0.3 | 1.6 | 1.9 | — | 0.3 | 0.5 | — | 2.4 | — |
| Fertilization × planting density | | | | | | | | | | |
| F value | 0.8 | 0.3 | 0.2 | 1.3 | 1.0 | 1.2 | 1.1 | 0.4 | 1.7 | 0.23 |

* Difference significant at 5% level.
** Difference significant at 1% level.

could be splitted more than three times with more emphasis placed at the latter stage of growth, if maximum yield production is to be obtained.

No significant interaction between ferilization and planting density was found in components of yield.

**Effects of Fertilization and Planting Density on some Agronomic Characters.**

A summary of the data and F values computed on these characters are presented in Table 3.

Heading date was not affected by either fertilizations or spacings in both crops. However, in the first crop, rice plant headed significantly earlier in plots of high planting density. Plant height was generally higher when fertilizers were split-applicated, while high planting density significantly shortened the plant height in both crops. Split fertilizations produced larger and heavier panicles than conventional one, the differences being statistically significant, indicating that panicle fertilization was highly effective. High planting density generally produced shorter and lighter panicles. The percentage of leaf blast occurrence was considerably lower in plots of split fertilizations especially in the first crop, suggesting that blast disease could be controlled to some extent by proper application of nitrogen fertilizer. Leaf blast was generally more serious in plots of high planting density. In all characters analyzed, interactions between fertilization and planting density failed to reach a significant level. These observations were generally similar to those of the previous experiments (Chang and Yang, 1964a, b).

**Effects of Fertilizer Application and Planting Density on the Length of Internodes and Lodging.**

The average length of internodes, the percentage of lodging and F values are summarized in Table 4.

It was found that the third, fourth, and fifth internodes were considerably shortened by split fertilizations in comparison with those of conventional one, the difference in the third internode being highly significant in the first crop. However, the first and second internodes of rice plant in plots of split fertilization were longer than those of conventional one, differences being significant at 1% level in the first crop for the first internode and in the second crop for the second internode. From a standpoint of plant type, rice plant with longer internodes at upper culm and shorter internodes at lower part of the culm would appear to be the most productive one. Hosika (1961) reported that the length of the first internode was associated with the yielding ability of rice plant, the longer the first internode, the higher the yield. Furthermore, shorter basal internodes are necessary for lodging resistance, as suggested by Matsuwura (1962). Since the percentage of lodging was relatively low in both crops, no attempt was made to associate lodging with the length of internodes. However, lodging seems highly likely when longer internodes are accompanied with larger and heavier panicles.

Internodes of rice plants were shorter in plots of high planting density than

Table 4. Means and F values of internode length and lodging percentage of rice variety Chianung 242 subjected to methods of fertilization and planting density

| Treatment | Length of Internodes (cm) | | | | | | | | | | Lodging (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | | 2nd | | 3rd | | 4th | | 5th | | | |
| | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 | 2nd crop 1964 | 1st crop 1965 |
| Fertilization | | | | | | | | | | | | |
| Conventional | 43.3 | 38.5 | 22.3 | 21.2 | 15.6 | 13.6 | 9.6 | 6.0 | 3.3 | 0.7 | 26.7 | 0 |
| Splitting 1 | 43.6 | 41.7 | 22.9 | 21.5 | 15.5 | 11.8 | 8.6 | 5.2 | 3.0 | 0.7 | 29.0 | 8.5 |
| Splitting 2 | 44.7 | 41.5 | 23.1 | 21.5 | 14.9 | 12.0 | 8.5 | 5.7 | 3.1 | 0.7 | 29.3 | 0.3 |
| Splitting 3 | 43.6 | 43.0 | 23.4 | 21.8 | 15.1 | 10.7 | 8.1 | 4.6 | 2.8 | 0.5 | 33.4 | 2.1 |
| F value | 1.9 | 27.5** | 5.7** | 0.7 | 2.6 | 8.4** | 2.4 | 2.9 | 0.9 | 0.2 | 0.1 | 4.1* |
| LSD 5% | — | 1.1 | 0.6 | — | — | 1.2 | — | — | — | — | — | 3.5 |
| Planting density | | | | | | | | | | | | |
| 64 hills | 43.4 | 41.3 | 22.8 | 21.6 | 15.5 | 12.4 | 9.5 | 5.6 | 3.3 | 0.6 | 33.7 | 0.5 |
| 96 hills | 44.2 | 41.0 | 23.0 | 21.4 | 15.0 | 11.6 | 7.9 | 5.2 | 2.7 | 0.8 | 25.6 | 2.9 |
| F value | 2.7 | 0.5 | 0.8 | 0.2 | 6.2* | 3.2 | 14.6** | 1.4 | 10.4** | 0.4 | 1.0 | 2.4 |
| LSD 5% | — | — | — | — | 0.4 | — | 0.84 | — | 0.4 | — | — | — |
| Fertilization × planting density | | | | | | | | | | | | |
| F value | 1.3 | 1.6 | 5.1** | 0.5 | 2.0 | 2.5 | 0.5 | 2.0 | 0.4 | 1.6 | 0.2 | 5.6** |

* Significant at 5% level.
** Significant at 1% level.

those of low one, differences in the third, fourth, and fifth internodes being significant in the second crop. Interactions between fertilization and planting density were not significant in most of internodes.

## SUMMARY

The effects of 3 split applications of nitrogen and potash fertilizers and 2 planting densities on yield and some agronomic traits evaluated in the second crop of 1964 and the first crop of 1965 at Chiayi Agricultural Experiment Station are reported.

Split fertilizations generally outyielded conventional one in both crop. The yield increase appeared to be due largely to the increase in either number of grains per panicle or grain weight. Grain yield was also increased by close spacing which was attributable to increase in the number of panicles per unit area. An evidence of interaction between fertilization and planting density was detected for grain yield in this experiment.

The weight and length of panicles were significantly increased by split fertilizations but decreased by close spacing. Heading date and plant height were not significantly affected by split fertilizations. Rice plant was shorter and headed earlier in plots of high planting density.

Split fertilization increased the first and second internodes but decreased the other three indernodes at the lower part of the culm. All internodes were shorter in plots of high planting density. Lodging was relatively light in this experiment.

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# 水稻肥料分施與栽植密度對產量，產量構成因子及其他主要農藝性狀之效果(三)

張萬來　楊遜謙

## 摘　要


本文係報告嘉義農業試驗分所在民國53年第2期作及54年第1期作舉辦三種氮、鉀素肥料分施法及兩種栽植密度對水稻產量、產量構成因素及其他農藝性狀效果之試驗結果。

肥料分施在第1、2期作產量其產量均較慣行法爲佳，其增產原因爲每穗粒數及（或）千粒重之增加。密植亦能增產，其產量之提高乃得自單位面積總穗數之增加。產量在肥料分施與栽植密度之間，有顯著之交感作用。

穗長、穗重皆因肥料分施而顯著增加，但隨栽植密度之增加而減少，生育日數與株高受肥料分施之影響較少。密植可縮短生育日數及減低株高。

稻莖第1及第2節間長度均因肥料分施而增加，惟其餘3節則見縮短。在密植區之稻莖各節之節間長度均較疏植區者爲短，稻田只發生輕微之倒伏，故其與稻莖節間之關係無法詳予考察。

# 印度棉引種之產量分析

孫　貽　謀

## 一、引　　言

世界棉業諮詢委員會第二十二屆年會，於一九六三年四月在印度南部 Baglore 城開會。我國出席年會之代表携回印度棉業研究報告多種，其中印度棉業專報一種，即達1486頁。目前印度棉業之主要資源仍爲印度鷄脚棉 (*Gossypium arboreum L.*)，次之爲草棉 (*Gossypium herbaceum L.*)。因爲印度鷄脚棉之適應能力較强並且容易栽培，合乎「簡易」原則，所以始終爲印度農民所喜種。並且生產成本低廉，一方面經營者之利潤優厚，他方面又能在國際貿易上站立得穩。

本省種植印度棉之時間還不久，近年小規模種植的結果，產量不低於陸地棉，而成本却低廉（約爲陸地棉成本之50%）。印度鷄脚棉除可供製被胎外，品質較優者亦可紡棉紗（十支以上至三十餘支，最低者六支）。草棉之品質可以媲美陸地棉。茲將印度棉在其本土之研究成就及本省近年之試驗結果合述如下以供參考。（本文曾提出農業技術研討會報告）

## 二、印度棉之種類與來源

對於繁複的印度棉種類，起源，演化及分布流傳經過，近世學者如 Hutchinson, Harland, Silow 諸氏研究的結晶可以認爲是研究印度棉各項問題的重要鑰匙。

印度棉之來源最早係由非洲南部 Nagamiland 與葡屬南非洲之灌木叢林地帶之「非洲草棉」而來，其學名爲 *G. herbaceum race africanum*。經過阿拉伯及波斯灣沿岸乃進入印度境內而成今日之一年生「印度草棉」*Gossypium herbaceum race Wightianum*。並由印度草棉分化而成目前栽培之印度鷄脚棉 *G. arboreum L.* 根據 Silow 氏最近棉作分類法，印度鷄脚棉 (*G. arboreum L.*) 包括小種甚多：例如印度小種，孟加拉小種，中國小種等等。草棉與印度鷄脚棉之間，有一項多年生棉曰 Rozi，在分類上應屬印度鷄脚棉，而其外表形態則似草棉。此亦爲草棉分化而成印度鷄脚棉之一證據。

今日「印度草棉」*G. herbaceum race Wightianum*，在印度紡織業上，佔據極重要地位，因纖維長而脫粒易，衣分又高。印度草棉在農藝上亦有特點，即棉蒴開張角度小而抗風，又播種期較遲而適於晚播。尤其孟買周圍草棉區之 *Wagad 8* 品種生長極强，至8,9月尚可播種。按孟買草棉區之緯度與雨季，相同於本省之臺南，故孟買周圍之草棉可資本省借鏡之處頗多。

草棉在土耳其者曰 *Kuljianum* 小種；在伊朗者曰 *persicum* 小種，亦均爲有用之材料。

至於印度鷄脚棉之種類，甚爲繁複，且與地區名稱相混。此類棉種幾佔印度棉作面積之半，在南部者多屬 *Indicum* 小種，在中部與北方者多屬 *Bengalense* 小種，在東部者尚有 *Cernum* 小種。其中面積最廣而品種最多者爲 *Bengalense* 小種，此項小種之諸品種可簡單的分爲四型：(1)白花紫心鷄脚葉者統稱曰 *Roseum* 型；(2)黃花紫心鷄脚者統稱 *Verum* 型；(3)白花紫心普通葉者統稱曰 *Cutchicum*型；(4)黃花紫心黃通葉者統稱曰 *Malvense* 型。

舉例言之，印度南部之鷄脚棉品種如 *Gaorani 6, Gaorani 12, Karungann 2, H. 420, Cocanadas 2* 等品種均屬 Indicum 小種。

印度北部之 *U. P. desi, 35/1, Roseum 231, Ganganagar 1* 等爲 *Roseum* 型。印度中部之 *Virnar, Jarila, Pratap, Mathio* 等品種爲 *Verum* 型。印度中部之 *Malvi, Malini* (*M. 5A*) 等爲 *Malvense* 型。旁遮普省之 *Mollisoni* 品種則爲 *Cutchicum* 型。

除了草棉和鷄脚棉兩種以外，印度更種植陸地棉 *G. hirsutum L.* 約佔全面積之 15-20%。更於 Kerala 地區種植少量之海島棉 *G. barbadense L.*，目前已相當成功。

## 三、印度棉之品種

印度全境之內，現有優良品種數目頗多。計草棉品種11個已正式命名，鷄脚棉品種23個，陸地棉品種18個；海島棉品種1個。詳見印度棉業專報卷1第5章。此項品種多由選種而來，亦有由雜交育成者，至於引種而得者甚少。

依地域而分，品種數目以孟買區最多，計30品種：其中計草棉8個品種如下：*Wagad 8, Digvijay, Wagotar, Kalyan, Suyog, Vijalpa, B.D. 8., Vijay*。又鷄脚棉品種17個如下：*Jarila, Virnar, Y. 1., Pratap, C.J. 73, V 434, V 262, Gaorani 6, Gaorani 12, Daulat, Malini, H 420, Raichur 19, H. A. 11, No. 91, 1585, 1422*。又陸地棉品種5個如下：*Buri 107, Buri 034, 170-Co. 2, 134-Co. 2 M, Parbhani-American 1*。

馬特拉斯區，計16品種：陸地棉11個品種如下：*Co. 1, Co. 2, Co. 3, Co. 4, 4466, 920, M. C. U. 1, M. C. U. 2, 9030, 9030G, 0734* 等。鷄脚棉5個品種如下：*C. 7., K. 1, K. 2, K. 5, 6186-9* 等。

Madhya 邦現有9個品種；計鷄脚棉7個品種如下：*Malvi 9, Malvi 10, Malvi 12, Bhoj, Nimar 1, Nimar 2, Maljari*, 等，又陸地棉2個品種如下：*Indore 1, Indore 2.*

Mysore 區現在有8個品種，其中陸地棉品種3個如下：*Laxmi, M. A. 2, M. A. 5.* 草棉品種3個如下：*Sel. 69, Jayawant, Jayadhar*, 陸地棉品種2個如下：*D. 1, Gadag 1.*

Andhra 邦現在8個品種，鷄脚棉4品種如下：*Rayalaseema 1, 2196-4, 1821-1-1, N14* 等；陸地棉2品種如下：*C1, C2* 等；草棉2品種如下：*H1*，*H25*。

旁遮普省現有7品種；其中陸地棉5品種如下：*H14, L.L. 53, L. L. 54, 216F, 320F* 等；鷄脚棉2品種如下：*Roseum 231, J-34.*

Uttar 邦現在有4品種：其鷄脚3品種如下：*35/1, C. 520, C. 402* 等；陸地棉1品種如下：*Perso-American.*

Rajasthan 區有鷄脚棉3品種如下：*Ganganagar 1, M 49-398, M 48-4* 等。

Kerala 區有海島棉1品區種如下：*Andrew*。

Assam 區有鷄脚棉1品種如下：*D46-2-1*

## 四、印度棉之品質

印度棉業卷三專述品質與軋棉貿易運銷。關於品質之檢定如下表。約略言之，草棉之纖維品質高於鷄脚棉之品質，故草棉品質堪與陸地棉相伯仲，因此草棉品質深值吾人注重。

（表一）標準印度棉之纖維品質紡紗價值 (1955-56)

| 品種 | 種類 | 絨長 (mm) | 長度不整齊率 (%) | 絨重 (每cm) $10^{-6}$gm | 拉力 (gm) | 成熟率 M-H-I (%) | 最高支數 |
|---|---|---|---|---|---|---|---|
| *Jarila* | *G. arboreum* | 21.3 | 21.4 | 1,63 | 4.22 | 62- 8-30 | 26 |
| *191-3 (Virnar)* | 〃 | 22.6 | 18.5 | 1,96 | 4.74 | 64- 8-28 | 27 |
| *H. 420* | 〃 | 22.6 | 12.8 | 2.43 | 5.56 | 72- 8-20 | 27 |
| *Gaorani 6* | 〃 | 21.5 | 12.9 | 1.97 | 5.50 | 77- 6-17 | 31 |
| *Gaorani 12* | 〃 | 22.0 | 14.9 | 1.72 | 4.66 | 70- 7-23 | 36 |
| *Karunganni 2* | 〃 | 21.8 | 20,7 | 2.22 | 5.43 | 74- 5-21 | 26 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Karunganni 5* | *G. arboreum* | 22.4 | 21.3 | 2.11 | 5.24 | 71- 9-20 | 28 |
| *Nandyal 14* | 〃 | 22.2 | 15.6 | 2.07 | 6.05 | 73- 7-20 | 29 |
| *Vijay* | *G. herbaceum* | 22.7 | 14.0 | 1.83 | 5.61 | 66- 9-25 | 38 |
| *Surat (1027 A.L.F.)* | 〃 | 24.6 | 16.6 | 2.20 | 5.54 | 64- 8-28 | 31 |
| *Vijalpa (2087)* | 〃 | 24.0 | 18.3 | 1.80 | 4.70 | 63- 7-30 | 37 |
| *Kalyan* | 〃 | 21.2 | 17.1 | 1.86 | 3.60 | 46-13-41 | 25 |
| *H1 (Western 1)* | 〃 | 21.8 | 12.9 | 1.95 | 3.72 | 55-11-34 | 32 |
| *Jayadhar* | *A hybrid* | 22.4 | 16.8 | 2.02 | 4.04 | 66-11-23 | 36 |
| *Laxmi (9-3)* | *G. hirsutum* | 22.7 | 21.6 | 1.31 | 3.02 | 34-11-25 | 46 |
| *L.S.S.* | 〃 | 22.0 | 19.0 | 1.72 | 4.00 | 62-10-28 | 29 |
| *320 F.* | 〃 | 23.1 | 19.3 | 1.77 | 3.85 | 62- 8-30 | 34 |
| *Buri 0394* | 〃 | 24.0 | 18.7 | 1.82 | 4.08 | 60-12-28 | 37 |
| *P.A. 1* | 〃 | 23.1 | 26.1 | 1.71 | 3.30 | 45-16-39 | 30 |
| *Cambodia (Co.2-440)* | 〃 | 22.5 | 20.8 | 1.66 | 3.49 | 53-11-36 | 30 |
| *M.C.U. 2.* | 〃 | 23.6 | 27.5 | 1.35 | 3.30 | 43-13-44 | 41 |
| *M.C.U. 1 (Winter)* | 〃 | 21.8 | 20.7 | 2.22 | 5.43 | 74- 5-21 | 26 |

## 五、印度棉栽培法

印度棉業卷二詳述生理研究與農藝栽培研究。在農藝研究中着重於肥料與灌溉，以期挽回印度棉區地力衰退之趨勢。茲將栽培各端分述如下：

1. 灌溉：除一部份陸地棉以外，印度棉田多無灌溉。目前有灌溉之處，佔棉田 6 %，分布於 Punjab, Uttar, Madhya, Andhua, Madras 等地。陸地棉灌溉爲5–6次，每次 3 時水量；水源則利用井水，深井水，塘水，河水。灌溉方法多爲「表土」面灌水法，而無地下灌水法或噴灑灌水法。

2. 播種期：鷄脚棉多在六、七月；草棉可遲至八、九月；北部陸地棉播種在四、五月；而南部分夏，冬二作。

3. 播種法：陸地棉、草棉、鷄脚棉均爲條播或點播，僅 Mewar 區之鷄脚棉爲撒播，行株距隨各地而不同。

4. 肥料：在 1950 年前，很少有施肥料的習慣。最近爲 40–0–0 者居多。燐鉀功效不明顯。

5. 間苗：鷄脚棉 (*G. arboreum*) 均不間苗，其他亦有間苗者。

6. 生長促進素：在鷄脚棉田中，施用生長促進素 N.A.A. 功效頗著。其濃度爲10–20 p.p.m. 其他棉種則無功效。

7. 採收：草棉之採收常連蒴壳一同收穫，此外多以手採籽棉爲多。

## 六、印度棉之病蟲害

1. 病害情形：印度棉病害計有枯萎病，根腐病，炭疽病，幼苗猝倒病，腰折病，菌核枯萎病，鈴腐病，濕枯病，角斑病等。而印度鷄脚棉品種，多有抵抗角斑病之能力，此因印度鷄脚棉經過長時期自然淘汰與選擇之故。就一般而論，印度棉之病害抵抗力較强，易於栽培。

2. 蟲害情形：印度棉蟲害計有紅鈴蟲，金鋼鑽，棉浮塵子 (Jassid)，棉白蠅，棉象鼻蟲，捲葉蟲，蚜蟲，棉薊馬，鑽莖蟲，螞蚱，蟋蟀，赤星椿象，棉椿象等。其中印度之浮塵子與本省二點小綠浮塵子不同。

## 七、印度棉引入本省經過

1933～1934年分別引進印度棉23品種，由嘉義農事試驗支場保存種植，至1945年光復時尚保全

各品種種子。印度草棉 (*G. herbaceum L.*) 三品種種子係 1940年由日本京都帝國大學教授山下孝文寄交嘉義農事試驗支場保存種植，在光復後未曾見到，似已在戰時損失。以上品種多係輾轉引入本省。來源以印度之孟買省爲主，其緯度與本省西南部同。

光復以來，本省種植印度鷄脚棉雖極粗放，而單位面積之產量頗豐。1964年向印度農業部引進印度鷄脚棉 3 品種，草棉 2 品種。試種結果頗佳，詳見表四。1965年繼續向印度引進中。

本省栽植陸地棉已有數十年之歷史，但因栽培困難而未得大量栽培。印度鷄脚棉在此方面略勝一籌，栽培頗易。

印度鷄脚棉在臺灣省之單位面積產量，比較在印度本土之單位面積產量，高出甚多。其原因何在，今尙未全明。

根據印度近年研究統計，印度鷄脚棉等最近十四年之平均產量，每公頃僅產皮棉98.9公斤，卽籽棉約300公斤上下。又根據印度鷄脚棉在印度本土之試驗成績，平均籽棉產量爲 841 kg/ha。但本省成績則在一倍以上。下列數點，可能爲高產量之原因：

1. 開花數目：

印度鷄脚棉在印度本土之開花數目不多，例如1948年 Dastur 氏之生長促進素試驗，記載鷄棉品種 *Malvi 9* 之開花平均數爲 17.2～21.2 個，但 1965 年本省種植35/1之每株開花數在 57 以上，甚至可達200個左右。此爲極顯著之例證。

2. 結鈴率：

在印度之鷄脚棉，由花成鈴之百分率，可較陸地棉爲高。在本省之鷄脚棉結鈴率亦高達56%，故總結鈴數因開花數之增加而增加。

3. 氣溫之晝夜差：

印度之棉區，多屬大陸性氣候，故氣溫之晝夜相差甚大，影響花芽形成與自然脫落均大。但本省棉區氣候，乃屬於或近於海洋性氣候；故氣溫之晝夜相差不大，於花芽形成有所裨益。

## 八、印度鷄脚棉在本省之成績

印度鷄脚棉在本省之試驗成績不多，據最近十一年在臺南之紀錄，可得數項成果如下，材料係黃花紫心鷄脚葉（26號）。

1. 產量與雨量之相關現象：

若以每年七月下旬至九月上旬之臺南雨量，與臺南鷄脚棉產量（試驗籽棉），作成相關表，就最近十年（1954～1963）資料計算，則得到明顯的相關係數如表二。$r = -0.63$。在統計立場上已有顯著意義。詳言之，在七月下旬至九月上旬之雨量愈少，產量之增加甚爲顯著！印度鷄脚棉向以不灌溉看天栽培爲主，故無灌溉水量混淆其間。故相關現象甚爲單純。

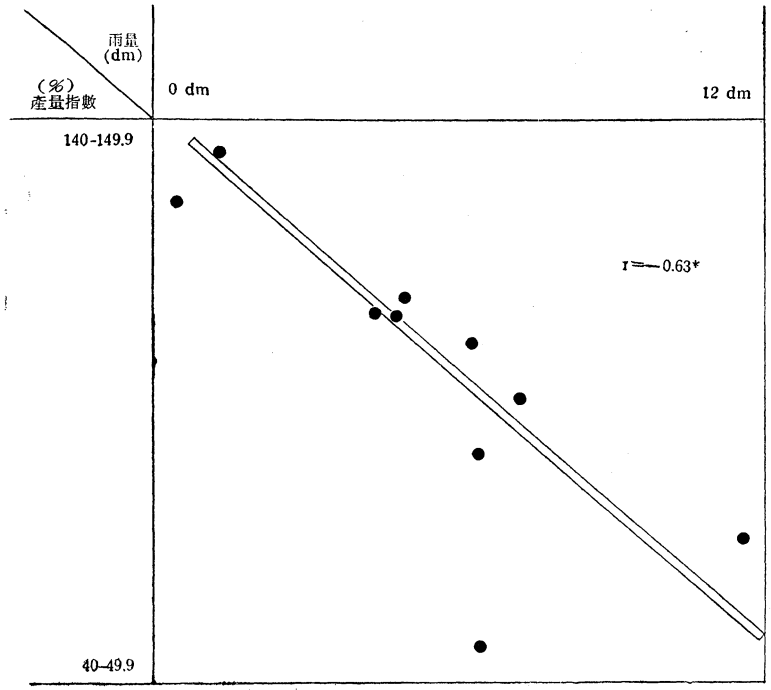
2. 產量與颱風頻率之相關現象：

印度鷄脚棉之若干品種，莖部堅靱，對於風力之抵抗頗强。比較陸地棉之脆弱易折，大不相同。又印度鷄脚棉葉裂甚深，風力之阻滯較少。根據近十一年之紀錄，計算相關係數如下：$r = -0.54 \pm 0.21$ 此項相關現象尙未達顯著程度。足見印度鷄脚棉所受颱風影響不大。尤其播種較遲則颱風季節尙在幼苗期間，不受重大影響。

3. 印度鷄脚棉籽棉產量與陸地棉之比較！

根據近十一年來之籽棉產量紀錄，在同一試驗中，印度鷄脚棉之籽棉產量略高於陸地棉，並且 t 值測定結果，已達顯著程度。茲將十一年來籽棉產量結果，列如表三。

（表二）最近十年鷄脚棉產量指數與雨量相關圖




*註：5% r 顯著值=0.602
1% r 顯著值=0.735

（表三）歷年印度鷄脚棉與陸地棉籽棉產量比較表（1953～1963）

| | 印度鷄脚棉籽棉產量 (kg/ha) | Delfos 關東 119 籽棉產量 (kg/ha) | Empire 籽棉產量 (kg/ha) |
|---|---|---|---|
| 1953 | 1,340 | 1,695 | |
| 1954 | 2,130 | 1,840 | |
| 1955 | 1,925 | 2,115 | |
| 1956 | 880 | 1,030 | |
| 1957 | 2,515 | 2,285 | |
| 1958 | 1,594 | 1,242 | 1,564 |
| 1959 | 1,713 | 1,196 | 1,624 |
| 1960 | 1,256 | 793 | 1,623 |
| 1961 | 2,028 | 1,076 | 1,000 |
| 1962 | 1,982 | 1,608 | 1,624 |
| 1963 | 2,370 | 2,174 | 1,955 |
| 平均值 | 1,796.6 (11年) | 1,550.5 | |
| | 1,823.4 (近6年) | | 1,565.0 |
| 指 數 | 115.9 | 100.0 | |
| | 116.5 | | 100.0 |
| C.V. | 20.6% (近10年) | | |

4. 印度鷄脚棉與陸地棉產量之相關現象：

在同一地區，印度鷄脚棉與陸地棉，在產量上有頗高之相關係數。在近十一年內，r=0.79±0.21

。換言之，凡印度鷄脚棉適宜之年份，陸地棉亦相當適宜。在印度鷄脚棉產量之環境因素內，與陸地棉相同者佔62.3%。就一般而言，本省氣候對於印度鷄脚棉之適應性，高於陸地棉。因爲印度鷄脚棉之蒴果下垂，纖維較粗，栽培簡易，莖幹堅韌，自然脫落較少，多毛茸。均有利於產量之提高。

5. 印度鷄脚棉，草棉重要品種之性狀：

各重要品種之性狀，列如表四。

（表四）印度鷄脚棉、草棉品種記載表

| 品　種 | 成熟期 | 來　源 | 特　徵 | 播種期 | 農藝性狀 | 纖維長度 | 紡紗支數 |
|---|---|---|---|---|---|---|---|
| Rosea 231 (231 R) | 早 | Punjab 地方品種選出 | Roseum 型，高莖（2.5m 上下）莖達60節左右，第10～12節起爲果枝（在印度爲11.1～18.9）小白花，紫心，鷄脚葉，粗幹，開花數多，結實每株可達九十餘鈴。毛茸多，衣分高（43%） | 4～7月（本省爲6月） | 極豐產，性强健，抗角斑病，宜於山地栽培。 | 9/16″ | 6 s |
| 35/1 | 特早 | Uttar 省 | Roseum 型，矮莖（1m 餘），莖只20～30節。小白花，紫心，鷄脚葉。細幹，開花期短，結鈴多，毛茸多，第8節起卽爲果枝，衣分中（37%）籽棉產量2665kg/ha. | 4～7月 | 產量豐，適應廣宜於高緯度栽培。 | 10/16″-12/16″ | 16 s |
| Gaorani 6 | 晚 | Bombay 省之Bani 棉種選出 | 不屬 Bengalense 小種，另屬Indicum 小種，高莖，達 2.5m 以上，粗幹，第15～22節起爲果枝。黃花，紫心，普通葉，花期長，葉少毛茸，衣分低（32%） | 6 月 | 豐產，適應廣。 | 14/16″-15/16″ | 26-28 s |
| 26號 | 早 | 本省在印度棉中選 | Verum 型，矮莖，黃花，紫心，鷄脚葉，花期短，毛茸多，果枝多，衣分29～30% | 6 月 | 產量中等，適應廣。 | 12/16″ | 10-16 s |
| Jayawant | 極晚 | Dharwar 草棉 | Kumpta型，生長期較草棉 Surat 型約短2月。冬季葉乾枯。第二十餘節起爲果枝。矮莖直立性，多假軸性枝，蒴果小，種子小，每株開花數目甚多，幾乎近千。衣分低（26～29%） | 8～9月 | 產量中等 | 13/16″-15/16″（品質細） | 26 s |
| Jayadhar | 極晚 | Mysore 省雜交育種之草棉 | Jayadhar 乃 Jayawant 與 Rosea 之雜交後裔，性狀似 Jayawant 而莖幹較高，第22節起爲假軸性枝（果枝）。抗枯萎病，衣分低（29～30%） | 8～9月 | 產量中等 | 15/16″（品質細） | 36 s |

## 九、摘　　要

不可忽視之印度鷄脚棉，在臺灣省試植之結果如下：

1. 印度鷄脚棉籽棉產量，對於本省西南部之雨量（七月下旬至九月上旬），有明確之負相關（-0.63）。而印度鷄脚棉籽棉產量對於本省近年颱風頻率，並無顯著相關現象存在。$r=-0.54\pm0.21$

2. 印度鷄脚棉在本省西南部之產量，可超出陸地棉 Delfos 關東119品種之產量達15%；較

之印度鷄脚棉在印度之試驗成績平均產量幾達一倍。其原因尚未全明。

3. 印度鷄脚棉之栽培，在本省成功之可能性不下於陸地棉品種。

4. 印度鷄脚棉品質雖不如陸地棉，但印度草棉品質可與陸地棉相埒。草棉生產地大部集中於印度之孟買省。

5. 印度孟買省北部之緯度，與本省西南部相同。自1933年開始引進印度鷄脚棉以來，由孟買一帶引來之品種多可適應本省西南部之環境條件。此後，印度棉品種之引種成功希望不小。

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# YIELD ANALYSIS OF INTRODUCED INDIAN COTTON IN TAIWAN


by

I. M. SUN


## SUMMARY


1. The seed cotton yield of arboreum cotton in the southwestern part of Taiwan is negatively correlated with the rainfall in the period from late July to early September. $r=-0.63$. It is statistically significant. But the seed cotton yield of arboreum cotton is insignificantly correlated with the frequency of typhoon. $r=-0.54\pm0.21$.
2. The seed cotton yield of arboreum cotton in the southwestern part of Taiwan is 15% higher than that of upland cotton Delfos Kwantung 119. It exceed the average trial yield of arboreum varieties in India, 842 kg/ha, at the ratio of about 2:1. The reason why arboreum varieties give such a merit in Taiwan is unknown.
3. The possibility of success in cultivation of arboreum varieties in Taiwan is not less than that of upland cotton.
4. The quality of arboreum cotton can not be in competition with that of upland cotton. Neverthless, the quality of herbaceum cotton is almost equal to that of upland cotton, and the former is produced mainly in Bombay state of India.
5. The latitude of northern part of Bombay state is similar to that of the southwestern part of Taiwan, around cancer. Most of the introduced varieties of arboreum cotton have adapted themselves to the environmental conditions in the southwestern part of Taiwan since 1933. The possibility of success in future introductions of arboreum cotton from India is thought to be high.

# 柑桔砧木試驗

## 第一報「二重接」對於柑桔生理形態及品質變化之研究

翁　仁　祿

### 一、前　　言

本省柑桔製罐工業，由於加工技術之進步及世人之需要而近年來急激發達，可謂前途無限，惟本省主要栽培之柑桔品種『椪柑』『桶柑』等因果形高，種子多，製罐時之崩裂率 (broken) 高。成本增加，又因果肉色淡，白濁程度 (Turbidity) 嚴重，商品價值低，未得國外市場之好評。

溫州蜜柑在目前公認爲最適宜製罐之品種，惟由於本省過去該品種之栽培少，爲迅速收穫該品種果實及繁殖接穗計，近年來採用酸桔砧椪柑及桶柑株盛行高接，另一方面爲獲得抗柑桔萎縮病 (Tristeza) 砧木廣東檸檬種子亦普遍採用酸桔砧晚崙西亞、華盛頓臍橙、椪柑及桶柑等株施行高接工作，惟施行『二重接』者，因多受中間砧木同化養料之支配，樹勢、產量、果形及品質等均易引起變異，並似乎有遺傳至後代之現象。雖一般柑桔接木後發生之變異均以 Sectorial Chimera 或 Pericrinal Chimera 而論，都認爲不影響染色體數，但依接木等營養繁殖方法繁殖者易將母樹性質直傳至後代，爲解決「二重接」柑桔是否仍保持原有特性等問題，須有觀察「二重接」各組合間之親和性與血緣關係之必要。

本研究係採用本省現有之「二重接」溫州蜜柑及廣東檸檬等新梢與果實行鏡檢及分析工作，觀察生理形態及品質之變化，探究「二重接」之實用價值。

本試驗承國家長期科學發展委員會之經費補助得以進行，當試驗進行時，果汁成份分析得林禮輝先生，細胞鏡檢受吳福壽先生協助，又英文部份承蒙臺大蔣明南教授摘譯，特此誌致謝忱。

### 二、材料及方法

(一) 材　料

| 代號 | 處　理　別 |
|---|---|
| 1. | 溫州蜜柑／椪柑／酸桔 (*Citrus unshiu* Marc／*C. reticulata* Blanco／*C. sunki* Hort.) |
| 2. | 溫州蜜柑／桶柑／酸桔 (*C. unshiu* Marc.／*C. tankan* Hayata／*C. sunki* Hort.) |
| 3. | 溫州蜜柑／酸桔 (*C. unshiu* Marc.／*C. sunki* Hort.) |
| 4. | 溫州蜜柑／廣東檸檬 (*C. unshiu* Marc.／*C. limonia* Osbeck) |
| 5. | 溫州蜜柑／枳殼 (*C. unshiu* Marc.／*Poncirus trifoliata Rafin*) |
| 6. | 廣東檸檬／晚崙西亞／酸桔 (*C. limonia* Osbeck／*C. sinensis* Osbeck "*Valencia*"／*C. sunki* Hort) |
| 7. | 廣東檸檬／華盛頓臍橙／酸桔 (*C. limonia* Osbeck／*C. sinensis* Osbeck *Var. brasiliensis* Tanaka／*C. sunki* |

Hort.)

8. 廣東檸檬／椪柑／酸桔
(*C. limonia* Osbeck／*C. reticulata* Blanco／*C. sunki* Hort.)

9. 廣東檸檬／桶柑／酸桔
(*C. limonia* Osbeck／*C. tankan* Hayata／*C. sunki* Hort.)

10. 晚崙西亞／酸桔
(*C. sinensis* Osbeck *"Valencia"*／*C. sunki* Hort.)

11. 華盛頓臍橙／酸桔
(*C. sinensis* Osbeck *Var.brasiliensis* Tanaka／*C. sunki* Hort.)

12. 椪柑／酸桔
(*C. reticulata* Blanco／*C. sunki* Hort.)

13. 桶柑／酸桔
(*C. tankan* Hayata／*C. sunki* Hort.)

14. 廣東檸檬（實生）
(*C. limonia* Osbeck)

15. 酸桔（實生）
(*C. sunki* Hort.)

16. 枳殼
(*Poncirus trifeliata* Rafin.)

註：本報告所用圖表之代號均以本處理爲依據

㈡ 方　法：

A 果實分析：將樣品果實在省農業試驗所園藝系使用 Caliper, Dial thickness gauge 測定果實形狀，果皮厚及瓤皮厚，採用氫氧化鈉滴定法測定枸櫞酸含量，並以折光鏡及底糖比重計測定糖分及比重等，再將每樣果汁送至同所農業化學系採用 Bertrand 法測定還元糖及全糖之含量。

B 細胞組織鏡檢：將供試柑桔春芽用 hand section 法將新芽由先端3～5cm處取得髓部之縱斷面薄片後用顯微鏡放大細胞組織，再用 Abbe 氏描畫器描寫細胞圖後拍照縮小之。

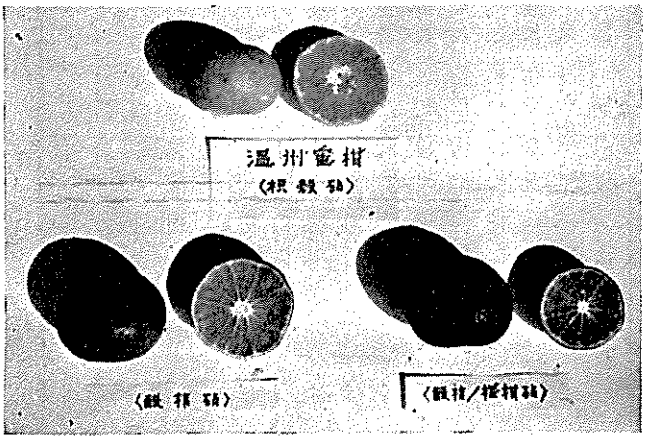
## 三、試　驗　結　果

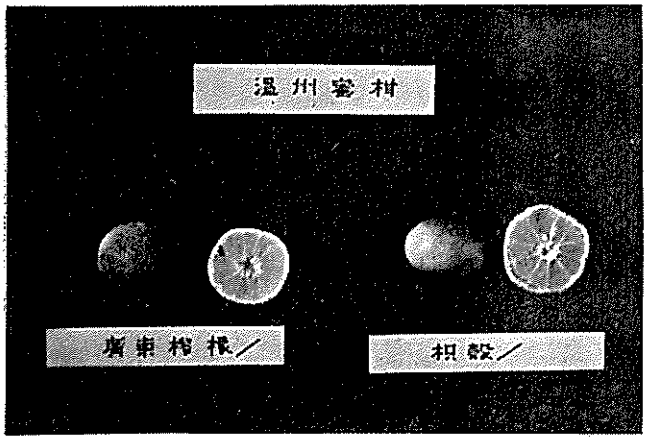
㈠ 果實形狀品質之變化：

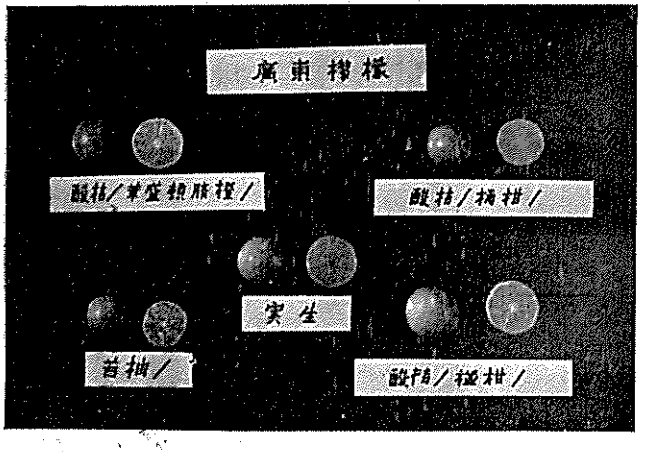
各處理樣品據成熟的前後送至試驗室測定果實外觀果肉品質及果汁成份等，溫州蜜柑部份主要觀察目的爲果實品質之製罐適應性，廣東檸檬部份主要調查項目爲含核量之多寡。如圖一，表一。

A 溫州蜜柑欄中，果形指數大者果形扁平，果瓤指數大者表示每果瓤肥短，製罐率高，製造成本低，適宜製罐。表中 1，2，3，4，及5，五者比較之，「二重接」果實 1 受中間砧木『椪柑』之影響果形較 3 爲高大，果瓤細長，果皮瓤皮均厚，果肉、果汁百分率減低、雖有含核率低之優點，但果肉粗糙，肉色淡，最不適於製罐。另一「二重接」果實 2 受中間砧木「桶柑」之影響較少，果形反較 3 扁平，果瓤肥短果肉果汁百分率增加，還元糖，全糖及枸櫞酸含量高，糖酸比低，種子數略增，以形狀及果汁成份而言，略適製罐，合於處理目的，但果肉組織粗糙，肉色淡，商品價值低。五者中 5 之果形最扁平，果肉緊密，果色鮮紅，最適於製罐。

B 廣東檸檬果實中 6，10及14三者比較之；6 之果實似乎受中間砧木晚崙西亞之影響，果實較 14之果實爲大；果形略扁平，果皮較厚，果肉果汁百分率及還元糖，枸櫞酸含量等雖略見減低，但差異少，種子數增加合於處理目的。




圖一　各種處理之果實形狀

## 表一：果實分析表

| 處理代號 | 供試個數 | 果實 | | | | | | | 果肉 | | | 果汁 | | | | | | | | 種子數 | 果皮厚※8 (mm/100mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 重量 g. | 橫徑 cm. | 縱徑 cm. | 果形指數※1 | 顆數 | 果顆指數※2 | 皮厚 (mm/100mm) | 重量 g. | 百分率 %※3 | 色澤※4 | 重量 g. | 百分率 %※5 | 還元糖 (g/100cc) | 全糖 (g/100cc) | 枸櫞酸 (g/100cc) | 糖分 %※6 | 糖酸比 | 比重※7 | | |
| 1 | 3 | 177.33 | 7.33 | 6.75 | 1.08 | 10.33 | 0.1045 | 407.67 | 125.33 | 70.67 | ++ | 97.00 | 54.76 | 2.94 | 6.19 | 0.54 | 7.27 | 13.50 | 7.50 | 0 | 30.00 |
| 2 | 5 | 147.40 | 6.79 | 5.30 | 1.28 | 11.00 | 0.1164 | 228.50 | 119.40 | 81.00 | ++ | 92.40 | 62.69 | 3.59 | 6.57 | 0.77 | 8.20 | 10.65 | 7.00 | 1.20 | 15.60 |
| 3 | 14 | 163.64 | 7.41 | 6.24 | 1.19 | 11.04 | 0.1058 | 293.00 | 126.64 | 77.39 | +++ | 92.29 | 56.39 | 2.79 | — | 0.46 | 8.10 | 17.61 | 8.50 | 0.57 | 19.93 |
| 4 | 4 | 103.50 | 6.95 | 5.69 | 1.22 | 12.00 | 0.1017 | 354.75 | 80.75 | 78.01 | +++ | 62.75 | 60.62 | 2.95 | 6.21 | 0.82 | 9.05 | 11.04 | 7.00 | 1.25 | 20.25 |
| 5 | 11 | 113.64 | 6.59 | 5.10 | 1.29 | 11.55 | 0.1117 | 280.65 | 82.45 | 73.15 | +++ | 66.55 | 59.03 | 2.85 | 5.48 | 0.55 | 9.52 | 17.31 | 8.50 | 3.55 | 20.60 |
| 6 | 10 | 85.27 | 5.69 | 5.03 | 1.13 | 8.81 | 0.1283 | 227.20 | 57.67 | 67.63 | + | 37.50 | 40.00 | 2.28 | 2.83 | 4.16 | 7.91 | 1.93 | 9.00 | 12.27 | 22.00 |
| 7 | 28 | 56.04 | 4.76 | 4.18 | 1.14 | 8.55 | 0.1333 | 167.00 | 38.30 | 69.05 | + | 23.90 | 43.21 | 2.00 | 2.48 | 5.12 | 8.84 | 1.73 | 8.50 | 8.00 | 24.75 |
| 8 | 10 | 63.00 | 4.62 | 4.60 | 1.01 | 5.90 | 0.1278 | 163.40 | 43.20 | 68.57 | + | 27.60 | 43.80 | 1.65 | 2.23 | 5.43 | 8.02 | 1.48 | 8.00 | 9.80 | 22.80 |
| 9 | 19 | 41.66 | 4.08 | 4.03 | 1.01 | 7.26 | 0.1391 | 152.53 | 30.53 | 73.74 | + | 22.11 | 53.03 | 2.13 | 2.54 | 5.48 | 8.44 | 1.54 | — | 5.32 | 23.63 |
| 10 | 2 | 154.00 | 6.71 | 6.26 | 1.07 | 9.50 | 0.1126 | 341.50 | 115.50 | 75.00 | + | 67.00 | 43.51 | 3.81 | 8.02 | 0.90 | 10.60 | 11.73 | — | 4.50 | 19.50 |
| 11 | 5 | 197.00 | 7.08 | 7.25 | 0.98 | 9.80 | 0.1000 | 350.00 | 154.80 | 75.57 | + | 104.40 | 52.99 | 4.62 | 9.02 | 0.73 | 11.16 | 15.29 | 9.00 | 0.60 | 17.25 |
| 12 | 15 | 206.00 | 7.80 | 6.93 | 1.13 | 10.13 | 0.1116 | 298.27 | 163.80 | 79.51 | +++ | 122.40 | 59.41 | 3.55 | 7.95 | 0.56 | 9.88 | 17.64 | 8.50 | 10.20 | 24.93 |
| 13 | 10 | 198.30 | 7.41 | 6.44 | 1.15 | 9.80 | 0.1173 | 353.40 | 148.80 | 75.04 | +++ | 108.40 | 54.66 | 2.46 | 6.94 | 0.58 | 9.76 | 17.17 | 8.25 | 1.50 | 21.90 |
| 14 | 20 | 56.70 | 4.69 | 4.43 | 1.06 | 7.85 | 0.1350 | 163.20 | 38.63 | 68.33 | + | 26.35 | 46.35 | 2.37 | 2.80 | 4.29 | 7.92 | 1.86 | — | 11.45 | 20.45 |
| 15 | 20 | 28.00 | 4.07 | 3.00 | 1.36 | 8.40 | 0.1619 | 169.40 | 15.68 | 56.00 | + | 12.80 | 45.71 | 1.66 | 5.01 | 2.92 | 9.46 | 3.24 | 5.00 | 14.15 | 21.03 |
| 16 | 30 | 41.83 | 4.07 | 3.93 | 1.04 | 6.53 | 0.1592 | 336.27 | 7.70 | 18.41 | + | 2.9 | 6.92 | 2.16 | 3.37 | 5.15 | 12.67 | 2.46 | — | 56.43 | — |

備註：2，12，16三品種係採用民國五十四年分析結果，其餘13品種係採用民國五十三年分析結果。

※1.果形指數：橫徑／縱徑（商值越大，果形越扁平）。

※2.果顆指數：果型指數／顆數（商值越大，果顆越肥短）。

※3.果肉百分率：果肉重／全果重×100。

※4.果肉色澤：依 Ridgway 1912 Color Standards And Nomenclature, 參考書中 Cadium Orange++++Orange+++Cadium yellow+ 爲標準表示之。

※5.果汁百分率：果汁重／全果重×100。

※6.糖　　分：用折光鏡 (Refractometer) 測定之。

※7.比　　重：用蔗糖計測定之。

※8.顆 皮 厚：用 Dial Thickness gauge 測定之。

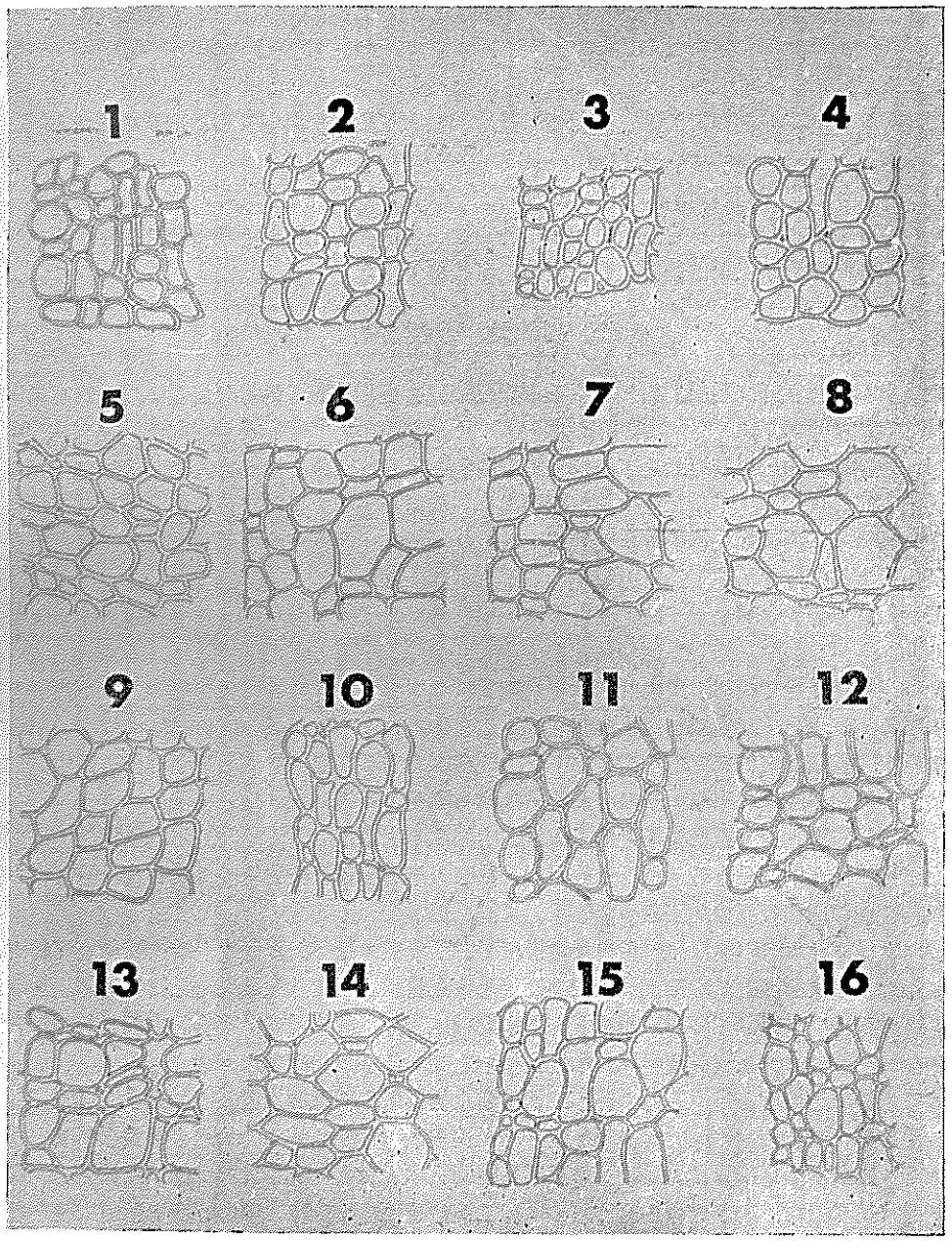
7. 11及14三者之果實相比之；7較14果形略扁平，含糖量低枸櫞酸含量稍高外，差異甚微，含核率減低不合處理目的。

8. 12及14三者之果實相比之；8之果形外觀雖與14相似，惟還元糖，全糖含量激減，枸櫞酸含量高，含核量稍低。

9. 13及14三者之果實比較之，9與13外觀，品質均相似，惟種子量激減，不合於處理目的。

㈢ 細胞組織之變化。

各處理株新萌春芽之髓部縱面切片，採用顯微鏡，用描畫器描寫後拍照縮小如圖二。




圖二　各種處理之幼稚髓縱面細胞組織圖

（註圖內各代號之說明請參考本報告二項材料及方法內之處理別）

A 溫州蜜柑：

1，3，12及15四者比較之，1似乎受中間砧木『椪柑』之影響，細胞之結構與12相似細胞中膠層 (middle lamela) 顯明，細胞間隙 (intercellular space) 較3爲多。

2，3，13及15四者相比之，2之排列及形狀等均略與13及15相似，細胞形狀與13之扁平者有明顯之差異。似乎以桶柑爲中間砧木時接穗部溫州蜜柑細胞組織有不受影響之現象。

B 廣東檸檬；

6，10，14及15相比之，6似乎受中間砧木『晚崙西亞』細長細胞組織之影響，細胞形狀呈長橢圓形與14之扁平方形細胞間有明顯之差異。

7，11，14及15比較之7似乎不受中間砧木『華盛頓臍橙』之影響，細胞形狀，結構、排列等均與14相似。

8，12，14及15比較之，8似乎略受中間砧木『椪柑』之影響細胞形狀略與12相似，但細胞結構 (structure) 未起變化，細胞中膠層不如後者之明顯。

9，13，14及15相比之；9似乎略受中間砧木『桶柑』之影響細胞形狀較14爲圓。

註：本試驗樣品係採自全省各地，由於各地區之氣候，地理環境及新芽着生部位之不同，細胞之大小及細胞膜之生長程度等，可能略受影響。

## 四、結論及討論

由本試驗結果，「二重接」柑桔之生理形態及品質之變化情形，研討各組合間之血緣關係[1]及二重接之實用價值如下：

1. 酸桔作砧木，以較近緣之『椪柑』爲中間砧木，所接溫州蜜柑，果實變高，果瓤瘦長且果皮厚，製罐時剝皮困難，不耐加熱藥品處理等操作，崩裂率甚高，果肉百分率低，瓤皮厚引起加工困難並提高成本，還元糖，枸櫞酸含量略高，糖分低，雖有種子數較少之優點，但果肉組織粗糙，肉色淡白，商品價值低，最不適於製罐。

細胞組織亦易受中間砧木『椪柑』之影響，細胞結構與『椪柑』相似，細胞中膠層顯明，細胞間隙多。

惟採用較遠緣之『桶柑』爲中間砧木時果實即不顯出中間砧木之特性，反呈因親和不良引起同化養料不易下降現象，果實扁平，果瓤肥短，果肉果汁百分率增加，果汁成份濃厚，惟果肉組織粗糙、肉色淡，製罐價值仍低。細胞組織亦不受中間砧木之明顯影響，排列及形狀等雖略與中間砧木『桶柑』，根砧『酸桔』相似，但細胞形狀與桶柑有顯明之差異。

似乎可得二重接溫州蜜柑易受近緣『椪柑』中間砧木之影響而改變品質及細胞結構等，但以較遠緣之『桶柑』爲中間砧木時，即不致於影響接穗部，果實品質及細胞組織等之初步結論（惟本次處理品種及個體數仍嫌過少，須繼續觀察。）

2. 酸桔作砧木，不論採用近緣之『晚崙西亞』『華盛頓臍橙』『桶柑』或較遠緣之『椪柑』爲中間砧木行廣東檸檬之二重接，均無法改變接穗廣東檸檬之果實外型及果肉品質等，惟果汁成份平均略見減少，含核率除『晚崙西亞甜橙』爲中間砧木者，以外均減低，不合於處理目的。惟含核率之增減與砧穗間之血緣關係或中間砧木之含核率之間，似乎無相關關係。

以『晚崙西亞甜橙』爲中間砧木時，二重接廣東檸檬新芽髓縱面細胞似乎易受中間砧木『晚崙西亞』之影響，改變細胞形狀，排列及結構等，但同屬於 Citrus sinensis之『華盛頓臍橙』爲中間砧木時，二重接廣東檸檬細胞組織，似乎不受中間砧木之影響，細胞排列，形狀或結構等均與實生者相似，以『椪柑』或『桶柑』爲中間砧木行二重接時雖略受中間砧木之影響，稍改細胞形狀，

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(1) 田中長三郎 1933 農業及園藝 Val 8, No.3, 707～720

但細胞結構似無改變，由上述結果知由於廣東檸檬樹勢旺盛，不論中間砧木之血緣關係如何，均無法改變二重接廣東檸檬細胞組織及果實品質等，反之含核率減低，不合處理目的。

3. 此等生理形態及品質之變化，是否限於當代或可遺傳至後代等問題須再經一代之嫁接觀察方能決定。

## 五、摘　　要

溫州蜜柑由於果瓤肥短，果肉緊密，含核率低，果肉色鮮紅而公認爲最適製罐之品種，又廣東檸檬，因近年來被認爲最耐柑桔毒素病之砧木而利用現有柑桔成株全省普遍盛行高接繁殖接穗及種子，惟『二重接』柑桔易受不同砧木之影響而改變生理形態及品質等，本試驗從民國五十三年七月起至民國五十四年六月止計一年其目的在調查『二重接』柑桔之生理形態及品質之變化觀察柑桔『二重接』各組合間之親和性與血緣關係以探究『二重接』在柑桔上之實用價值。

1. 本省現有各種砧木之溫州蜜柑果實分析結果，枳殼砧者果瓤最肥短，含核率低，可減低崩裂率，節省工資，且果肉鮮紅，商品價值高，廣東檸檬或酸桔砧者，品質均感有遜色，尤其酸桔砧，再加椪柑爲中間砧木之溫州蜜柑二重接者，果實品質由於果形高，果瓤瘦長，果皮瓤皮均厚果肉百分率低，製罐時之崩裂率，成本均高，果肉淡白，製品價值低，不適於製罐。酸桔砧桶柑再嫁接溫州蜜柑時似乎發生二重接溫州蜜柑同化養料不易通過遠緣之桶柑層，而果型反變扁平，果汁成份較濃厚之現象，惟果肉組織粗糙，肉色淡，製罐價值仍低。

2. 各種不同砧木之廣東檸檬果實分析結果；晚崙西亞橙、華盛頓臍橙、桶柑及椪柑等中間砧木並不影響二重接廣東檸檬之果形果肉、果汁成份等，惟果汁成份平均略見減少含核率除晚崙西亞橙當中間砧木者以外，均減低，不合栽培目的。但二重接廣東檸檬之含核率之增減與砧穗間之血緣關係及中間砧木含核率間，似乎無相關關係。

3. 酸桔作砧木採用近緣之椪柑爲中間砧木，再接溫州蜜柑時，中間砧木之細胞組織易影響至接穗，改變原有溫州蜜柑之細胞組織，細胞中膠層顯明，細胞間隙多，但以較遠緣之桶柑爲中間砧木時，即不致於影響接穗部細胞組織。

4. 酸桔作砧木以他品種柑桔爲中間砧木，再嫁接廣東檸檬時，不論中間砧木與接穗間之血緣關係如何，中間砧木均不易改變接穗廣東檸檬之細胞組織。

5. 此等生理形態及品質之變化，是否限於一代或可遺傳至後代等問題，須再經一代之嫁接方能決定。

# STUDY ON THE PHYSIOLOGICAL, MORPHOLOGICAL AND CITRUS FRUIT QUALITATIVE CHANGES AFFECTED BY DOUBLE GRAFTING

by

J. L. WENG

## SUMMARY

Using topworked trees, a study was made on the effect of an intermediate stock on physiological, morphological and qualitative changes of fruits of Citrus varieties grown in northern Taiwan. The rootstocks used were Sunki or Trifoliate orange and the scion varieties were Satsuma orange and Rangpur lime. In Rangpur lime, it was found that there is no appreciable difference in fruit form, juice composition whether Washington Navel, Valencia, Tankan or Ponkan were used as an intermediate stock. However, Rangpur lime on Sunki rootstock with an intermediate stock of Tankan produced fruits of decidedly inferior quality. In Satsuma orange, Trifoliate orange rootstock produced fruits of the best qualities in comparison with that produced by Sunki and Rangpur lime. As the same in Rangpur lime, Ponkan-intermediate-stock produced fruits of inferior quality in Satsuma orange.

Anatomical changes in the pith of young shoot was suspected due to the influence of an intermediate stock, but further study is needed to clearify this point.

# 馬鈴薯種薯供應試驗

## （第三報）馬鈴薯種薯貯藏溫度對種薯價值之研究

郭　國　柱

### 一、前　言

本省栽培之馬鈴薯，以農林一號品種爲最多。如將春植自留之種薯用室溫貯藏時，因貯藏期間溫度過高，又因該品種休眠期不長，故到秋冬季種植時，芽條多而長，種薯老化，影響產量甚大。

本試驗乃探求如何延長其休眠，而提高產量爲目的，將種薯以低溫貯藏，使種薯强制休眠，減少對產量之影響。

### 二、試　驗　材　料

1. 供試馬鈴薯品種及種薯來源：使用本省栽培最廣的品種農林一號，在省農試所園藝系民國52年12月16日種植，53年 2月16日收穫供試驗之用。

2. 使用種薯之貯藏處理情形：收穫後選擇每粒重量在 80 公克± 10 公克之種薯，每處理使用 200 粒，分別貯藏於臺大園藝系冷藏庫內，溫度分爲 5°C，15°C 及 25°C 等三種，於53年 2月26日入庫，53年 8 月15日取出，先以攤開待皮面乾燥後推起，供試驗之用。

### 三、試　驗　方　法

1. 種植時期：53年 9 月15日在省農試所園藝系種植。

2. 種薯切開方法：種薯在種植前一日縱切爲四片，分爲每重複使用一片。

3. 種植方法：每小區種植兩畦，每一畦連溝爲 120 公分，畦長10公尺，每畦種植兩行，株距25公分，每小區24平方公尺，重複四次。種薯種植後覆土 6 公分。

4. 栽培管理：栽培管理與普通栽培管理相同。

5. 收穫時期：在民國53年12月16日收穫。收穫之薯塊分爲兩種，50公克以下者爲下薯，50公克以上者爲上薯。

### 四、試驗結果及討論

1. 由冷藏庫取出之發芽情形：

| 處理溫度 Temperatures Treated | 芽長 Length of Euds (cm) | 芽徑 Diameter of Euds (cm) | 每粒芽數 No. of Eud per tuber |
|---|---|---|---|
| 5°C | 0.13 | 0.17 | 3.75個 |
| 15°C | 0.27 | 0.21 | 15.25 |
| 25°C | 0.44 | 0.43 | 18.25 |

依上表所知，農林一號品種，經冷藏 6 個月，在 5°C, 15°C 及 25°C 三種溫度以 5°C 貯藏取出時其長出之芽細而短並且芽數亦最少。如在 25°C 貯藏卽相反。卽以芽長觀之，5°C 區爲 0.13 公分，15°C 區爲0.27公分，然 25°C 區爲 0.44 公分。芽條之直徑而言亦以 5°C 爲最細而

25°C 最粗。即 5°C 區爲 0.17 公分， 15°C 區爲 0.21 公分，然 25°C 區爲 0.43 公分。對每粒種薯長出之芽條數而言，亦以 5°C 區芽數最少， 25°C 區爲最多。即 5°C 區爲3.75個， 15°C 區爲 15.25 個，然 25°C 區爲 18.25 個。以由冷藏庫取出時之發芽情形觀察，用 15°C 及 25°C 貯藏 6 月之農林一號馬鈴薯似過老化，不適用此溫度貯藏。

2. 種植後之生長情形

| 處理溫度 Temperatures Treated | 株高 Plant height (cm) | |
|---|---|---|
| | 10 月 13 日 Oct. 16 | 11 月 16 日 Nov. 16 |
| 5°C | 26.0 | 48.2 |
| 15°C | 23.5 | 45.1 |
| 25°C | 22.6 | 41.4 |

種植後 1 個月及 2個月時調查生長情形結果，兩次結果均以5°C區爲株高最長，即在10月16日時爲26.0公分，在11月16日時爲48.2公分。 15°C 區次之，即10月16日時爲 23.5 公分，11月16日時爲 45.1 公分。然 25°C 區爲最差，即在10月16日時爲 22.6 公分，11月16日時爲 41.4 公分。用高溫貯藏比低溫貯藏在種植後其植株變低之原因，係以高溫貯藏 6 個月之長時間，種薯已老化，塊莖內之養分消耗之關係，因此馬鈴薯種薯之貯藏最好使用較低溫爲宜。

3. 單位面積產量：（10a產量）

| 處理溫度 Temperatures Treated | 上薯 (50公克以上) Large tuber above 50 gram | | | 下薯 (50公克以下) Small tuber below 50 gram | | | 總重量 Total Weight |
|---|---|---|---|---|---|---|---|
| | 重量 Weight (kg) | 個數 No. of Tuber | 每粒平均重量 Mean Weight of per Tuber (g) | 重量 Weight (kg) | 個數 No. of Tuber | 每粒平均重量 Mean Weight of per Tuber (g) | |
| | 公斤 | 個 | 公分 | 公斤 | 個 | 公分 | 公斤 |
| 5°C | 516.7 | 6,482 | 79.7 | 431.6 | 15,558 | 27.7 | 948.3 |
| 15°C | 319.6 | 4,745 | 67.4 | 332.8 | 13,491 | 24.7 | 652.4 |
| 25°C | 219.1 | 2,833 | 77.3 | 195.9 | 9,735 | 20.1 | 415.0 |

上薯產量比較表

| 處理溫度 Temperatures Treated | 產量 (kg/10a) Yield |
|---|---|
| 5°C | 516.7 ×××××× |
| 15°C | 319.6 197.1 × ××××××× |
| 25°C | 219.1 297.6 100.5 × × |

L. S. D. 5%.....57.8151kg.

L. S. D. 1%××××××××87.5488kg.

單位面積總產量以 5°C 區之 948.3kg/10a 爲最高， 15°C 區之 652.4kg/10a 次之， 25°C 區之 415.0kg/10a 爲最低。

以上薯產量而言， 5°C 區亦爲最高，每10公畝有 516.7公斤， 15°C 區之 319.6 公斤次之，

25°C 區最差僅爲 219.1 公斤，與 5°C 區比較相差 297.6 公斤之多。又各區之相差均爲極顯著。

以上述各節觀之，用 5°C, 15°C 及 25°C 三種溫度貯馬鈴薯，在生長情形或產量方面均以 5°C 區爲最佳。至於用 5°C 以下之低溫貯藏結果是否更理想，待下次試驗卽可明瞭。

## 五、摘　　要

1. 爲探求本省生產之農林一號馬鈴薯種薯之貯藏方法，使用 5°C, 15°C 及 25°C 冷藏 6 個月後種植檢定其生產情形。

2. 貯藏後取出時之發芽情形以 5°C 區之情形最佳，其芽少而短，芽數亦少。

3. 種植後 1 個月時及 2 個月時調查生長情形亦以 5°C 區爲最佳。

4. 單爲面積產量亦以 5°C 區爲最高。並各處理間之產量差異爲極顯著。

5. 用上述之三種溫度貯藏種薯應用 5°C 爲理想。

## 六、參 考 文 獻

1. 川上幸次郎：馬鈴薯編。
2. 藤井健雄：蔬菜栽培技術。
3. 河野照義：蔬菜栽培全編。
4. 永田利男：馬鈴薯の話。

# EXPERIMENT ON SEED POTATO PRODUCTION (3) EFFECTS OF VARIOUS STORAGE TEMPERATURES ON SEED POTATOES

by

K. C. Kuo

## SUMMARY

1. A storage experiment was made to study the best temperature for storage seed tubers of No-lin No. 1, potato produced in Taiwan. The tubers were stored under 5°C, 15°C and 25°C for six months. The condition of tubers at the end storage period was recorded plant growth and yield from tubers stored under different temperature were compared, the result were summarized as follows.
2. The condition of the tubers under 5°C was the best, it has the least number of germinated buds and it's sprout remained small.
3. Tubers stored under 5°C gave the best plant growth two months after planting.
4. Significant difference in yield per unit area was observed between tubers stored under different temperature, tubers stored under 5°C gave the highest yield.
5. It was concluded that 5°C was the best temperature for storage on No-lin No. 1, potato seed tubers produced in Taiwan.

# EFFECT OF SHADING ON TONKAN ORANGE (*CITRUS TANKAN* HAYATA)

## I. The effect of shading on wind injury, fruit quality, size, and rate of fruit growth

by

*MONG-YU YEN and **CHOU-HAI LIN

## INTRODUCTION

The tonkan orange (*Citrus tankan* Hayata) is the most popular citrus species in Taiwan and occupies more than 50% of the total citrus acreage. In 1964, more than 230,000 cases of Tonkan orange which represent 72.07% of the total citrus fruit export were delivered to the foreign market.

Taiwan is geographically located along the passage of typhoons. The Tonkan orange is always under the threat of severe damage caused by the extreme high velocity wind and torrential rain whenever typhoon happens to sweep through or passes near by the Island.

In order to test the effectiveness of Acacia (*Acacia confusa* Merr.) as windbreak for citrus orchard, experimental plots were established in which Tonkan orange and Acacia were interplanted. It was then observed that orchard interplanted with Acacia produced orange of better appearance.

This paper reports the results of observations made on the effect of Acacia as windbreak and its shading effects on the wind injury, quality, size, and rate of fruit growth.

Of the many studies made on shading processes, Jawanda[8] applied the shading for the study of growth rate of sweet orange fruits; Graner[5] and Suarez[12] used shade tree for coffee; Barva[2] and Wight[15] used shade tree in tea plantation; Cunningham[3] studied shade and fertilizer requirements of cocoa.

## METHOD AND MATERIAL

This experiment was conducted from January 1963 to January 1966. The orchard site was chosen near the sea cost at Tansuei of Taipei Prefecture where citrus trees are usually subject to wind damage.

Tonkan trees of 7 years old were employed for this trial. Each treatment contained one tree with 3 replications. Three treatments were employed in this study namely: whole shading, in which citrus tree was interplanted with Acacia tree in four directions; semi-shading, interplanted with Acacia in two directions only, and no shading as check.

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The methods of measurement and analysis of citrus fruits were as follows:

1. The standard used for determining wind injury is set at 5% of wind injured scurf/fruit. Fifty fruits per plot were chosen for testing.
2. Description of fruit:
   a. Weight in grams, size, height, and diameter in centimeter.
   b. Color of peel, pulp, and juice classified according to Ridgway[10].
   c. Thickness of peel in millimeter measured on fruit apex, median, and base.
   d. Thickness of segment wall measured in millimeter by Oial thickness gauge.
   e. Number of segment and diameter of axis.
   f. Number of seeds.
3. Ten fruits of each tree were examined for counting the number and size of oil glands as seen from peel. The samples were washed with water, and dried with a cloth. A thin piece of peel (0.5 mm. thick) was cut from the rind surface on the equator of fruit. Tangential slices were taken from the equator of rind and placed under microscope for examination. Slices calibrated into 0.5 $cm^2$ were placed over the slides, then the diameter of oil gland was measured in micron and the number of oil gland (per 0.5 $cm^2$) was counted.
4. Observations on the growth rate of fruit after physiological dropping were made at successive growing period. Twenty sample fruits per tree were measured in cubic centimeter which was developed by Shisa[11].
5. The percentage of sugar in juice was measured by Hitachi Hand Refractometer (0°–30° Brix degree).
6. Vitamin C, reducing sugar, total sugar, and acidity were analyzed by A. O. A. C.[1] procedures.

## ENVIRONMENT OF TEST PLOT

The quality of Tonkan orange are greatly influenced by the difference of soil and meteorological conditions. Fig. 1–4 indicate the climatic factors including the the temperature, precipitation, duration of sunshine, and velocity of wind. Soil conditions under different treatments were tested for pH value, organic matter

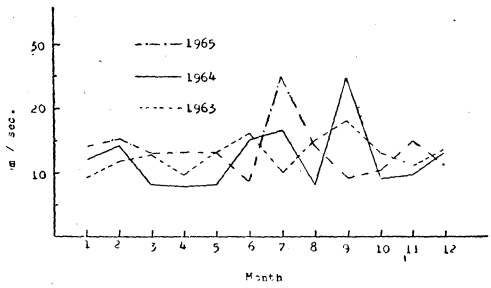



Fig. 1. Maximum wind velocity in the course of this experiment.

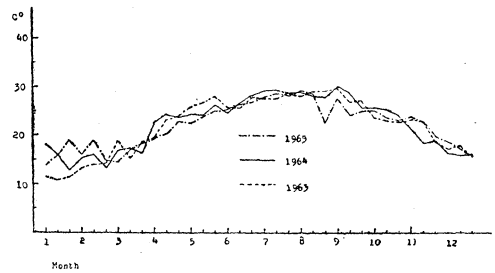



Fig. 2. Average temperature during the experiment.

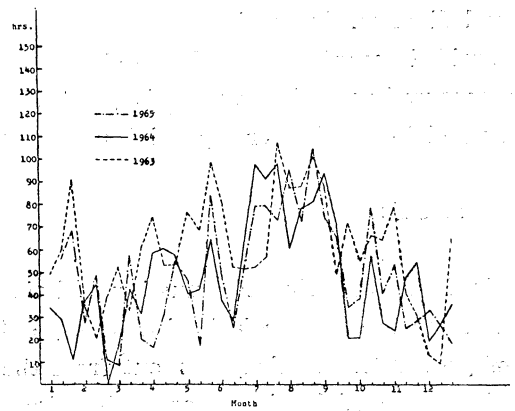



Fig. 3. Length of sun light during the experiment.

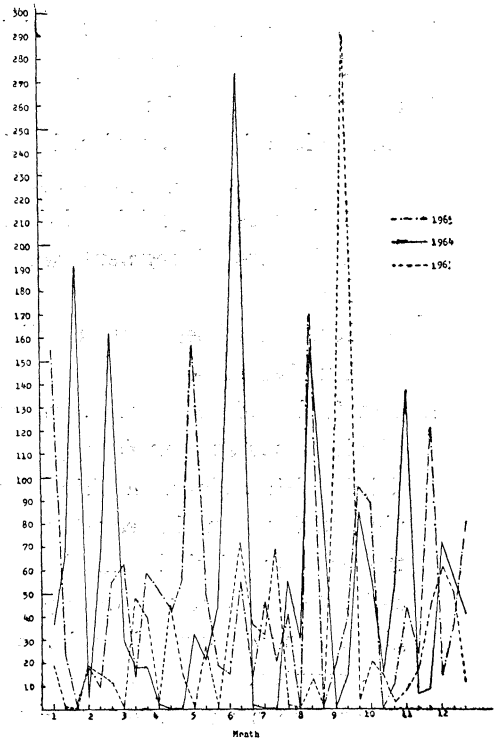



Fig. 4. Monthly rainfall during the experiment.

Table 1. Description of soil

| Soil factors Treatment | pH | Organic matter (%) | Available P (ppm) | Available K (ppm) |
|---|---|---|---|---|
| Semi-shading | 5.0 | 4.58 | 30.3 | 37.6 |
| Whole shading | 4.8 | 5.00 | 33.2 | 58.0 |
| Check | 4.8 | 3.88 | 28.8 | 28.8 |

* pH value: Glasselectrode method (Soil: Water=25:25).
Organic matter per cent: Walkley and Black's rapid titration mothod for organic matter.
Available P: Bray's P test.
Available K: Mehlich method.

content, available potassium and phosphorus as in Table 1.

Two highest wind velocities occurred during July 16 of 16.5 m/sec. (Wendy's) and September 11 of 25 m/sec. (Cloria) in 1963, and July 26 of 25 m/sec. (Harriet), August 18 of 14.3 m/sec. (Mary) in 1965, whereas no typhoon occurred in 1964. (Fig, 1)

High temperature occurs mostly between July and September, thererfore, in average, the growth rate of Tonkan is three times faster during July, August, and September, with the exception of the occurrence of drought in these months. (Fig. 2)

Long duration of sun shine mostly occur between July and September in Taiwan. This explains why the percentage of citrus fruit caused by sun scald was lower in

the shade plots during these months. (Fig. 3)

Record of the growth rate of Tonkan increased in August and September 1964 when the precipitation was high, but almost ceased to grow during dry July. These phenomena were especially true in the plot without shading. No records of growth rate in 1963 was taken. Erratic curves of precipitation show the influence of typhoon. (Fig. 4)

The properties of soil were shown in Table 1. It is interested to note that shading plots contained much higher organic matter than without shading. It was attributed to the accumulation of leaves and stems resulted from the prunning of Acacia in the winter season.

## RESULTS AND DISCUSSION

1. The effect of shading on the wind injury of fruits:

The foliage of citrus tree may be greatly injured by strong winds, Taiwan is lying in the tropical and sub-tropical zone, and is crossed by the tropic of Cancer in the south. Its climate is influenced by both the Pacific ocean and the Chinese mainland and is characterized by strong-wind. So Taiwan often suffers from damages of typhoon in July to September. During this time, Tonkan orange is still in small green fruit rubbing against other twigs or branches resulting in a thin scurf closely imitating thrips markings. When the fruit is more nearly mature such a rubbing may result in a still more deep-seated scurf. Table 2. show that the percentage of wind injured scurf appeared on fruit was found less in shaded plots than those in the plots without shading. Most prominent case was found in 1963 and 1965. It was probably due to the typhoon occurred in July and September of 1963 and July and August of 1965 whereas no typhoon throughout in 1964. This observation serves as strong evidence that Acacia is an effective of windbreak, as Goto[6] reported that a well-established windbreak, combind with the use of relatively tall shade tree interplant in the coffee might have sufficient wind ptotection under certain conditions.

*Table 2. The effect of shading on the wind injury

| Treatments | Wind injury** | | |
|---|---|---|---|
| | 1963 | 1964 | 1965 |
| Semi shading | 14.12 | 6.25 | 15.75 |
| Whole shading | 11.94 | 5.25 | 13.50 |
| Check | 25.06 | 14.87 | 27.25 |
| L.S.D. 5% | 1.7243 | 0.8134 | 0.8580 |
| L.S.D. 1% | 2.3932 | 1.1289 | 1.1910 |

* All data in the table are average of 8 replications.
** Percentage of scurf

2. The effect of shading on occurrence of sunburning:

The sunburning is frequently mistaken for certain diseases on citrus. Indeed, certain bark diseases frequently begin under high light intensity, the radiation of the sun either weaken or kill the bark and make it easy for microorganisms to enter. In check plot without shading, the intense radiation after injure or kill the expose portion of trunk or fruit, causing these portion to dry and peel off, resulting in sun scald condition.

The occurrence of sun scald was partially due to the rapid growth of cell of fruit skin under the high light intensity and long duration of sunshine in summer as suggested by Ogaki[9]. From the weather data observed during the three-year trial it indicated that high temperature and long duration of sunshine were found in August as given in Fig. 3. Yet less occurrence of sun scalded orange in shaded plots proved the shading effect.

3. The effect of shading on fruit quality:

Table 3 indicates that shading would significantly reduce the number of seed per fruit, which is similar to the results obtained by Webber[14]. Furthermore the number of seed per fruit was less in 1965, it probably due to the low temperature in February and March (the blossom period), which causes the formation of parthenocarpic fruit as indicated by Takahashi[13].

Table 3. The effect of shading on fruit quality

| Factor \ Treatment | | Semi-shading | Whole shading | check | L.S.D. 5% | L.S.D. 1% |
|---|---|---|---|---|---|---|
| weight gram/fruit | 1964 | 195.490 | 193.333 | 140.520 | 13.16 | 18.26 |
| | 1965 | 190.400 | 202.400 | 163.300 | 3.421 | 4.748 |
| Height (cm) | 1964 | 6.450 | 6.506 | 5.739 | 0.339 | 0.470 |
| | 1965 | 6.270 | 6.230 | 5.582 | 0.0501 | 0.0697 |
| Diameter (cm) | 1964 | 7.320 | 7.229 | 6.534 | 0.327 | 0.454 |
| | 1965 | 7.180 | 7.340 | 6.691 | 0.0566 | 0.0786 |
| Color of peel | 1964 | Cadmium orange | Cadmium orange | Orange | — | — |
| | 1965 | Capuci ne yellow | Capucine yellow | Orange | — | — |
| Thickness of rind (mm) | 1964 | 4.05 | 4.04 | 4.12 | N.S. | |
| | 1965 | 3.62 | 3.63 | 3.77 | N.S. | |
| No. of seed per fruit | 1964 | 2.283 | 1.838 | 2.287 | 0.215 | 0.293 |
| | 1965 | 0.520 | 0.330 | 0.530 | N.S. | |
| Diameter of fruit axis (cm) | 1964 | 1.451 | 1.310 | 1.194 | N.S. | |
| | 1965 | 1.130 | 1.190 | 1.110 | N.S. | |
| Thickess of segment wall (mm) | 1964 | 0.224 | 0.223 | 0.204 | N.S. | |
| | 1965 | 0.196 | 0.198 | 0.202 | N.S. | |

Fruits from the shaded plots offer much more attractive appearance in color and thiner thickness of peel in comparison with those from check plots which is similar to the results obtained by Jawanda[8] and Webber[14].

4. The effect of shading on pulp and juice:

The juice contained in the fruit obtained from shaded plots had more acidity than those from the plots without shading as shown in Table 4. This is perhaps due to the late maturity of fruit in the shaded plots. Color of pulp and juice was not affected by shading with the exception of the amount of juice which was higher in the fruit from shaded plots than that the plots without shading. This was probably attributed to fairly high humidity under the shaded area. Similar results as stated above had also been obtained by Webber and Batohor[14].

Table 4. The effect of shading on pulp and juice of fruits

| | Factor \ Treatment | | Semi-shading | Whole shading | CK | L.S.D. 5% | L.S.D. 1% |
|---|---|---|---|---|---|---|---|
| Pulp | Weights gm/fruit | 1964 | 134.49 | 138.32 | 95.99 | 25.96 | 36.03 |
| | | 1965 | 142.20 | 144.30 | 100.30 | 1.982 | 2.751 |
| | Pulp* % | 1964 | 68.79 | 71.54 | 68.31 | — | — |
| | | 1965 | 73.63 | 71.29 | 61.42 | — | — |
| | Color of pulp | 1964 | Orange | Orange | Orange | — | — |
| | | 1965 | Orange | Orange | Orange | — | — |
| | Weights gm/fruit | 1964 | 101.141 | 104.56 | 71.29 | 7.54 | 10.46 |
| | | 1965 | 109.30 | 120.60 | 82.10 | 1.514 | 2.102 |
| | Juice** % | 1964 | 51.87 | 54.08 | 50.73 | — | — |
| | | 1965 | 57.40 | 56.81 | 50.28 | — | — |
| | Color of juice | 1964 | Orange | Orange | Orange | — | — |
| | | 1965 | Orange | Orange | Orange | — | — |
| Juice | Citric acid g/100 cc | 1965 | 0.64 | 0.64 | 0.65 | N.S. | |
| | | 1965 | 0.78 | 0.79 | 0.73 | N.S. | |
| | Sugar*** % | 1964 | 9.756 | 9.652 | 10.200 | N.S. | |
| | | 1965 | 9.960 | 10.400 | 9.600 | N.S. | |
| | Sugar/acid | 1964 | 15.15 | 15.01 | 15.64 | N.S. | |
| | | 1965 | 12.77 | 13.16 | 13.15 | N.S. | |
| | Sp. gr. | 1964 | 9.41 | 9.67 | 9.41 | N.S. | |
| | | 1965 | 4.5 | 4.8 | 4.5 | N.S. | |
| | pH | 1964 | 3.60 | 3.60 | 3.80 | — | |
| | | 1965 | 3.49 | 3.54 | 3.71 | — | |
| | Vitamin c mg/100 g | 1965 | 33.63 | 33.39 | 33.01 | N.S. | |
| | Reducing sugars g/100 cc | 1965 | 2.66 | 2.61 | 3.11 | 0.223 | 0.310 |
| | Total sugars g/100 cc | 1965 | 7.22 | 7.57 | 8.72 | 0.284 | 0.394 |

* Pulp %=weight of pulp/weight of fruit ×100.
** Juice %=Weight of juice/weight of fruit ×100.
*** The sugar of juice was measured by Refactometer.

5. The effect of shading on number and size of oil gland:

Though the difference in measurements of number, size of oil gland from different treatments were insignificant in 1964. But it was significant in 1965 as shown

in Table 5. In general it shows a tendency that shading would reduce the size and increase the number of oil gland which might induce the development of smooth peel surface of fruits.

Table 5. The effect of shading on the number and size of oil gland*

| Treatments | No. of oil gland** | | Size of oil gland (micron) μ | |
|---|---|---|---|---|
| | 1964 | 1965 | 1964 | 1965 |
| Semi-shading | 30.35 | 28.87 | 524.62 | 499.88 |
| Whole shading | 30.75 | 29.87 | 500.87 | 479.75 |
| Check | 27.30 | 26.75 | 557.87 | 525.00 |
| L.S.D. 5% | N.S. | 0.425 | N.S. | 3.353 |
| L.S.D. 1% | | 0.589 | | 4.653 |

* All data in the table are averages of 8 replications.
** No. of oil gland per 0.5 centimeter square.

6. The effect of shading on size and grade of fruits:

In 1964 the size of fruit in the check plot was comparatively small as indicated in Fig. 5. Webber[14] had stated that the size and growth rate of citrus fruit was closely correlated with size and number of leaves per fruit on a given branch. We also found that less branches appeared in the check plot particularly in summer season while no branch emerged at all. The occurrence of large amount of small size fruit in the check plot from this experiment confirmed the finding of Webber

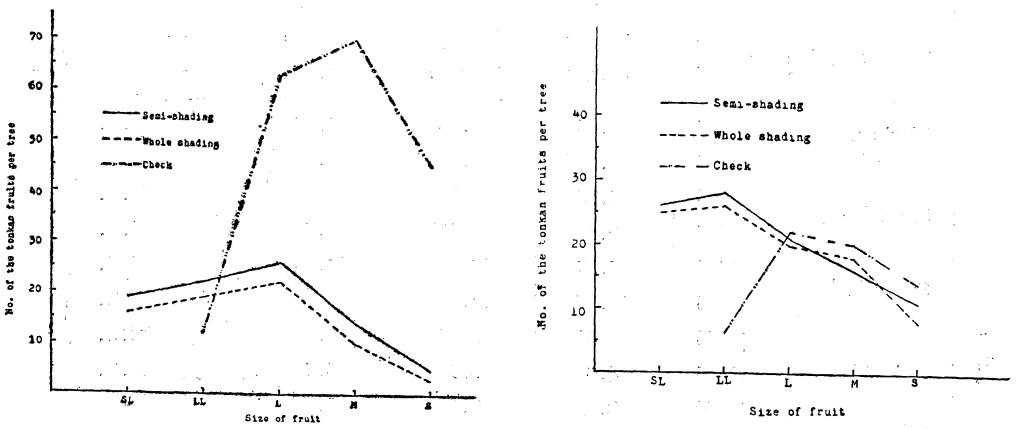



Fig. 5. Effect of shading on size and grade of fruit in 1964 (left) and 1965 (right). The classification of grade and size offruits was based on the standard stipulated by the Bureau of Inspection & Quarantine of Taiwan, i. e., SL, LL, L, M. S. represents above 25 cm, 23-25 cm, 21-23 cm, 19-21 cm and 17-19 cm, respectively.

7. The effect of shading on growth rate of Tonkan Orange:

The rate of fruit growth was successively surveyed from June 1964 to January 1966. It showed that the rate of growth increass noticeably in the months of August, September and October when the precipitation and temperature were high, and almost ceased to grow in dry July. These phenomina were especially true in the plots without shading. It suggested that shading might reduce the losses of

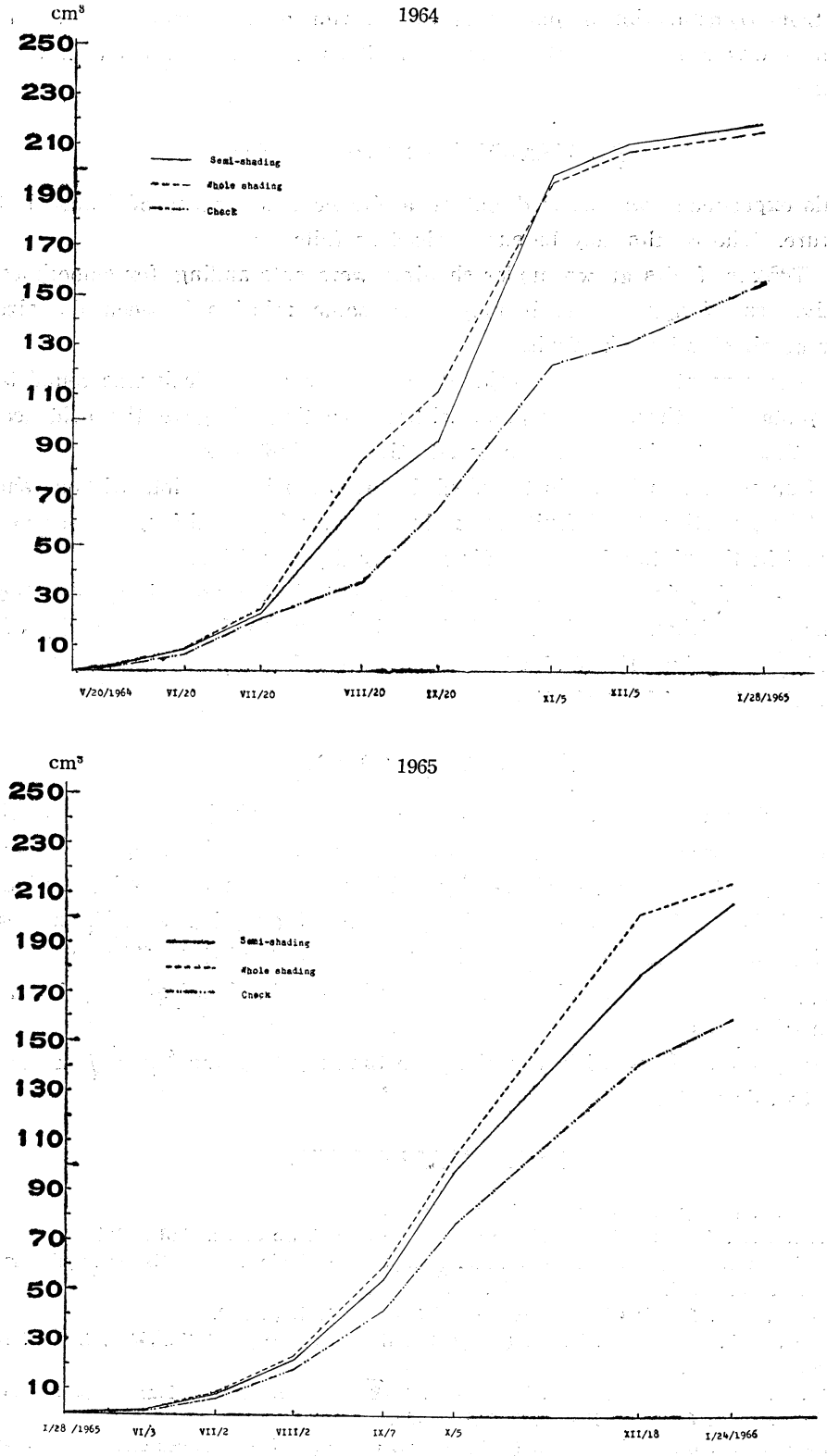



Fig. 6. The effect of shading on growth rate of Tonkan Orange.

water from transpiration of plant and evaporation of soil surface. In contrast to 1965, there was wet in July, the growth of citrus was normal even in the plots without shading.

## SUMMARY AND CONCLUSION

This experiment was carried out at a site near sea coast of Tansuei, Taipei Prefecture. The results may be summarized as follows:

1. Tonkan fruits grown under shading were outstanding for smoothness and attractiveness of appearance, it may have some relation between the size and number of oil gland of the fruit.

2. The percentage of wind injured scurf appeared on fruit was found less on shaded plots than those in the plots without shading. It gave the evidence that interplanting of Acacia would also be effective as windbreak.

3. Sun scald was lower in the shaded plots than in the plots without shading.

4. The growth rate of fruit was reduced under dry condition, almost no growth was found in the plots without shading during dry condition.

5. The fruit juice obtained from shaded plots had more acidity than those of from the plots without shading. This is perhaps due to the late maturity of fruit under shading. Thus the fruits in shaded plots should be harvested later than those in the plots without shading.

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# 柑桔遮蔭試驗

## 第一報 遮蔭對桶柑風害、品質、果實成長之影響

嚴夢如 林澤海

(中文摘要)

1. 遮蔭可使果皮光滑，油胞小數目多，無遮蔭區則反是。
2. 遮蔭對風害有減少可能，經三年果實檢查結果顯示遮蔭區風疤率較無遮蔭區爲低。
3. 遮蔭對日燒病有顯著功效。
4. 遮蔭對果實成長有帮助，尤其七月間短暫之旱期有遮蔭區仍在成長，而對照區則生育有停滯現象。
5. 遮蔭柑桔果汁含量較多，但酸度酸些，可能因遮蔭有晚熟現象，與對照區同時採收尙嫌太早感。

# 盤固草 (Pangola grass) 之栽培試驗

邱　裕　鴻

## 一、引　　言

爲配合臺灣畜牧事業的發展，增加牧草生產起見，本省自民國四十六年以來陸續不斷自世界各地引進優良牧草品種，尤於民國四十六、七年兩年間引進最多，共計達七十三種。此等種子種苗引進後立即在農業試驗所播種，育苗後分送全省九個地點進行試作，同時與過去優良牧草作比較及調查其特性等。此等引進之牧草品種部份甚爲良好，但亦有部份不適應本省之風土。其中盤固草成績特別優異，故報告於本文，以供參考。

本文承農復會黃技正嘉之鼓勵發表與校閱特此謹申謝意。

## 二、材 料 及 方 法

盤固草種苗於民國四十六年四月由農復會畜牧生產組長 H. W. Ream 氏自菲律賓引進(A24)後栽於瓦盆內，待植株生長後剪取再移本田繁殖。是時爲春季三月間，故很適合氣候環境，使其生長甚爲迅速，其繁殖倍數亦甚爲可觀，由一公頃苗圃在一年之中所採取的種苗可以繁殖三十五公頃以上。

玆將盤固草的栽培法摘要於次：

整地前先將地面之雜草除去，然後施用預先準備之石灰耕入土中。保持强酸性（PH4左右）的土壤，每公頃應施三公噸左右。基肥每公頃氰氮化鈣200公斤，過磷酸石灰200公斤，氯化鉀 150 公斤，撒播後與土均勻拌合。追肥在每次收割後視地力情形施用。

選取粗壯之匍匐莖截斷每支約30公分長有三節者作爲種苗，株距爲20～30公分，行距爲50公分。種植時將種苗的二節斜插土中，另一節露出外面。每穴種植1～2支苗。最好選在雨後土壤相當潮濕時種植。每公頃所需種苗250～300公斤。

因爲盤固草爲匍匐性且生長迅速，種植後經過約三個月已覆滿地面。盤固草種植後至覆滿土地以前看情形需除草1～2次。其他雜草以後完全不能生長，較種植叢生性之象草或天竺草等需要經常中耕除草者可節省不少人工經費。

## 三、試驗結果與討論

1. 盤固草與象草（狼尾草 Napier）的產量比較

盤固草爲一種多年生有匍匐莖的青割與放牧兼用的牧草。既往在本省有禾本科的象草天竺草 (Guinea grass) 及爬拉草 (Para grass) 等，而自有盤固草以來經過試作結果，認爲很適應本省之風土，容易栽植，其草質之優良及適合作爲乾草等爲象草等其他牧草中所不能及者。而象草天竺草及爬拉草等視環境及土質情形如何各有其特殊表現，故乃屬不可少的優良牧草。但在本省廣大的酸性坡地仍以盤固草爲最適宜之牧草品種。

玆將盤固草的特性及產量調查結果與象草在新化畜產試驗所（當時爲畜產試驗分所隸屬農業試驗所）42～43年爲一年間的收量試驗結果分別列表於次以資比較參考：

表一　盤固草之特性

原　產　地：南非洲

莖　　色：收割後在生長初期爲綠色，以後依生長漸趨變爲紫紅色
葉梢及葉色：整個生長期間爲綠色
開　花　期：長日照下每次收割後約達60公分時卽行開花
花　　色：淡綠色
收割期株高：50～60公分卽在孕穗期至開花始期
分　　蘖：多，種植初年將所有一面空隙匍匐滿，同時自節上生根後向上面直立生長
分　　枝：少
產種情形：可採種但種子不發芽（普通採用枝條扦插之無性繁殖法）

表二　盤固草種植後第二年之產量調查

| 收割次別 | 收割月日 | 收割所需日數（天） | 株高（公分） | 生草產量公斤／公頃 | 備註 |
|---|---|---|---|---|---|
| 第一次 | 2月10日 | 97 | 60 | 16,625.00 | 1.48年8月3日種植 |
| 第二次 | 4月28日 | 77 | 60 | 22,919.64 | 2.供試小區面積爲112平方公尺重複二次 |
| 第三次 | 7月 2日 | 65 | 60 | 24,151.78 | 3.生長至開花前卽進行收割 |
| 第四次 | 8月26日 | 55 | 60 | 23,321.42 | 4.每次收割後立卽施用每10公畝硫酸鋅20公斤，過磷酸鈣20公斤，氯化鉀15公斤的標準量。 |
| 第五次 | 9月26日 | 31 | 60 | 22,750.00 | |
| 第六次 | 11月10日 | 44 | 60 | 18,821.43 | |
| 合計 | | | | 128,589.27 | |

如前所述象草亦爲良好牧草之一，爲比較象草與盤固草的產量起見，茲將在新化分所做收割試驗成績列於第三表：

表三　不同收割期之象草之產量

| 收割次別 | 收割日期 | 株高（公分） | 生草產量公斤／公頃 |
|---|---|---|---|
| 第一次 | 48年8月3日 | 113.3 | 13,597.50 |
| 第二次 | 9月18日 | 115.7 | 11,668.89 |
| 第三次 | 10月14日 | 115.0 | 21,340.00 |
| 第四次 | 11月13日 | 165.0 | 30,000.00 |
| 第五次 | 49年2月2日 | 106.0 | 28,660.00 |
| 第六次 | 5月14日 | 106.0 | 12,513.00 |
| 第七次 | 5月25日 | 102.0 | 14,194.00 |
| 一年間總產量 | | | 131,973.39 |

（新化畜產試驗分所42～43年度試驗成績）

表四　生草成份表　　（單位：%）

| 品種＼項目 | 乾物質 | 蛋白質 | 脂肪 | 纖維 | 灰份 | NFE | 鈣 | 磷 |
|---|---|---|---|---|---|---|---|---|
| 盤固草 | 25.6 | 1.3 | 1.1 | 11.6 | 2.6 | 8.7 | 0.2 | 0.07 |
| 象（狼尾）草 | 11.7 | 1.1 | 0.4 | 4.8 | 1.4 | 4.3 | 0.03 | 0.07 |
| 爬拉草 | 20.0 | 1.6 | 0.7 | 5.8 | 1.4 | 10.9 | 0.02 | 0.07 |
| 天竺草 | 24.2 | 1.0 | 0.5 | 7.5 | 2.2 | 13.0 | 0.08 | 0.09 |

資料來源　臺糖種畜場分析「牧野改良概說刊載」

如第二及第三表所示象草之產量高於盤固草，因試驗地點與年度不同且此兩種牧草的特性完全不同，盤固草爲匍匐性莖葉細小，象草爲莖葉粗大直立性。據品種觀察區在同一區域內之比較結果亦有同樣傾向，故可以認爲象草的產量高於盤固草，但因象草莖基部粗大容易硬化，故不爲牛隻所食吃，因此損失部份不少，而盤固草在開花前之莖基亦非常幼嫩，可完全被利用，由此點而言，盤固草之產量雖稍低於象草，其利用價值仍不亞於該草。並且盤固草容易晒製品質優良之乾草，供冬季及旱季之需。

以第四表之臺糖種畜場分析結果來說，也知得盤固草在幾種代表性牧草中其各項重要成份，含量較其他品種爲優。

根據初步試驗結果，盤固草爲適合臺灣海拔 500 公尺以下之山坡或平地栽培之良好牧草之一。

## 四、摘　　要

1. 經二年栽培與觀察的結果選出盤固草，適宜在紅土山地栽培，與象草同在適當時期收割來比較產量，雖然象草的產量較多，但其莖基部份容易硬化，即會損失此部份。盤固草可以全部供飼用，因此利用價值不亞於象草。象草則宜在肥沃之壤土上栽培。

2. 種植盤固草後經約三個月即覆滿地面的關係，不需經常除草。象草就因有行間存在的關係，每次收割後均需中耕除草管理上比較繁雜。

3. 不可認爲種盤固草簡單而過於粗放，種植前必須與其他農作物相同；先將土地全面耕耘耙平打碎，尤於雜草連根除淨，應先施肥後種植。因此不但可以節省種植當年的除草需費而且可使原野地眞正變成良好的牧草地。

4. 盤固草爲無性繁殖，種苗取生長期間45～60天而且較爲粗壯的匍匐莖，行距50公分，株距20～30公分，每穴種1～2支苗。

5. 盤固草有好幾個品系在本文所說的是 A24，爲能抵抗禾本科萎縮病的品系。

# STUDIES ON THE CULTIVATION OF PANGOLA GRASS

by

Y. H. CHIU

1. Pangola grass, one of the most promising forage crops in Taiwan was studied regarding agronomic characters, cultivation practice and other related problems.
2. Napier grass, though gave high yield when grown in the fertile loam but the stem base is too stiff to be eaten by the animals, therefore reduce its value as feeds.
3. In cultivation of Napier grass, it usually takes much labour for weeding while Pangola grass does not need to weed too often, because of its vigorous growth which exhibit the growth of miscellaneous weeds.
4. After a two-year observation, it was found that Pangola grass is not suited to grow in lateritic soil of the mountainous slop land, and considered to be the good forage crop under the present condition of Taiwan.
5. Among lines of Pangola grass, observed, strain A24, was found to resist dwarf disease most strongly.

# A FIELD TRIAL WITH A SINGLE APPLICATION OF INSECTICIDES TO CONTROL THE RICE STEM BORER, *CHILO SUPPRESSALIS*

S. Y. LEE and W. Y. HONG

The authors have previously reported (1963) that poor kill of the larvae of the paddy borer, *Schoenobius* (*Tryporyza*) *incertulas* Walker became evident with some foliar sprays applied by a conventional knapsack sprayer beyond certain stage after transplanting when growth of the plants was so dense preventing the sprays from hitting the straws in which the larvae were feeding.

In this trial, an investigation was made to determine whether or not significant control of the rice stem borer, *Chilo suppressalis* Walker which similarly feeds in the straw as the paddy borer, could be obtained with some compounds applied only once soon after transplanting before growth of paddy reached undesirable conditions for foliar treatment.

## MATERIALS AND METHODS

The trial was conducted in the paddy field at Taiwan Agricultural Research Institute, Taipei. The variety of paddy used was Taichung No. 65, transplanted on March 26th 1964 (distances between hills: 25×25cm). Each plot was 0.36 hectare in area, and was arranged at random. Insecticides were applied on April 25th when the infestation with the rice stem borer averaged about ten percent, and most of the borer were in their first or early second instars. The test chemicals and the dosages used were as follows: 1.8 kg of gamma BHC per hectare for 6 % BHC granule and 3 % BHC dust; 1,000 liters of water containing 0.05 % actual ingredient per hectare for 50 % Imidan wp, 50 % Dimecron wp, 50 % Cidial ec, 47 % perathion ec, and 45 % EPN ec. Sprays were applied after draining the irrigation water with a knapsack mist blower; the plants being blown twice from the opposite directions so as to secure good coverage with the liquids. There was a rain fall a day after treatment, flooding over two plots treated with BHC (granule, replicate no. 4; dust, replicate no. 4). In two plots received BHC (granule, replicate no. 1; dust, replicate no. 4), irrigation water leaked completely in three days. However, they were irrigated again as soon as little free water was standing on soil. Mortality of the larvae was counted on 50 hills on May 1st and 2nd, and again on 30 hills on May 4th and 5th. The results are shown in table 1. On July 3rd and 4th, infestation with the borers was investigated by examining the white ears caused primarily by the rice stem borer. The crop was harvested on July 6th, and the green weight of grains produced in each plot was recorded. These data are presented in table 2.

## RESULTS

Results of the present work show that highly effective control of the larvae was obtained with such insecticides as parathion, Cidial, EPN, and Dimecron when applied as foliar sprays on the first crop about one month after transplanting. However, Imidan was rather inferior, and BHC was poor, which seemed owing, in this case, to rain or some other causes unknown. At the heading stage, however, no significant difference was found in number of the white ears caused primarily by the rice stem borer, and in yield of rice between treatments. Since this trial was conducted in a rather isolated paddy field, it is considered that re-infestation with the borer originated from the pest multiplied in untreated plots, or in some treated plots where kill of the larvae was not adequate. When treatment is made on the entire plot in a large plantation at a proper time, significant control of the borer might be possible with this single treatment method with certain compounds.

Table 1. Effectiveness of some insecticides against the larvae of the rice stem borer, *Chilo suppressalis* Walker, Taipei, 1964.

| Treatment | Percent Mortality of Larvae | | | | |
|---|---|---|---|---|---|
| | Replicate I | II | III | IV | Avg |
| 6 % BHC granule | 18.9 | 43.8 | 11.4 | 60.0 | 33.5 |
| 3 % BHC dust | 60.5 | 36.4 | 55.6 | 11.5 | 41.0 |
| 50 % Imidan wp | 50.7 | 65.1 | 92.3 | 76.1 | 71.1 |
| 50 % Dimecron wp | 73.0 | 86.8 | 97.6 | 98.8 | 89.1 |
| 50 % Cidial ec | 93.0 | 100.0 | 97.0 | 94.0 | 96.0 |
| 47 % Parathion ec | 100.0 | 99.0 | 96.8 | 92.3 | 97.0 |
| 45 % EPN ec | 89.4 | 93.8 | 92.5 | 95.7 | 92.9 |
| Untreated | 4.6 | 1.5 | 1.5 | 2.7 | 2.6 |
| LSD at 5 % Level | | | | | 19.3 |
| 1 % | | | | | 27.0 |

Table 2. Number of white ears caused primarily by the rics stem borer, *Chilo suppressalis* Walker, and yield of rice in various treatments, Taipei, 1964 (each plot 0.36 hectare in area).

| Treatment | No. of white ears in 4 replicates and (avg) | | | | | Green weight (kg) of grains in 4 replicates and (avg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 % BHC granule | 309 | 109 | 132 | 616 | (292) | 16.1 | 17.3 | 17.7 | 19.7 | (17.7) |
| 3 % BHC dust | 296 | 141 | 37 | 261 | (184) | 19.0 | 17.8 | 16.9 | 19.9 | (18.4) |
| 50 % Imidan wp | 187 | 108 | 71 | 59 | (106) | 19.7 | 17.1 | 19.7 | 13.9 | (17.6) |
| 50 % Dimecron wp | 181 | 62 | 93 | 44 | ( 95) | 19.9 | 16.7 | 19.9 | 14.5 | (17.8) |
| 50 % Cidial ec | 192 | 67 | 91 | 44 | ( 99) | 19.4 | 16.9 | 20.5 | 13.7 | (17.6) |
| 47 % Parathion ec | 253 | 75 | 253 | 73 | (164) | 17.1 | 17.6 | 22.8 | 16.3 | (18.5) |
| 45 % EPN ec | 132 | 81 | 159 | 40 | (103) | 18.2 | 17.7 | 18.0 | 14.9 | (17.2) |
| Untreated | 218 | 114 | 132 | 106 | (143) | 18.2 | 15.7 | 13.3 | 13.8 | (15.3) |
| LSD at 5 % level | | | | | | | | | | 3.4 |
| 1 % | | | | | | | | | | 4.6 |

## REFERENCE CITED

Sung-yang Lee and Wen-yau Hong. 1963. Residual Toxicity of Some Insecticides against the Newly Hatched Larvae of the Paddy Borer, *Schoenobius incertulas*. Agr. Res. Vol. 12, No. 3, pp. 40-51.

# 水稻二化螟蟲田間單次施藥試驗簡報

李 淳 陽　　洪 文 堯

## 摘　　要

水稻移植二個月後行莖葉噴藥方法對三化螟幼蟲無大防治效果之試驗報告曾提出於本刊（1963年3月），因此設想在移植後一個月間應用前項噴藥法行一次用藥或許能有防治效果上之意義。本工作即基於該概念使用數種藥劑對二化螟進行試驗，其結果 Parathion, EFN, Dimecron 及 Cidial 等對其幼蟲具有充分之殺蟲力，但爾後調查其白穗發生數及收量，各處理區間未獲得有意義之差異。然由於本項試驗僅以小試驗區進行，對照及藥效較差之試驗區留存之螟蟲似能繁殖而移至他區爲害，因此大面積之稻田照本試驗之方法行一次施藥或可收到相當之防治效果。

# 亞麻夜蛾科害蟲發生種類調查

杜 金 池　林 祖 燁

## 一、前　言

亞麻 (*Linum usitatissimum* L) 爲本省重要纖維作物，其纖維特性爲抗磨擦力大，不易起毛，導熱性佳，吸濕率小，拉力强，彈性大，適於製造帆布、漁網、線類、紙張等。其種子兼可製亞麻仁油，故爲本省重要經濟作物之一。

亞麻在本省之栽培，早自1921年卽由日本北海道引種栽植，中日戰爭後，臺灣在日本佔據下，以新興纖維資源作物而推廣種植。其栽植區域主要分佈於中南部之臺中、南投、彰化、雲林等縣，光復後，亞麻在臺中縣、彰化縣成爲第二期水田之後作，歷年栽培面積均在 3,000 公頃以上。

近年來，亞麻之栽植，因害蟲之猖獗而形成無限困擾。亞麻受害蟲侵害後，發育受阻，產生分歧，纖維品質變劣，種子產量減少，是以引起各方之重視。臺灣亞麻之害蟲，據日人楚南仁博氏 (1940) 之調查，其種類包括直翅目 (Orthoptera) 半翅目 (Hemiptera) 鱗翅目 (Lepidoptera) 等共28種之多。其中最重要之害蟲，據筆者等之觀察，厥爲鱗翅目夜蛾科之夜盜蟲 (Lepidoptera: Phalaenidae)。因此，亞麻夜盜蟲之研究及防治方法之探討，乃爲亞麻增產上不可忽視之工作。

臺南棉麻試驗分所自民國51年起承　農復會補助經費進行本項調查。調查期間蒙　農復會植物生產組劉組長廷蔚之鼓勵與指導，前本分所技術員葉世煌先生，工礦公司亞麻廠之協助與幫忙，文成復蒙劉博士廷蔚，季分所長景元及臺南糖試所潘榮松先生之批閱斧正，同事歐陽聯成先生代攝相片，均此申謝。

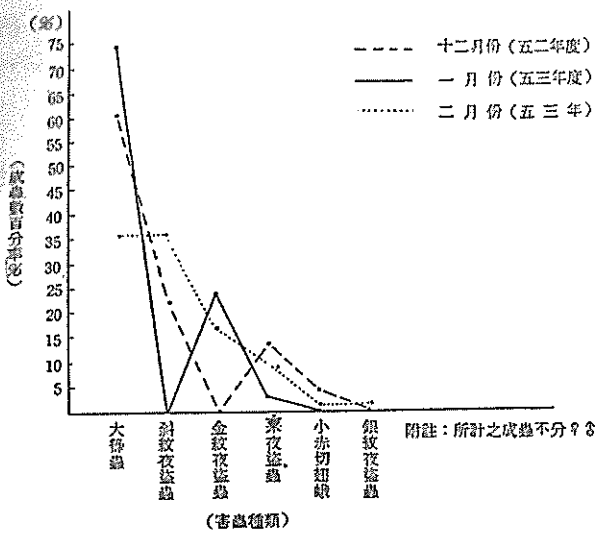
## 二、亞麻夜蛾科害蟲發生種類及其在亞麻栽培期間之消長。

依據自民國50年12月至53年 3月底，將近 3年來，分別在臺中、彰化兩縣亞麻栽培地區，以田間採集及誘蛾燈 (10W 綠色螢光燈) 誘集結果，爲害亞麻夜蛾科 (Phalaenidae) 害蟲共有 8 種之多，按其加害嚴重性順序排列如次：1. 大綠蟲 (*Heliothis obsoleta* Hübner) (圖 2)。2. 斜紋夜盜蟲 (*Prodenia litura* Fabricius) (圖 3)。3. 金紋夜盜蟲 (*Phytometra intermixta* Warren) (圖 4)。4. 粟夜盜蟲 (*Cirphis unipuncta* Haworth) (圖 5)。5. 小赤切翅蛾 (*Anomis fimbriago* Stephens) (圖 6)。6. 銀紋夜盜蟲 (*Phytometra ni* Hübner) (圖 7)。7. 白一紋夜盜蟲 (*Laphygma exigua* Hübner) (圖 9)。8. 球菜夜蛾 (*Agrotis ypsilon* Rottenberg) (圖 8)。

民國52年12月至53年 2月底，配合亞麻栽培時期，在臺中縣烏日鄉設立誘蛾燈，誘集夜蛾類亞麻害蟲，用資明瞭各類害蟲在田間之消長情形，茲將 3個月間，各月份成蟲田間消長情形，列如圖 1。

由圖 1 可知大綠蟲 (*Heliothis* sp.) 之發生率確實冠於其他害蟲之上。12月份係亞麻栽培之初期，在此期間除大綠蟲大發生外，其次爲斜紋夜盜蟲，再次爲粟夜盜蟲及小赤切翅蛾，而金紋夜盜蟲及銀紋夜盜蟲未曾發生。1 月份係亞麻生育中期，此時期仍大綠蟲最大發生時期，其次之重要害蟲則爲金紋夜盜蟲及粟夜盜蟲。2 月份爲亞麻生育之末期，亞麻大部均已結種，此時期之大綠蟲及斜紋夜盜蟲之發生同等重要，其次爲金紋夜盜蟲及粟夜盜蟲，再次則爲小赤切翅蛾及銀紋夜盜蟲。

圖1. 亞麻夜蛾類害蟲之成蟲各月份田間消長情形




## 三、臺灣亞麻夜蛾類害蟲之形態及習性概述。

㈠ 大綠蟲

1. 學名：*Heliothis obsoleta* Hübner
2. 英名：Cotton boll worm, Corn earworm, Tomato fruitworm.
3. 中名：大綠蟲，棉鈴蟲，玉米穗蟲，蕃茄果實蛾。
4. 寄主作物：亞麻、高粱、玉米、棉花、蕃茄、蔬菜、牧草、蠶蟲、花生、甘藷。
5. 形態：

成蟲：體及前翅灰褐色，體色因溫度、濕度及食物而異，淡褐、灰綠至黃褐色均有之，全體被毛，頭三角形，顏面圓而膨大，口器虹吸式，觸角絲狀，複眼大。胸部短，深褐色，被灰色鱗毛。前翅內側一半具不明顯之二道波紋，中線及賢狀紋不顯著，中室三環狀紋退化爲一或二黑斑。中線外側之第一線紋至外緣間之色調較深，其上有許多淡褐色波狀或圓形斑紋，外緣內側灰色，具1列爲數7—8之三角形斑紋，此斑紋後方有小形黑點列。前翅後面部份有顯著之波形或圓形斑紋。後翅白色，半透明，緣毛白色，後緣有一粗色帶，翅脉棕色明顯。脚跗節5，具2爪，脛節跗節上具刺，腿節上具2距，具生有長毛，腹部灰色，節間灰黃色，雄蟲外形可見8節，雌蟲7節，雄蟲尾端向上舉，尖形，雌蟲尾端鈍形，開孔明顯，體長18—20公厘，展翅38—42公厘。

卵：微帶黃色，有光澤，表面扁平，頂端渾圓，周圍有放射狀縱起線及與之相交之橫線。

幼蟲：色調及斑紋之變異至大。背面淡棕色，背線及背面瘤突起均深黑色另有黑色條紋存在背面，瘤突起上長黑毛，氣門黑色，氣門線淡黃色，側區近脚處淡紅褐色，腹足淡青黃色，胸足淡色，腹線白色，體長33公厘，前胸寬約4公厘。

蛹：長約16—18公厘，前胸寬約4—6公厘，紡錘形，頭端平滑，尾端微尖，腹端具鉤刺二個，初化蛹時青白色，後轉深色，羽化前深黑褐色，口脇與翅同長，翅達第4腹節後緣。

6. 習性概述：

大綠蟲爲一種世界性之雜食害蟲，根據食性而有許多別稱，即大綠蟲，棉鈴蟲，玉米穗蟲，蕃茄果實蛾。本蟲可爲害七十多種植物，主要爲害棉花、亞麻、高粱、玉米、蕃茄、煙草，各種豆科植物及一部份之蔬菜。在臺灣已形成棉花、亞麻、高粱、蕃茄、玉米等作物之嚴重威脅害蟲。

本蟲爲一相當貪吃並對藥劑具有耐性之昆蟲，其幼蟲期具各種不同之色彩及斑紋，隨其食料、

環境而變化，通常爲綠色，故有「大綠蟲」之稱。

每年可發生6—7代，但室內飼養可達 9 代之多。成蟲晝伏夜出，吸食各種花卉或蚜蟲之蜜汁，雌蛾交尾後，其產卵數爲通常 900 粒左右，卵散生於亞麻嫩葉上，大都於葉梢頂，正背面均可產卵，初產下時爲純白色後轉爲淡黃色，將孵化時呈黑色，孵化後即爬入亞麻葉芽內啖食生長點，如有蒴果即鑽入其內啜害，本蟲之卵期爲$2^1/_2$—8天，幼蟲期12—54天，蛹期14—67天，成蟲期 3—12天，一世代爲 31—141 天，視溫度變化而定，幼蟲脫皮 5 次，共 6 齡。兩蟲相遇則互相殘殺，弱肉强食，以 3 齡以上者爲多。

老熟幼蟲離開亞麻株而鑽入土中，通常在地面下 2～3cm 處營造蛹室，並作一隧道而化蛹其內。羽化後自隧道口爬出。

㈡ 斜紋夜盜蟲：

1. 學名：*Prodenia litura* Fabricius
2. 英名：Tobacco Cutworm.
3. 中名：夜盜蟲、行軍蟲、地蚤。
4. 寄主作物：亞麻、蘿蔔、蔬菜、瓜類、芋、甘藷、花生、煙葉、甘藍、茶葉、棉、苧麻、黃麻、柑橘等。
5. 分佈：臺灣、中國大陸、日本、海南島、印度、澳洲、非洲。
6. 形態：

成蟲：體及前翅皆褐色，前翅基部約三分之二處，有灰色細線紋數條，其中有一條明顯而較寬斜走之灰白帶紋，故曰斜紋夜盜蟲。前翅上外橫線之外側尚有光亮之灰白色粗帶一條。前翅外緣端部爲翅脉及橫線分割成14個左右之黑褐色小長方形點。後翅白色透明，翅脉明顯可見，其緣毛基部具一條褐色條紋，緣毛白色。胸背後面有白色叢毛，腹部暗褐色，近基部處有茶褐色之叢毛，體長約16公厘，展翅36—40公厘。

卵：淡綠色，饅頭狀，有放射狀之縱起線及與此相交之橫線，直徑約0.5公厘。

幼蟲：一、二齡者頭部深褐色、背線、亞背線、氣門下線均白色，另有多數圓紋。第三齡以後，胴部各小紋局部消失，氣門上線成白紋，出現於各節中央，各節背面有眼狀黑紋，尤以第10—11節上之黑紋大而四角形，氣門下線不顯明，腹面呈灰黃色，老熟者體長約40公厘。

蛹：橢圓形，初化蛹各部均爲青色，腹部微帶青色而呈腊紅色，其後色調較深，最後呈深赤色，翅達第四腹節後緣近處，口吻與中脚同長，後脚末端略長翅，氣門橢圓，腹端有尾刺一對，向下彎曲，長 18mm 寬 5.5mm。

7. 經過與習性：

本蟲在臺灣每年可發生 8 代，但於亞麻栽培期則爲 3 代，尤於12月中旬～下旬之幼苗期間爲害最烈。雌蟲產卵於葉裡，100—400 粒成卵塊，上覆母蟲之暗黃色尾毛，每一雌蟲產卵量約 1,200 粒，分2—5個卵塊，卵期4—8日，孵化之幼蟲，羣棲於葉裡，食害葉肉而殘留表皮，二齡以後漸行分散，晝伏夜出，自葉緣嚙食全葉，並切斷嫩莖，老熟後潛入土內，化蛹於離地面 3-6cm 之深處。幼蟲期約 20—35日，蛹期 8—12日。幼蟲爲雜食性，爲蔬菜、煙葉、苗圃及一般作物幼苗期之大害蟲。

㈢ 金紋夜盜蟲

1. 學名：*Phytometra intermixta* Warren
2. 英名：Noctid coterpillar
3. 寄主作物：亞麻、蘿蔔、甘藍、白菜、胡蘿蔔、蕃茄、豌豆、苧麻。
4. 分佈：臺灣、中國大陸、日本、非洲、歐洲、印度、小亞細亞。
5. 形態：

成蟲：全體朱色或赤褐色，肩板及脚紫褐色，腹部背面與側面爲淡褐色，略帶卵黃色，前翅紫褐色，亞基線，內橫線灰色，線紋也較細，從 Sc 脉之基部至外緣有一廣大之鐮狀金色紋存在，緣毛褐色並有暗色之波狀線，後翅爲黃褐色，中央暗色。

卵：初生爲黃色，有光澤，扁圓形，頂端渾圓，底面扁平，周圍有不明顯之縱行隆起線，自頂端分射至底面，數目爲25—30條，兩縱線間分歧許多橫斑紋，較細小，快孵化時變黃褐色，長約 0.3 mm，寬約 0.4mm。

幼蟲：初齡幼蟲頭部黑褐色，體爲淡黃綠色，胸部前胸背面有一黑褐色帶，胸足黑褐色，其間有白色交錯，體上具有多數剛毛瘤突，此瘤突以腹部前端較大，愈近後端愈小。其足型爲 3000 2001式，氣門下瘤大，老熟幼蟲爲 27～30mm，全體呈綠色，步行時如尺蠖狀，頭部綠色，頭側有一不明顯之黑色縱紋存在。

蛹：頭胸部黑褐，體暗褐色，腹部腹面淡黃色，觸角達中足之尖端，小顎達於第五腹節，尾端錐形略突出，其末端具矩形之鉤狀尾刺二個，其外側另有小形鉤狀刺六個。

6. 經過與習性：

本蟲過去一向被列爲本省蔬菜、豆科植物，甘藍等作物之害蟲，惟自本省開始栽培亞麻以來，即大量猖獗爲害亞麻葉部，尤其加害亞麻嫩葉並切斷幼莖，使亞麻生長停止，產生分枝，使纖維失去使用價值。本蟲一年可發生5—6代，室內飼養可達 8 代，但在亞麻栽培期間爲害亞麻者可發生 2 代，自12月中旬— 2月下旬，及 2月下旬— 3月下旬，本蟲發生時間及世代較整齊，經室內飼養結果，卵期3—13天，幼蟲期16—35天，蛹期 7—41天，成蟲期6 —12天，幼蟲脫皮 4 次 5 齡，卵散生於亞麻嫩葉上，產卵數爲400—1,500 粒左右，以蛹態在亞麻株間結蛹苞越冬，至 2月下旬才羽化飛出。

㈣ 粟夜盜蟲：

1. 學名：*Cirphis unipuncta* Haworth.
2. 英名：Armyworm
3. 中名：粟夜蛾、剃枝蟲、行軍蟲。
4. 寄主作物：亞麻、甘蔗、粟、陸稻、玉蜀黍。
5. 分佈：世界各地。
6. 形態：

成蟲：體與翅皆黃褐色，下唇鬚及腹部背面爲暗褐色。前翅上有暗色鱗片散布，前翅之橫線爲一黑色小點線，另有褐色斜帶一條，其前端起於翅頂，後端與外橫線相接，環狀線與腎狀線爲淡褐色，各翅脉間外緣有暗褐色點，緣毛黃褐色。後翅外端暗褐色，基部黃白色，緣毛黃色。體長 18 mm，展翅 38–42mm。

卵：饅頭狀、色淡黃，10—60粒一處，排列成兩行，產於葉背或莖上。

幼蟲：頭部黃褐色，顏面上有不鮮明之網狀紋，體背有兩條黑色粗縱紋，腹面淡黃，胸部黃褐色，其末端黑色，腹脚及尾脚皆淡黃色，體長 30mm 左右。

蛹：紡錘形，赤褐色，後脚與口吻及翅同長，前翅約爲翅長之半，尾端有强大之鉤狀尾刺兩個，體長 18mm。

7. 經過習性概述：

每年發生5—6代，在亞麻栽培期爲害亞麻兩代發生於10月下旬—12月中旬及 1 月中旬— 3 月下旬，由卵孵化之幼蟲，初爲多數羣集，食害亞麻葉和花，不分晝夜，三齡以後乃分開，白天隱藏於落葉或土中，夜間出而喰害葉片，老熟幼蟲潛入地下 3–6cm 土中化蛹，本蟲爲雜食性，爲禾本科作物之重要害蟲，其大發生時，作成羣結隊之移動，故有「行軍蟲」之稱。

㈤ 小赤切翅蛾

1. 學名：*Anomis fimbriago* Stephen
2. 英名：Noctuid caterpillar
3. 寄主作物：亞麻、棉、蓖麻。
4. 分佈：臺灣、中國大陸、印度。
5. 形態：

成蟲：雌雄體色殊異。雄蟲之頭及胸部爲澄黃色，腹部褐色。前翅基部半節橙黃色，外半節暗色，亞基線內橫線，中橫線爲暗赤褐色，有不規則之赤褐色，內橫線及後中橫線二者相接於後緣，中室有小白點一枚，外橫線暗褐色細小，第三脉以後消失，前翅外緣之中央部略突出，後翅略暗褐，基部色較淺淡，無線條，雌蟲色較淡，前翅黃色，體長 12–15mm，展翅 29–33mm。

卵：青綠色，饅頭狀，其上有縱橫隆起線數條，直徑 0.6mm 左右。

幼蟲：綠色，腹部第三節無脚，腹部第四節上脚特小，胸部有七條不連續縱線，亞背線及氣門上線間有大白色縱線，氣門楕圓橙黃色，體長 35mm 左右。

蛹：頭、胸及翅黑褐色，腹部赤褐色，頭頂約突出 1mm 左右，體長 17mm 左右。

6. 經過習性概述：

一年發生數世代。成蟲夜間活動，卵一粒粒在葉背沿葉脉產下，幼蟲日間靜止葉背，黃昏始沿葉緣食害，老熟幼蟲捲葉並在其中化蛹，幼蟲作尺蠖樣爬行。

(六) 銀紋夜盜蟲。

1. 學名：*Phytometra ni* Hübner
2. 英名：Noctuid Caterpillar
3. 寄主作物：同金紋夜盜蟲。
4. 分佈：同金紋夜盜蟲。
5. 形態：

成蟲：體及前翅暗褐色，前翅中央有腕狀銀色斑紋，後翅亦暗褐色，觸角絲狀，體長約12mm，展翅約 32mm。

卵：饅頭狀，淡綠色，直徑約 0.5 mm。

幼蟲：淡綠色，身體兩側各有條不大明顯之白色線紋，身體尾部較大，向頭部逐漸縮小，第三、四腹節無脚，故步行時作尺蠖狀，第八腹節有脚，氣門白色楕圓，體長約 30mm。

蛹：頭部及胸黑褐色體暗赤褐色，小顎末端突出於第五腹節，觸角達中脚之尖端，尾端圓筒形略突出，其末端具長形之鈎狀尾刺二個，體長 15mm 左右。

6. 經過習性概述：

每年發生5—6代，在亞麻栽培期爲害亞麻時，可發生1—2代，2月下旬—3月下旬間，成蟲產卵於葉背粒粒分散，幼蟲脫皮四次有五齡。幼蟲自葉裡穿孔食害並喰食花蕊，老熟幼蟲卽在葉裡作楕圓形之白色薄繭化蛹。

(七) 白一紋夜盜蟲：

1. 學名：*Laphygma exigua* Hübner
2. 英名；Beet armyworm
3. 中名：甜菜夜蛾。
4. 寄主作物：亞麻、葱、李、甜菜。
5. 分佈：日本、中國、歐洲、埃及、秘魯、澳洲、夏威夷。
6. 形態：

成蟲：腹部背面基部有一毛魄。體翅皆灰褐色，前翅之內外橫線各有暗褐色之細線二條，外緣黑點密布，緣毛基部暗色，後端白色，後翅白色，前緣部及外緣部微帶暗褐色，體長 11mm，展翅 24–27mm。

卵：成卵塊，上有灰黃色之鱗毛覆蔽，卵粒爲淡黃色球形，有眞珠之光澤，直徑0.5mm左右。

幼蟲：體青綠色或淡綠色，體側具青色之縱紋。長約 30mm。

蛹：赤褐色，有尾刺二對長短不一。

7. 經過習性概述：

一年發生6—7代，雌蟲產卵於亞麻葉頭，呈卵塊，卵塊上覆以母蛾之灰黃色鱗毛，孵化之幼蟲喰食葉片，老熟幼蟲化蛹於地面並以落葉作繭苞。

(六) 球菜夜蛾

1. 學名：*Agrotis ypsilon* Rottenberg
2. 英名：Black catworm
3. 中名：切根蟲（別名）
4. 寄主作物：亞麻、蔬菜、黃瓜、茄子、蕃茄、棉、麥、煙草。
5. 分佈：臺灣、亞洲、非洲、澳洲、南北美洲。
6. 形態：

成蟲：全體灰褐色，頭部暗褐色，胸部灰褐，腹部灰色，複眼漆黑色，觸角深黃褐色，足除腿節爲灰色外，餘略作黑色，各節相連處則爲白色，前翅黑褐色，前翅之中室端除腎狀紋外，其外方尙有劍狀之黑紋一個與此相對處尙有二個較小之黑紋，接近外緣處淡色，後翅灰白而透明，外緣附近爲灰褐色，緣毛灰白色，脉紋灰褐色，前脚之脛節之兩側各生有赤褐色之小刺八支，體長約 19.5 mm，展翅約 41mm。

卵：饅頭狀，初呈淡黃色，後轉深黃色，孵化前則呈赤褐色，頂端四周稍淡色，卵色有光澤，表面有放射狀之縱起隆線及與此相交之橫線直徑約 1mm。

幼蟲：初孵化之幼蟲，長約 1.6mm，全體灰褐色，頭黑色，前胸之硬皮板暗褐色，其中央有暗黃色縱線一條，第二節以下，各有不明顯之暗黃褐線二條，各體節上生有11個瘤狀突起各生短毛一根，氣門黑色，體下方爲暗黃灰色，體之第12節生有矩毛 8 根，排成前後二列，體長約39mm。

蛹：全體作淡赤褐色或暗褐色，具光澤，氣孔梭形，翅達第四腹節之後緣，口吻末端達中脚與後脚之間，後脚與翅同長。後端具尾刺二個，長約 21.5mm，寬約 9mm。

7. 經過習性概述：

每年發生5—6代，雌蛾產卵於雜草葉上或落葉地面，1—2粒一處，約6—8天孵化，幼蟲期約一個月，幼蟲白晝喜潛伏土內，夜則出而爲害，取食時先將初苗幼苗嫩莖之近地部或根部咬斷，再食片，故又名「切根蟲」「小地老虎」。幼苗一經其害，輕者產生分枝，重者則鮮能復活，以幼蟲或其蛹蛰伏土中越冬，每雌蛾能產卵 500—1,400粒，平均爲 800 粒左右，成蟲活動於夜間，有趨光性及趨化性。

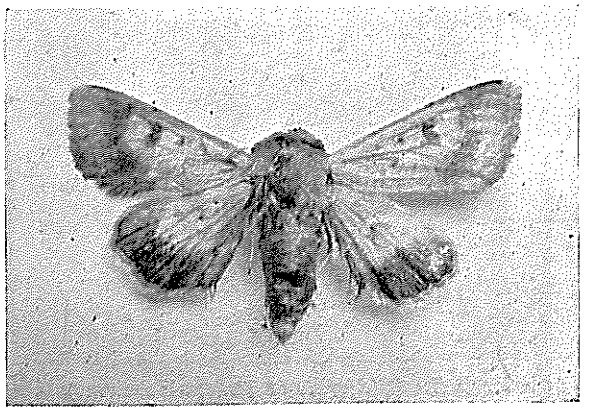


圖2. 大綠蟲 (*Heliothis obsoleta* Hübner)

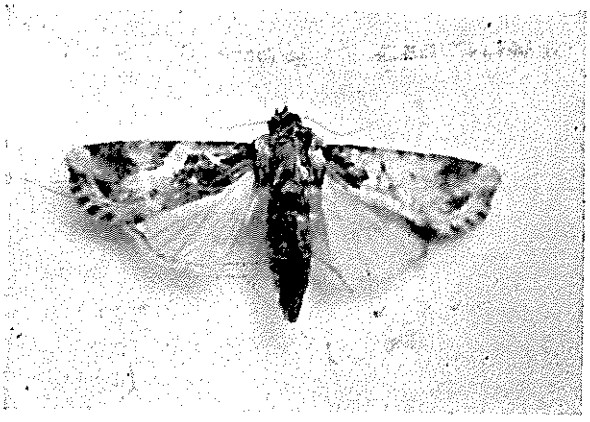


圖3. 斜紋夜盜蟲 (*Prodenia litura* Fab.)

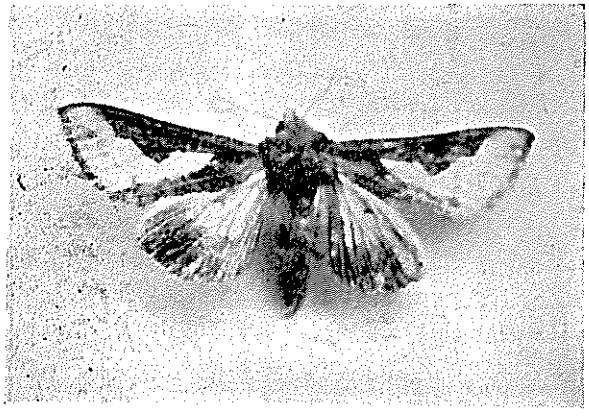


圖4. 金紋夜盜蟲 (*Phytometra intermixta* War.)

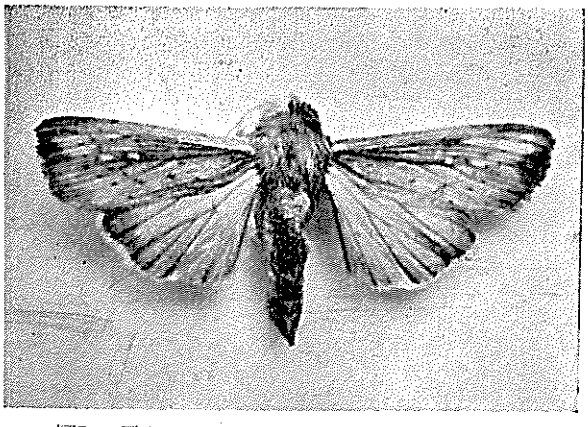


圖5. 栗夜盜蟲 (*Cirphis unipuncta* Howarth.)

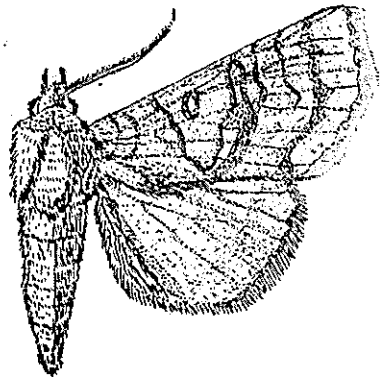


圖6. 小赤切翅蛾 (*Anomis fimbriago* Staphen)

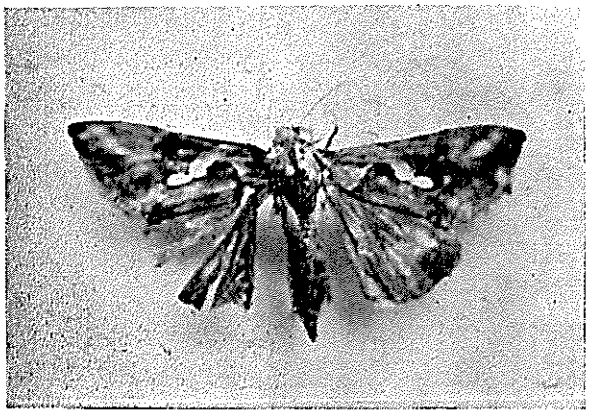


圖7. 銀紋夜盜蟲 (*Phytometra ni* Hübner)

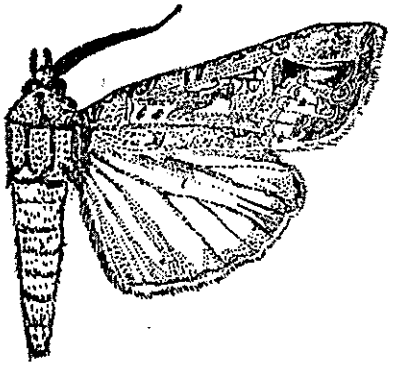


圖 8.球菜夜蛾(*Agrotis ypsilon* Rottenberg.)

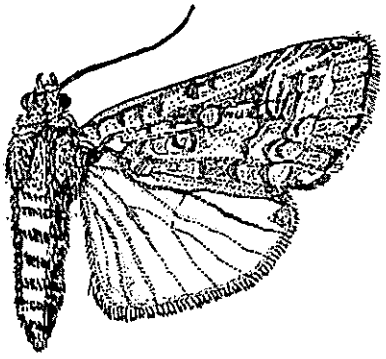


圖9. 白一紋夜盜蟲 (*Laphygma exigua*、Hübner)

## 四、討論及結論

臺灣亞麻之害蟲，據楚南仁博氏（1940）之調查，共有28種，分屬於直翅目 (Orthoptera) 5種，半翅目 (Hemiptera) 3種，鱗翅目 (Lepidoptera). 20種，鱗翅目害蟲屬於夜蛾科 (Phalaenidae) 者8種，其名稱爲：金紋夜盜蟲 (*Phytometra intermixta* Warren)、銀蚊夜盜蟲 (*Peytometra ni* Hübner)、球菜夜蛾 (*Agrotis ypsilon* Rottenburg)、粟夜盜蟲 (*Cirphis unipuncta* Haworth)、草白夜蛾 (*Cirphis loreyi* Dupenchel)、白一紋夜盜蟲 (*Laphygma exigua* Hübner)、擬大煙草蛾 (*Chloridea obsoleta Fabricius*) 及斜紋夜盜蟲 (*Prodenia litura* Fabricius) 等。按筆者等自民國50年12月—53年3月，將近3年來在臺中、彰化、亞麻主產地調查結果，關於夜蛾科害蟲仍然有8種之多。惟其種類略有出入。除金紋夜盜蟲、銀紋夜盜蟲、球菜夜蛾、粟夜盜蟲、白一紋夜盜蟲及斜紋夜盜蟲等6種相一致外，更發現大絲蟲(*Heliothis obsoleta* Boddie) 及小赤切翅蛾 (*Anomis fimbriago* Stephen) 等二種，而楚南氏記載之擬大煙草蛾及草白夜蛾則未發見。尤值注意者，楚南氏未曾記載之大絲蟲，據筆者等之調查，實乃亞麻夜蛾科害蟲中爲害最嚴重，發生密度最高之大害蟲，白一紋夜盜蟲及球菜夜蛾在51/52年期亞麻曾發生爲害，52/53年期則未見發生。該兩種害蟲，爲害亞麻，因年份而呈現不穩定現象。

民國52年12月到53年2月下旬，在亞麻生育期間在臺中烏日鄉以誘蛾燈誘集亞麻夜蛾類害蟲之成蟲，觀測田間消長情形結果，當12月份正值亞麻生育初期，害蟲以大絲蟲爲主，斜紋夜盜蟲及粟夜盜蟲次之，金紋夜盜蟲及銀紋夜盜蟲未見發生。1月份爲亞麻生育中期，此時乃大絲蟲最大發生時期，金紋夜盜蟲亦開始發生，其嚴重性僅次於大絲蟲而居第二。2月份爲亞麻生育之末期，此際亞麻之害蟲，大絲蟲及斜紋夜盜蟲之發生同等重要。金紋夜盜蟲之發生密度雖略遜於前2種害蟲，但爲害花及蒴果，可使亞麻蒙受極大損失，其重要性不容忽視。

綜觀上列結果，爲害亞麻夜蛾科害蟲雖有8種之多，而最主要者不外乎大絲蟲，斜紋夜盜蟲及金紋夜盜蟲等3種，其中尤以大絲蟲之發生率冠於各種害蟲之上，在亞麻全生育期間均大量發生。當亞麻在生育初期時，爲害頂葉，喰食生長點，使受害亞麻因而發生分歧，纖維品質因之劣變，在亞麻生育中、後期，加害花，蒴果，使種子產量大減。該害蟲在亞麻栽培前途上，已形成嚴重威脅。

按大絲蟲爲世界性之雜食害蟲，寄主作物分佈極廣，除亞麻外，高粱、玉米、棉花、蕃茄、蔬菜、牧草、蚕豆、花生、甘藷、太陽麻等均爲其嗜好食料，本蟲在亞麻栽培期間大量發生，與亞麻栽培地區之作物種類，亞麻田前後期作物有極大關係，欲竟治蟲之事功，不得不注意及此。

## 五、摘　　要

臺中，彰化地區亞麻夜蛾類害蟲發生種類一覽表

| 害蟲名稱 | 學名 | 爲害部位 | 發生世代數 | 越冬處所及越冬蟲期 | 爲害亞麻時期 | 爲害狀況 | 爲害程度 |
|---|---|---|---|---|---|---|---|
| 大絲蟲 Corn earworm. | *Heliothis obsoleta* Hübner | 葉、花、蒴果。 | 6-7代，在亞麻栽培期間發生2～3代 | 以蛹期在地下3-10公分處越冬 | 10月下旬-12月下旬<br>12月上旬- 2月下旬<br>2月中旬- 3月下旬 | 雌蛾產卵在亞麻頂葉上，孵化幼蟲加害頂芽生長點，致植株生育停頓產生分歧，三齡後啜食蒴果。 | 重要 |
| 斜紋夜盜蟲 Tobacco cutworm. | *Prodenia litura Fab.* | 葉、莖、蒴果。 | 8代，在亞麻栽培期間發生2代 | 以蛹期在地下3-6公分處越冬 | 10月上旬-11月上旬<br>2月中旬- 3月下旬 | 雌蛾產卵葉裡以覆毋蟲尾毛。孵化幼蟲，羣聚剝食葉肉，切斷幼莖，成長後分散。 | 重要 |
| 金紋夜盜蟲 Noctuid caterpillar | *Phytometra intermixta war.* | 葉、莖、花。 | 5-6代，在亞麻栽培期間發生2代 | 老熟幼蟲在葉裡作橢圓形白色薄繭化蛹越冬 | 12月中旬- 2月下旬<br>2月下旬- 3月下旬 | 雌蛾散生卵於亞麻幼葉或莖上。孵化幼蟲加害頂端嫩葉，並切斷幼莖三齡後嚴重加害。 | 重要 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 粟夜盜蟲 Army worm. | *Cirphis unipuncta* Haworth | 葉、花。 | 5-6 代，在亞麻栽培期間發生 2 代 | 以蛹期地下 3-6 公分處越冬 | 10月下旬-12月中旬 1月中旬- 3月下旬 | 幼蟲夜間加害葉片、花有羣居性嚴重時全園，不見莖葉 | 次要 |
| 小赤切翅蛾 Noctuid Caterpillar | *Anomis fimbriago* Steph. | 葉、莖。 | 數代，在亞麻栽培期間發生 1 代 | 老熟幼蟲捲葉化蛹越冬 | 1月下旬- 2月下旬 | 幼蟲黃昏後開始自葉緣取食葉肉 | 輕微 |
| 銀紋夜盜蟲 Noctuid caterpillar | *Phytometra ni* Hübner | 葉、莖、花。 | 5-6 代，在亞麻栽培期間發生1-2代 | 同金紋夜盜蟲 | 2月下旬～3月下旬 | 幼蟲自葉裡穿孔爲食，並加害花蕊 | 輕微 |
| 白一紋夜盜蟲 Beet Armyworm | *Laphygma exigua* Hübner | 葉、花、蒴果 | 6～7 代 | 以落葉作繭化蛹於地面越冬 | 不　　明 | 幼蟲喰食葉及蒴果 | 輕微 |
| 球菜夜蛾 Black cutworm | *Agrotis ypsilon* Rottem. | 根、莖及花。 | 5～6代，在亞麻栽培期間發生1-2代 | 以老熟幼蟲或蛹在土中蟄伏越冬 | 10月上旬-11月中旬 11月下旬- 1月上旬 | 幼蟲爲害幼苗，切斷莖部並嚙食葉部 | 輕微 |

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# THE INVESTIGATION ON NOCTUIDS OF FLAX

by

C. C. Tu and T. H. Lin

## ENGLISH SUMMARY

By collecting larvae from the flax field to feed in the laboratory and capturing adult with light trap, Tainan T.F.E.S. has carried the works of investigation and classification of flax insects of the family Phalaenidae, for three years. Eight species of this family were found: the corn earworm, *Heliothis obsoleta* Hübner; Tobacco cutworm, *Prodenia litura* Fabricus; noctuid caterpillar, *Phytometra intermixta* Warren; army worm, *Cirphis unipuncta* Haworth; noctuid caterpillar, *Anomis fimbriago* Stephen; noctuid caterpillar, *Phytometra ni* Hübner; beet armyworm, *Laphygma exigua* Hübner, and the black cutworm, *Agrotis ypsilon* Rottenberg.

The occurrence of these insects in flax field was investigated from December, 1963 to February, 1964. six species of the above insects except the beet armyworm and black cutworm have been collected.

In December, the initial stage of flax growth, corn earworm was the insect abunduntly occurred in the field, the next was tobacco cutworm, *Predenia litura*, while none of the noctuid caterpillar, *Phytometra intermixta*, was discovered. The corn earworm reached its peak stage in January, the middle stage of flax growth. *P. intermixta* and the armyworm were also found to be the important insect pests at this time. Besides the serious injuries of corn earworm and tobacco cutworm in February when majority of flax blossoming and bearing fruits, damages of the noctuid caterpillar, *P. intermixta* and the armyworm also become to obvious. Noctuid caterpillar, *Anomis fimbriago* Stephen and noctuid caterpillar, *Phytometra ni* were also found.

# 文 獻 介 紹

# ABSTRACTS OF LITERATURE

## 一、病原菌分化與分類之關係 [M. P. Kernkamp (1965) Phytopathology 55 (8): 821～822]

往日有關燕麥銹病之命名法 (Puccinia graminis pers. var. avenae Eriks & E. Henn)，是模糊不清的，同時本文也將以此爲材料作爲討論之基礎。檢討結果具有三個不定因素；

(1)判別品種。

(2)環境因子對小種鑑定之影響。

(3)研究人員間缺少交換意見。

以前對燕麥銹病分化因子型之鑑定遭遇困難且與小種之分類有關。Stakman 等氏首次以判別品種 Victory white tartar 及 Monarch 鑑定其生理型。其後 Bailey 氏叙述五個生理型，Gordon, Bailey, Cotter, Johnson, Newton 等氏於燕麥上從小種14上又分化出小種 6。其時所採用之判別品種間之遺傳性不穩定，但係經過同一分化及反覆考察者。稍後之研究者開始報告有生態型小種之出現，Johnson 等報告小種 7A 侵害判別品種 Rodney 於是增列品種 Garry 以分出新之小種，同時 Stakman 等於1954年小種之鑑定上增列11個輔助判別品種。

Roberts 報告用三個判別品種另加六個品種鑑定結果有57個小種，亞種，生態型或因子型之出現，當世界各地之研究者以相異之判別寄主來分化命名生態型時引致更多之混亂。

Faria 等氏在巴西記述生態型 3A 及 4A 對 Saia 及 Gustarson 品種具有强烈之病原性。

在瑞典則 3A, 4A 對 Rodney 具强烈之病原性，Faria 等氏也叙述 7A 在 Saia 上具罹病性，因此巴西存有小種 3A, 4A 及 7A，瑞典 3A 及 4A，加拿大 7A。

此外尚有相似之小種。按照 Roberts, 3A (瑞典) 及3D (哥倫比亞) 具有相似之發病型，同時 12A (U.S.A.) 及 12c (哥倫比亞) 係屬同一小種。

Goto 叙述一種變種 7B 因其較小種7較早形成各多胞子堆，同時 Gordon 闡述 6Y 及 3Y 因其形成黃色之銹胞子，此外尚有研究者定出許多變異種。

Roberts 確定小種7之一個變種，小種6之四個變種，6A 之二個變種，Orjuela 確定小種3，4，6，7，12及13有22個亞種。

由於不斷之探究，燕麥銹病小種，判別品種及溫度間之相互關係已知之甚詳。

Gordon 曾以小種1，3，4及5於品種 Joanette 上測定溫度 (75.4，71.9，64.8 及 57.4F)對發病型之影響，結果渠證實 Joanette 在高溫時變爲易於罹病性，同時申述昔日於不同溫度下所作小種分化困難之眞正意義。

列如在 75.4F 時生理型1成爲生理型2，71.9F 及 64.8F 時則成生理型 5, 75.4F 時生理型3變爲生理型7，同時 75.4F 及 64.8 時生理型4變爲生理型6而祇有在 57.4 時這些生理型才正常，因此吾人鑑定菌系時必須盡可能在同一之環境行之，同時也應採用遺傳性穩定之判別品種。(朱啓魯)

## 二、病原菌胞子與寄主植物組織間之相互作用 [Syoyo Nishimura & R. P. Scheffer (1965) Phytopathology 55 (6): 629～634]

1. 病原菌本身能產生毒素以抑制寄主苗之生長：將水稀釋之胞子液一滴滴於玻片和橡樹葉上，及將培養液稀釋之胞子液一滴滴於玻片上，經保溫一段時間後，取出胞子液，測定胞子之發芽百分率，再將胞子去掉，以測定胞子液之毒素，結果發現休眠胞子能產生多量之毒素；不論在玻片上或葉上均在三小時內可產

生。不過不具病原性的胞子或已發芽之胞子却不產生毒素。然而具病原性的與不具病原性的胞子都是一樣地能在寄主葉上發芽，產生侵入初期的狀態。

2. 寄主葉子能產生促進病原菌胞子發芽之刺激物質：此種物質的產生並非由於病原菌與寄主相互作用後而產生乃是由未受傷之寄主組織所產生，故胞子液滴於玻片上者根本就不會產生。因此只要將水滴滴於寄主葉上，經過一段時間後，此水滴中卽含有能刺激促進胞子發芽之物質。此現象之產生不論是抗病性的寄主或是罹病性的寄主，皆一樣地能產生。大部份的刺激現象受着主要刺激物質之影響，此物爲一種臘樣的成份，但尙未被鑑定出來；除此之外尙有二種較不重要的刺激物質，其一亦爲臘樣的成份，而另一則被鑑定爲 palmitic acid。

3. 寄主葉子能產生抑制病原菌發芽之抑制物質：關於此點看來似與上項發生矛盾，不過事實上此物質之產生乃由病原菌與寄主組織相互作用後所產生的，因此單單胞子液或是水滴於葉子上都不會產生此類物質，此物也許就是所謂的"phytoalexin"，雖然此物質之產生，其最後濃度罹病性寄主會多於抗病性寄主，可是此抑制物質，對於病原性胞子及不具病原性胞子之反應都是一樣，而且在抗病性與罹病性寄主組織上之反應還是差不多。抑制物質的產生並不因爲病原菌胞子產生毒素而有所影響，而更顯明者，乃病原菌胞子懸浮於毒素液中所產生之抑制物質與懸浮於水中者完全無差別。因之，單以毒素液或水不具胞子滴於寄主葉上，皆不會產生抑制物質。這種抑制物質雖能抑制胞子的發芽但對於病原菌初期侵入之抵抗性毫無關係。此物質雖經分離獲得但未經鑑別確定。

4. 相互作用與時間的關係：

(1)刺激物質於胞子液滴於寄主葉上十分鐘後卽可發現，二小時後，卽達永恒的狀態。

(2)毒素的產生爲發生在胞子液滴於寄主葉上二小時後，很快的卽可達到高濃度而不再增加。

(3)抑制物質的產生爲在胞子液滴於寄主葉上十二小時後，而在十五至廿四小時之時間中，抑制物質濃度之增加與時間有直線的關係。（周廷光）

## 三、BCB 對菠菜抽苔，開花與決定性別之影響(一) [太田敏郎(1962) 茨城大學農學部學術報告 10:5～12]

材料與方法：實驗(一)於1962年 3月10日在 1/5000 a 大小之化學樹脂缽播種，供試品種爲日本在來種與 King of Denmark，子葉展開時以土壤灌注法處理植物矮化物質 Bromocholine Bromide (BCB) 250cc，濃度爲 $10^{-2}$，$1/3\times10^{-2}$，$10^{-3}$ M等三種，對照區以同量之水代替 BCB 溶液。實驗(二)於6月2日播種，用上述兩品種與其他10品種。除日本在來種仍按照實驗(一)之3種濃度處理外，其他11品種以 $1/3\times10^{-2}$ M處理。實驗(三)係調查性別爲目的，於8月28日播種，使用日本在來種，爲促進抽苔，開花起見，在夜間距缽上約1.5m處點燃 20W 螢光燈2支（等於日照時間24小時），處理濃度爲 $10^{-2}$，$1/3\times10^{-2}$ M 之兩種。

對菠菜之影響：在實驗(一)與(二)，濃度高之 BCB 處理在抑制初期生長，但在生長後期（抽苔，開花期），實驗(一)所得之結果與實驗(二)不同，卽實驗(一)，BCB 處理區之植株生長旺盛，莖長亦較對照區爲長；但在實驗(二) BCB 處理區之生長被抑制。作者認爲此現象與生育期間之長短有關，卽3月10日播種者自播種到達抽苔，開花之日數較5月2日播種者爲長，因此前者之 BCB 處理區初期生長雖然緩慢，但後來由於 BCB 處理反而生長轉旺，併有充裕之時間趕上甚至超出對照區。

對抽苔與開花之影響：實驗(一)之 BCB 處理區，除 King of Denmark 之 $10^{-3}$ M 處理外，其他均有提早抽苔與開花之趨勢；但在實驗(二)供試之各種均因 BCB 處理而延遲抽苔與開花期，惟 Nobel, King of Denmark 等抽苔較晚之品種之延遲程度較出他品種爲輕。

對決定性別之影響：經過三次實驗之觀察，BCB 處理使日本在來種雌性化；但在實驗(二)供試之11品種中（不包括日本在來種），抽苔，開花較早之品種卽無雌性化之趨勢。由於 BCB 處理誘發之菠菜性別之變化是否與品種，環境或前兩者導致生長期間長短而不同——關於此問題作者認爲值得令人感興趣。(洪祖仁)

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