# 農業研究

第十四卷　第二期

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Beginning from March 1964, this Journal, formerly named, 「AGRICULTURAL RESEARCH」 (Vol. 1 to Vol. 12), is now to be named 「JOURNAL OF TAIWAN AGRICULTURAL RESEARCH」.

# A STUDY ON THE INFLUENCES OF ENVIRONMENTAL FACTORS TO THE PURE LINE SELECTION FROM HYBRID POPULATION OF RICE*

## Part 1. The Response of Yielding Capacity Among Different Pure Line Groups Selected at Different Localities

by

T. S. MIU**

## INTRODUCTION

In this study, the following two hybrid combinations were used:

(A) Chia-nung 242×Baritol

(B) Taichung 65×Baritol

in which, parent varieties "Chia-nung 242" and "Taichung 65" are the most popular rice varieties in Taiwan. "Baritol" is an upland rice variety cultivated in the aboriginal region of Taiwan.

By the use of two crossing combinations mentioned above, it is expected that through the successional generation of selections in the breeding program, new rice varieties with disease and drought resistant characters might be developed. How environmental factors influence the chance of pure-line selection from the hybrid populations having the same parental combinations was also involved in the study. $F_2$ individuals in each of the populations were divided into 4 equal portions and sent to 4 localities situated at from the north to the south of the Province, for segregation and natural selection under the different natural conditions in order to obtain data and references for the readjustment of rice breeding regions according to natural environs.

## MATERIALS AND METHODS

After the $F_2$ generation in 1960, seeds of each of the two hybrid combinations were thoroughly mixed, they were divided into 4 equal portions for planting at 4 different localities, namely, Taipei, Taichung, Chiayi and Pintung. From agricultural point of view, these 4 localities represent 4 marked rice regions in Taiwan. At each of these 4 localities two crops of rice in a year are grown. Each of the two crops was applied with standard levels of fertilizer, or at a rate of 80N, 40 $P_2O_5$, 40 $K_2O$ kg/ha. Seeds obtained from each combination at different localities were kept in separate. But seeds of each combination at each locality were thoroughly mixed and a portion of which taken at random was used for planting of next crops. This was continued until $F_6$ generation. Thereafter, selections for better individuals from each of the population were made and tested for their breeding-trueness by means of

* This topic is a part of the author's research work on "The Causes of Low Yield of Rice in Tropical and Subtropical Regions" which is subsidized by Rockefeller Foundation in the rice breeding program.

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headrows. In comparative experiments of these lines, most of the poorer lines were discarded. The agronomic characters of the selected lines were also compared, 12 desirable lines from each locality, having 6 lines from combination (A) and 6 lines from combination (B) were collected. Thus there were 48 lines in total from the 4 localities (12×4). A regional test of these lines was then conducted at the four localities. Their adaptation to the localities in relation with the source of the group of rice variety is then traced.

The selected rice lines or varieties for the regional test are shown in the following:

| Combination / Breeding Station | Combination A<br>Chia-nung 242×Baritol | | | Combination B<br>Taichung 65×Baritol | | |
|---|---|---|---|---|---|---|
| Taipei | Taipei No. 1 | Taipei No. 2 | Taipei No. 3 | Taipei No. 7 | Taipei No. 8 | Taipei No. 9 |
| | Taipei No. 4 | Taipei No. 5 | Taipei No. 6 | Taipei No. 10 | Taipei No. 11 | Taipei No. 12 |
| Taichung | Taichung No. 1 | Taichung No. 2 | Taichung No. 3 | Taichung No. 7 | Taichung No. 8 | Taichung No. 9 |
| | Taichung No. 4 | Taichung No. 5 | Taichung No. 6 | Taichung No. 10 | Taichung No. 11 | Taichung No. 12 |
| Chiayi | Chiayi No. 1 | Chiayi No. 2 | Chiayi No. 3 | Chiayi No. 7 | Chiayi No. 8 | Chiayi No. 9 |
| | Chiayi No. 4 | Chiayi No. 5 | Chiayi No. 6 | Chiayi No. 10 | Chiayi No. 11 | Chiayi No. 12 |
| Pintung | Pintung No. 1 | Pintung No. 2 | Pintung No. 3 | Pintung No. 7 | Pintung No. 8 | Pintung No. 9 |
| | Pintung No. 4 | Pintung No. 5 | Pintung No. 6 | Pintung No. 10 | Pintung No. 11 | Pintung No. 12 |

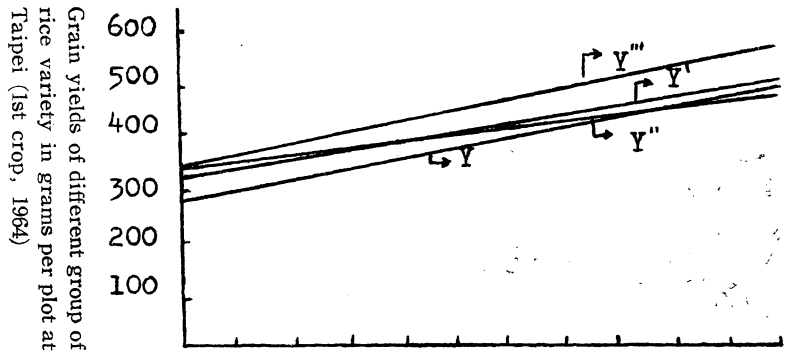
The varieties shown above were included in the regional test using random blocks were carried out at Taipei, Taichung, Chiayi & Pintung. Each of the experiments had 2 replications in the test during the first crop of 1964, and 6 replications the second crop of 1964, in order to make the results of this experiment more reliable.

## EXPERIMENTAL RESULTS AND DISCUSSION

From Fig. 1 (Page 3), when we compared the grain yield, it was found that among 4 variety groups, the lines selected at Pintung were the highest yielder in Taipei during 1st crop. But its heading time was 3.31 days, in average, later than those lines selected at Taipei. While the yields of Taichung varieties was the next higher than the lines selected at Taipei and their heading time was 1.25 days later than those selected at Taipei. Lines from Chiayi yielded only little higher than those selected at Taipei, but their heading time was 3.43 days later.

The grain yields of 4 variety groups shown by trend line are as follows:

$Y = 283.06 + 18.08\,x$ (Taipei varieties)
$Y' = 328.55 + 15.87\,x$ (Taichung varieties)
$Y'' = 335.90 + 12.64\,x$ (Chiayi varieties)
$Y''' = 347.31 + 19.58\,x$ (Pintung varieties)

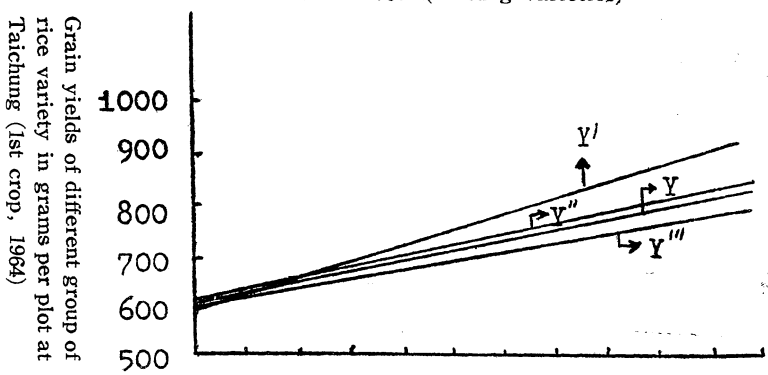



Each scale represents the position of each variety (pure line) arranged by order of yielding ability.

Fig. 1: Trend lines of yielding capacity of 4 rice variety groups bred at different localities cultivated in Taipei, 1st crop, 1964.

According to the adaptability of the 4 variety groups in Taipei, it may be seen that the varieties developed from the southern regions of the Province is always higher in yielding capacity than those bred in Taipei when they were grown during first crop. In other words, there seems to be that Taipei is not a most suitable place for rice breeding of the Province, because that the new lines of this experiment selected from central and southern Taiwan appeared to be having acquired more yielding potential as tested during 1st crop in Taipei. However, varieties selected from Pintung and Chiayi were 3 days more later in heading time then these selected

$Y = 605.14 + 20.96\,x$ (Taipei varieties)
$Y' = 602.83 + 31.15\,x$ (Taichung varieties)
$Y'' = 618.29 + 21.22\,x$ (Chiayi varieties)
$Y''' = 601.12 + 17.60\,x$ (Pintung varieties)




Each scale represents the position of each variety (pure line) arranged by order of yielding ability.

Fig. 2: Trend lines of yielding capacity of 4 rice variety groups bred at different localities cultivated in Taichung, 1st crop, 1964.

in Taipei, from the crop rotation point of view, it is better to use varieties from Taichung which is comparatively earlier in maturity in Taipei.

Taichung is located at central part of Taiwan, and where the soil fertility is more rich than the other regions. Under such a condition, lines selected from Taichung & cultivated in Taichung gave the highest yield. The slope of trend line of yielding capacity rises steeply after 1–2 grade on X coordinate. It shows that Taichung is a more ideal place for rice breeding for the 1st crop.

In comparison with the yielding capacity of four rice groups (Fig 2), Taichung varieties yields highest in place where they originated (Taichung). Where as Chiayi varieties ranked next; Taipei varieties the third. and Pintung varieties the last in yielding capacity.

It is quite evident that there is a tendency for the yielding capacity of different rice groups in Taichung to decrease with the increase in distance between the breeding station and the Taichung region.

As for the heading period among the 4 variety groups in Taichung, lines selected in Taipei were earlier than the other 3 groups, the average number of days from sowing to heading is 131.54, But Taichung varieties were 1.33 days average later than the Taipei lines, and Chiayi varieties 3.67 days more, and Pintung varieties, 2.71 days more than Taipei varieties, on average.

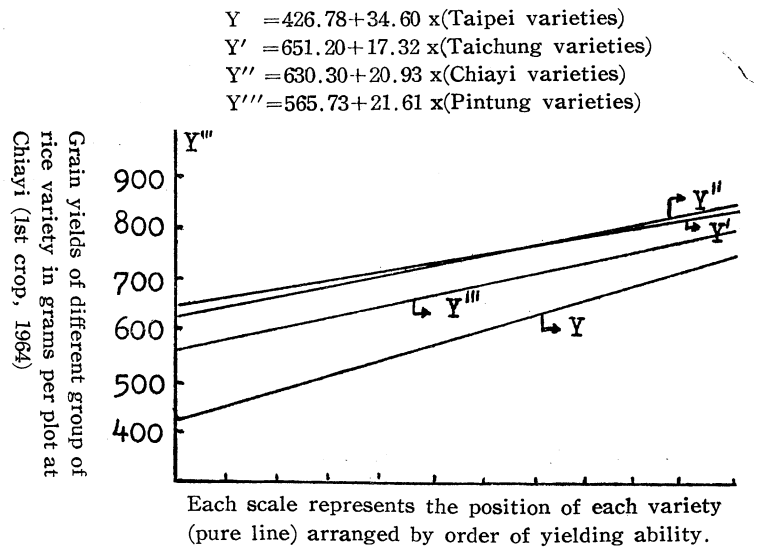



Fig. 3: Trend lines of yielding capacity of 4 rice variety groups bred at different localities cultivated in Chiayi, 1st crop, 1964.

From Fig. 3, the results in Chiayi were discussed. In first crop of the year, we had a serious drought there, so the irrigating water was not sufficient. The yielding capacity of Taichung and Chiayi variety groups was somewhat close with each other as shown on the trend lines Y′ and Y″. The two lines crosses each other on the middle point but the opposit vertical angle is very acute which supposes that a part of the two groups of varieties may be replaced each other in practical cultivation.

The grain yields of Pintung varieties were lower than Chiayi and Taichung varieties in Chiayi, and the Taipei varieties in Chiayi due to drought weather condition and serious pest damages (rice-blast and moth-borers were the more important) showed the lowest yields.

The water levels under ground are higher both in Taipei and Pintung, so varieties bred in such a condition, naturally can not tolerate drought.

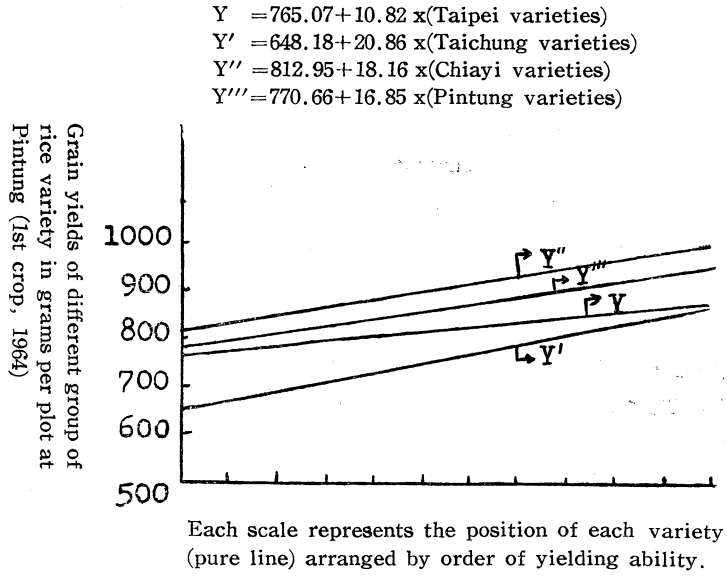



Fig. 4: Trend lines of yielding capacity of 4 rice variety groups bred at different localities cultivated in Pintung, 1st crop, 1964.

In Pintung (see Fig 4), the grain yields of Chiayi varieties were the highest among the 4 lines. But the yield trend line of Pintung varieties is little lower than the line of Chiayi varieties though the latter is very closely parallel to it. As for trend lines of Taipei & Taichung varieties, they are much lower than the former two lines. It indicated that rice varieties developed from Taipei and Taichung cannot adapte to Pintung environment during the period of the 1st crop of rice. But Taipei varieties in Pintung yielded higher than Taichung varieties when we compare the grain yields of the two groups. We found that it may be caused by under-ground water levels. In Pintung the water level under the paddy field is usually higher which is somewhat similar to the condition of rice field in Taipei.

Then we conclude the first crop experiments. Although the soil fertilities of this experiment at 4 localities were not on a homogeneous level, but when we compared the yielding capacities among the 4 groups of varieties cultivated at single place, it may find out that in rice cross-breeding program in this Province, varieties developed from southern part of this Island may be adapted to north-ward areas, but conversely, the northern varieties are always not adapted to south-ward parts. (compare the trend line)

During the 1st crop, Taichung varieties may be adapted to the southern area until Chiayi region is reached or to the north, Taipei. But when they were introduced to Pintung area, the most southern part of the Island, the grain yields were not so good.

Because Taicheng is located at central Taiwan, it seems to be a most suitable place for rice-breeding. According to the regional test of the 1st crop in Taichung (see Fig. 2) the rice varieties developed from Taichuug yields highest than all the other variety groups developed from other regions. It may be concluded that, there exists a relationshjp between the geographic distance from Taichung and yielding capacity of rice group cultivated in Taichung. In order words, the near the station located to Taichung, the higher the variety yields. This phenomenon shows Taichung is a most suitable place for rice breeding during the 1st crop period of Taiwan.

Any variety group of this experiment introduced to Taichung may always get a suitable return of grain yields, and the variability of grain yield among the 4 rice groups cultivated in Taichung gives the smallest magnitude in distribution of yielding ability. This also indicate that Taichung is the most favorable region for breeding rice varieties for this Province.

From Fig. 3, we can see that in Chiayi, the two fitting lines of Chiayi and Taichung varieties respectively are crossing each other near the middle point, and the vertical angle formed by the two lines is rather acute. So we may suppose that some of the Taichung varieties may be adapted to Chiayi during 1st crop period. But it seems that varieties from Pintung are not so adaptable to Chiayi according to the position of Pintung's line in Fig. 3. While the Taipei varieties are the lowest yielder in Chiayi. Because of the higher yields of Chiayi varieties in Chiayi, so we say that Chiayi is also a suitable place for breeding rice varieties during 1st crop.

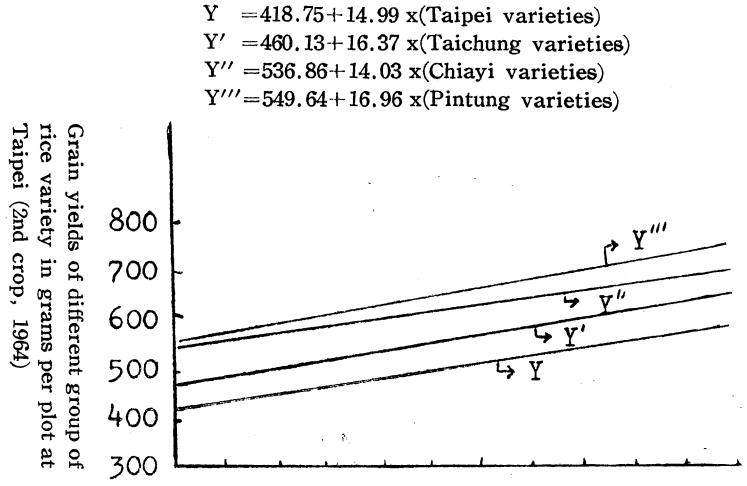



Fig. 5: Trend lines of yielding capacity of 4 rice-variety groups bred at different localities cultivated in Taipei (2nd crop, 1964)

In Fig. 4, it shows that Chaiyi varieties may be well adapted to Pintung and even better than those Pintung local bred lines.

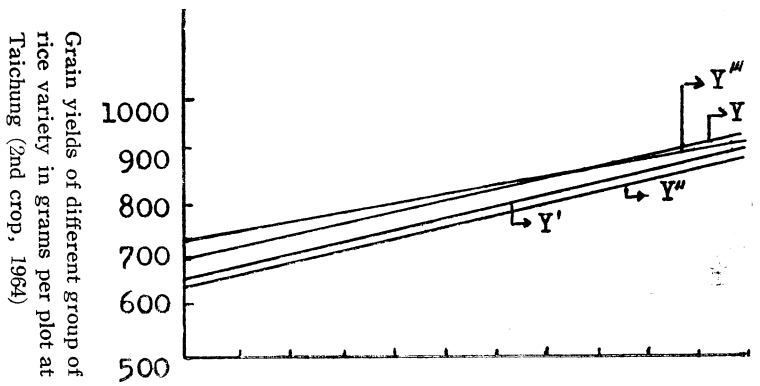
We may now proceed to discuss the results of second crop of the experiment which was also carried on at the 4 localities from north to south in the Province.

From the record of grain yields of 2nd rice crop 1964 in Taipei (Fig. 5, page 6), we found that when 4 variety groups cultivated together in Taipei, the Pintung group was the highest yielder. And the growing duration from sowing to heading was also the longest. This further noted that the Chiayi varieties rank next, the Taichung varieties, the third, and the Taipei varieties the shortest in the number of days of growing duration. The weight of grain yield is positively propertional to the number of days of growing durations.

Under Taipei weather condition, if hybrid progenies are too late in maturity in the 2nd crop, they are always discarded either by natural or by artificial selection. However, though the rice varieties developed from Pintung and Chiayi are among the highest yielders, but they were always mixed with many green grains. Due to colder weather in late Fall in Taipei, so we may say that only the Taichung varieties yielded plump seeds are better than Taipei varieties in the 2nd crop in Taipei region.

If the varieties from Pintung and Chiayi were cultivated in Taipei during the the 2nd crop period, they do not happen to meet the early-coming cold weather in Oct. & Nov., then they would able to give a better harvest in Taipei than Taipei local bred varieties. So it indicats that the varieties developed from southern part of this province may have the posibility to adapt to the regions north-ward of Pintung or Chiayi. However, it may be certain that only the Taichung varieties may give better repening grains during the second crop period in Taipei.

$Y = 696.20 + 22.83\,x$ (Taipei varieties)
$Y' = 655.44 + 23.95\,x$ (Taichung varieties)
$Y'' = 641.21 + 22.79\,x$ (Chiayi varieties)
$Y''' = 726.76 + 18.42\,x$ (Pintung varieties)




Each scale represents the position of each variety (pure line) arranged by order of yielding ability.

Fig. 6: Trend lines of yielding capacity of 4 rice variety groups bred at different localities cultivated in Taichung (2nd crop, 1964)

In Taichung (see Fig 6), the second rice crop of 1964 in the experiment was suffered from Sclerotium diseases. In addition to the soil condition of the experimental field which was too rich, most of the varieties in the experiment were not prevented from lodging. But the Taipei and the Pintung varieties were not so serious when they compared with Taichung and Chiayi varieties.

During the breeding programs were taken place in Taipei and Pintung, both regions were under the circumstances of being more easily attacked by the Sclerotium pathogen, and hence most individuals which were not resistant to Sclerotium diseases were discared in early generations. In addition to the artificial selection, the varieties developed from Pintung and Taipei are more resistant to Sclerotium disease than the Taichung and the Chiayi varieties.

All varieties developed from the 4 localities yield steadily in Taichung, and the range of grain yield of the varieties from minimum to maximum is rather narrow than the other 3 experimental places.

Comparing the yielding capacity of four rice variety groups in Taichung, we find that Taichung is the highest yielding place of rice crop than the other 3 experimental localities in the second rice crop.

It seemed to be that Taichung is the best place for growing many rice varieties from different places during the 2nd crop. But if one want to extend a good variety in Taichung successfully for the second crop it should be able to resistant to Sclerotium diseases and to with-stand from lodging.

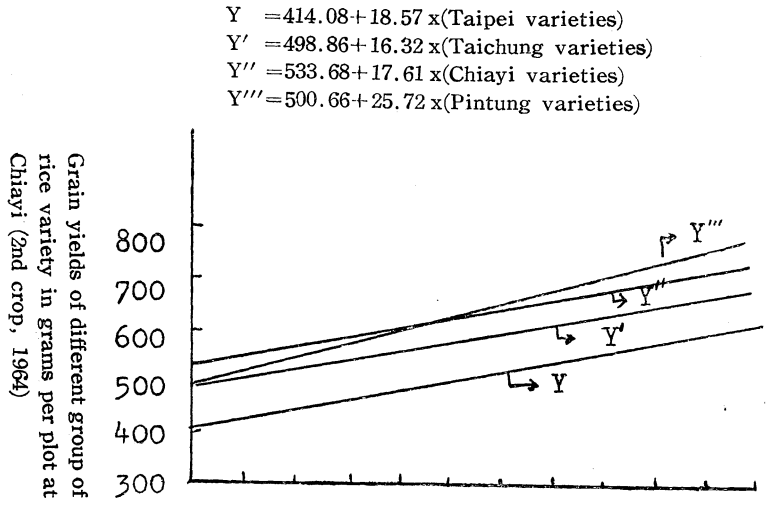



Fig. 7: Trend lines of yielding capacity of 4 rice variety groups bred at different localities cultivated in Chiayi (2nd crop, 1964)

In Chiayi(see Fig 7),during the second crop of 1964, all rice varieties in this experiment were attacked by a new virus which occured only in recent years and originated from Pintung. Varieties developed from Chiayi and Pintung are comparatively

resistant to this sort of disease, whereas varieties from Taichung & Taipei are most susceptible to it. So the yielding capacity of Pintung and Chiayi varieties are rather higher than those of Taichung and Taipei varieties. This fact was discovered in a former research work by the present author that some Ponlai varieties (Japonica) developed from Pintung & Chiayi are very resistant to the new virus disease.

So far as we know, the following varieties; (1) Chianan 2, (2) Kao-yu 10 (3) Kaohsiung 68 and (4) Kaohsiung 122 are all the most resistant varieties developed from the southern Taiwan. [The number (1), was bred from Chiayi, & the (2) (3) & (4) from Pintung.]

The Taichung and the Taipei rice varieties were susceptible to the new virus disease, and some of the varieties, suffered very seriously to such a extent that they near to extinguish.

The relavent experiment was also carried out in Pintung during the 2nd crop of 1964. The results are abnormal due to poor drainage of the experimental field. So the data are not availiable for comparative studies.

## CONCLUSION

According to the experimental results are shown above, Taichung & Chiayi should be the better sites for rice breeding work in Taiwan, The varieties developed from there possessed more extansive adaptability than Taipei & Pintung varieties.

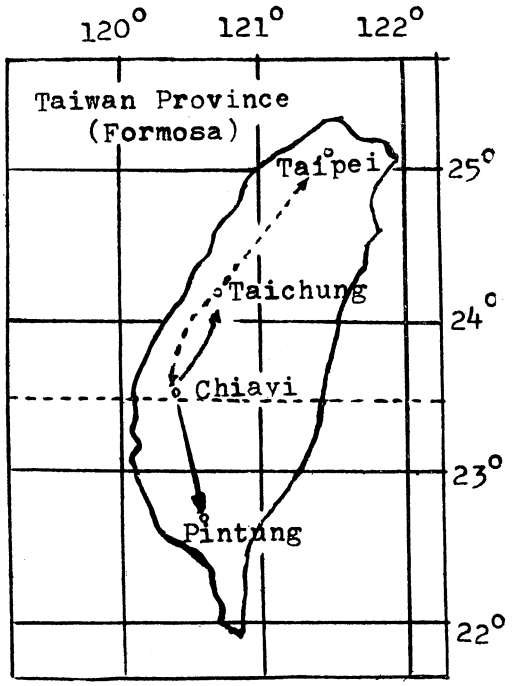
Varieties developed from Taipei and Pintung excepting in a few cases are always with narrower adaptation. Not only during 1st crop but also in the 2nd crop of rice as well, the southern varieties may adapt the regions northward, but conversely, the northern varieties have very little possibility of adapting the region southward. Temperature and photoperiodism condition may not be the only cause, but there must have existed some characters of the varieties which may resist to pest and insect damages of the southern varieties. Pest & insect damage are more serious in southern part, than in the north, when a pureline is selected from the hybrid population in the southern area, it is always quite resistant to many sorts disease and insects. Lines retained after natural and artificial selection in the south were possessing characters with tolerated to the adverse environment more than the northern varieties.

In the first crop, varieties developed from Taichung were adapted well northward to Taipei, and southward until reached Chiayi. But in the 2nd crop, these varieties are not so tolerate to some new sorts of disease which occured in the southern part, even in Chiayi. Taichung varieties did not have good performance in the 2nd crop in south because of new virus disease infection. However, Taichung is neverthless a good place for rice breeding in Taiwan. Because the varieties developed from the region may adapt to both the northern and the central regions of Taiwan. Yet in the futere, rice breeding in Taichung should use artifitial inoculation with all important discases in order to select more resistant lines.

Chiayi varietes yielded higher in Pintung in the 1st crop, whereas Pintung varieties were not so adaptable to Chiayi. So it seems to be that Pintung is only

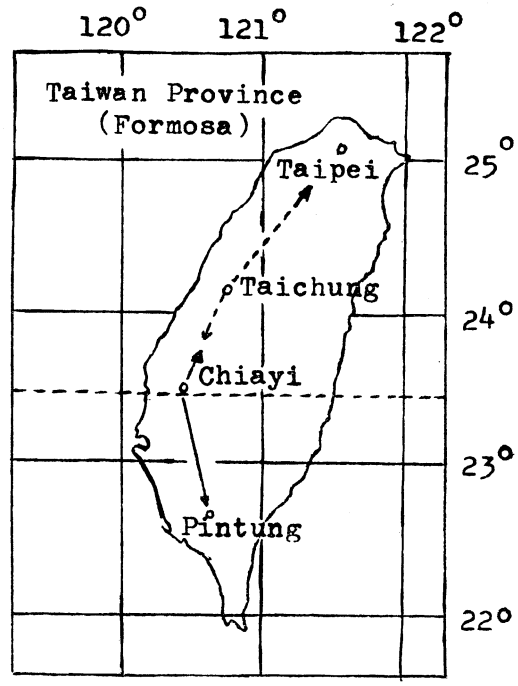
the place for breeding local rice varieties. Apparently, Chiayi is an ideal place for breeding rice varieties for the southern Taiwan. In addition to its varieties having broad adaptation in southern area it has also the benefit of good natural environment in which rice blast disease prevail. It is in this connection that the Chiayi Agricultural Experiment Station has its increasing importance in the rice breeding task of this Province. Taipei or Pintung may carry on rice breeding work for their own special purpose, the development of new lines resistant to the local disease, as well as some foundamental researches on rice crop which would be strengthened in the future.

After this study, a conception of two efficient centers (Taichung and Chiayi) for rice breeding in this province was found, and the adaptation of their variety groups are shown as the following figures:




----→Most Suitable Extension Direction of the Taichung Rice Varieties (1st Crop)
——→Most Suitable Extension Direction of the Chiayi Rice Varieties (1st Crop)

Fig. 8: Extension Directions Available for the Rice Variety Groups Bred in Taichung and Chiayi Respectively During First Crop.




----→Most Suitable Extension Direction of the Taichung Rice Varieties (2nd Crop)
——→Most Suitable Extension Direction of the Chiayi Rice Varieties (2nd Crop)

Fig. 9: Extension Directions Available for the Rice Variety Groups Bred in Taichung and Chiayi Respectively During Second Crop.

## REFERENCES

(1) Chen, C. C., Chien, C. C. & Hwang, T. T. (1961): Studies on the Sclerotial Disease of Rice Plant in Taiwan. Jour. of Taiwan Agri. Resear. Inst. Vol X, No. 2.

(2) Chang, S. C., Tseng H. D. & Pun, Y. S. (1948): A Discussion on the Experimental Results of the Optimum Fertilizer Ratio for Rice in Taiwan. Bulletion 7 of T. A. R. I.

(3) Chiu, R. J., Lo, T. C., Pi, C. L. & Chen, M. H. (1965): Transitory Yellowing of Rice and Its Transmission by the Leafhopper *Nephotettix apicalis apicalis* (Motsch.) Botanical Bulletin of Academia Sinica Vol VI No. 1.
(4) Lo, T. C., & Hsieh, S. P. Y., (1964): Studies on the Stem Rot of Rice Plant 1. Distribution & Economic Significance of the Disease. Plant protection Bulletin Vol. VI. No. 3.
(5) Miu, T. S. & others (1959): A Photographic Monograph of the Rice Varieties of Taiwan. Special Publication II of T. A. R. I.
(6) Miu, T. S. (1964): A General Review of Rice Breeding Work in Taiwan.
(7) Miu, T. S. (1964): The Theoretical and Practical Aspects of Using Resistant Variety of Rice to Repress Brownwilt Disease of Paddy in Pintung. Jour. of Taiwan Agri. Resear. Inst. Vol. XIII, No. 4.
(8) Taiwan Agri. Resear. Inst. (1961): Symposium of Studies on the Causes or Low Yield of Rice in Tropical and Sub-tropical Regions.

# 不同環境因子對稻雜交育種後代集團遺傳形質選擇之影響

## 第一報　各地育成新品系羣產量趨勢線之差別

繆　進　三

### 摘　要

作者舉行兩個稻品種雜交組合，㈠嘉農242×Baritol，㈡臺中65×Baritol，母本「嘉農242」及「臺中65」，均爲目前本省適應性較强之水稻品種。父本則爲山地陸稻；希望由此育成抗病及耐旱品種，並同時研究相同遺傳質之雜交後代集團，在連續世代中，因在不同緯度環境下分離組合，由於自然因子之淘汰作用，在育種過程中，所加於品系入選機會之影響，有何差異，以供研究本省稻作育種，自然分區之論據。

48年（1959）夏，種植上述兩組合之 $F_1$ 種子，各 20 粒，乃得充分之 $F_2$ 種子；此項 $F_2$ 種子充分拌和後，於49年春，平均分配於臺北、臺中、嘉義、屏東等四處地方，每地每組合各種植2,000株，如此就收穫之 $F_3$ 及其連續後代種子，逐年抽取 $1/10$，爲次代種植之用。每年分春、秋兩季各種植一期，直至第6代起，選擇單株，分區建立純系；再經各地歷年穗行試驗及品系比較試驗，作產量比較，及抽穗期比較，（選擇比對照種臺中65號產量稍高或相等，且其抽穗期相差 1-2 天以內者），予以淘汰選擇，每處各選出12品系，四處合計48品系，舉行綜合性之區域適應試驗，試驗地點仍分在原來之四處育種地點。每處12品系，包括來自第㈠及第㈡組合者各 6 品系，其代號如下：

| 育成地 \ 組合 | 嘉農242×Baritol | 臺中65×Baritol |
|---|---|---|
| 臺北品系 | 北 北 北 北 北 北<br>① ② ③ ④ ⑤ ⑥ | 北 北 北 北 北 北<br>⑦ ⑧ ⑨ ⑩ ⑪ ⑫ |
| 臺中品系 | 中 中 中 中 中 中<br>① ② ③ ④ ⑤ ⑥ | 中 中 中 中 中 中<br>⑦ ⑧ ⑨ ⑩ ⑪ ⑫ |
| 嘉義品系 | 嘉 嘉 嘉 嘉 嘉 嘉<br>① ② ③ ④ ⑤ ⑥ | 嘉 嘉 嘉 嘉 嘉 嘉<br>⑦ ⑧ ⑨ ⑩ ⑪ ⑫ |
| 屏東品系 | 屏 屏 屏 屏 屏 屏<br>① ② ③ ④ ⑤ ⑥ | 屏 屏 屏 屏 屏 屏<br>⑦ ⑧ ⑨ ⑩ ⑪ ⑫ |

以上各品系分在臺北、臺中、嘉義及屏東四處地方種植，53年第一期作三行區每行10株（7×8寸）重複二次，53年第二期作則重複六次。本田在幼苗活着後，一律採取每隔5日之節水輪流灌溉，其他一切肥培管理，均照當地例行習慣，成熟期收穫種穀，配合產量趨勢線，以資互相比較。

根據本研究結果，在臺灣，稻作育種，以在臺中及嘉義二地效率最佳。臺北及屏東育成品系，除少數特殊情形外，適應範圍均較狹。再則無論第一期作或第二期作，南部品系尙可向北適應；臺北品系，甚少有向南能適應者。除由於光照溫度之感應關係外（溫度影響尤大），南部天氣溫暖，病蟲害種類較多，而病況常較重。在該種情形下磨煉淘汰後，所有南部育成品種對病蟲害抵抗力均較强。臺中育成品系無論第一期作或第二期作，向臺北或嘉義均尙有相當適應力，但就第一期作已有之資料表示，並不適應於屏東；又第二期作如在嘉義遭遇新毒素病時亦減產。嘉義育成品系，向南可適應於屏東。向北常因遲熟而效果欠佳。屏東地區除栽培其本身育成之品系外，以種植嘉義育成品系爲佳。

根據本試驗研究所得數據，予以統計分析及推理研究，臺中、嘉義二地，臺中居全省中央；嘉義位於北廻歸線上，且有適宜之天然接種稻熱病及螟蟲環境，育成品系適應性均較强，應爲本省稻作實用性育種之兩大自然中心。但仍應加强育種過程中之人工接種病蟲害設備及措施。屏東及臺北，僅可能育成地方性品種適應局部特殊環境之需要；並適宜作育種理論性問題之基本研究。第二期作缺少屏東區數據，正繼續試驗中。

# 水稻經放射線處理後之變異（預報）

嚴　威　添

## 一、緒　言

自 Muller（1927）發現放射線處理生物可增加突變率，而經 Stadler（1928）證實之後，x 射線，r 射線，熱中子等放射物質，便被廣泛地應用於生物人工誘變研究方面。水稻人工誘變之研究，始於山田氏（1917），其後有中村氏（1918）之研究。此等研究表示水稻經 x 射線處理後，可增加產量，但以後小室氏（1931）經數次試驗後，否定其結果。市島氏（1934）曾以 x 射線，紫外線及高溫等之處理，獲得多種水稻之突變體，如矮性、密穗以及早熟等等。河合及鳥山氏均曾由放射線性燐，鈷六十及熱中子處理的後代中，育成早熟或植株矮，但具有原親本相同生產力之突變體。此等早期之研究，以誘發遺傳因子變異爲目的，而以誘發染色體構造之變異爲目的者，有 Ramiah 及 Parthasarathy（1935），永松（1950）、西村（1952）、岡（1953）等人的研究。在臺灣，張（1955）、張和謝（1957）、謝（1959）曾由放射線處理後代中，獲得染色體相互轉座系統，供作連鎖因子分析。謝（1961）對熱核子與 x 射線處理當代，放射線之量與染色體變異率之關係之作研究。在育種方面，黃（1960）由放射線處理後代曾獲得抗病强，短桿和早熟等系統。李和胡（未發表），自放射線處理在來稻後代中，獲得矮而抗倒伏的系統，表示放射線育種，有實用之可能性。爲更進一步了解，放射線對水稻所產生的生育影響及對染色體分裂行爲之影響，乃進行此試驗並已得初步結果。

## 二、試驗材料及方法

於1957年，將臺中65號，嘉南8號，烏尖和臺中在來一號等四品種之乾燥種子 200g，送往日本國立遺傳研究所，接受 x 射線20kr和40kr；r射線（鈷六十）25kr 和50kr及熱中子15小時和20小時（流量×時間各爲 $3.6\times10^{13}$ 和 $4.9\times10^{13}$）。於 1958 年另將臺中65號乾燥種子各 100g，送往臺大醫院，各以 x 射線和 r 射線（鈷六十）500r、1,000r、2,000r、4,000r、8,000r、16,000r、24,000r 和36,000r處理。x 射線處理時，種子放於距線源 25cm 處，無遮蓋。r 射線處理時，則放於距線源 50cm 處。處理後之種子於1958年單株栽培，依一般管理方法分別將第一次處理者，種於臺中中興大學。第二次處理者種於臺北，臺灣省農業試驗所。其調查項目及方法分述於下：

1　**發芽率之調查**：1959年2月，處理後及未處理之種子各150粒。分三行均勻播於溫室木箱之乾燥苗床上並供給充足之水分。發芽後每日記載其發芽數，死亡數等，最後計算其發芽百分率，死亡率，並於35日左右量取幼苗株高。

2　**生育期及成熟期農藝性狀之調查**：利用種植於田間之材料，每品種對照區各取10株，各處理區各取20株。觀察並記錄其田間生育情形，抽穗期、抽穗所需日數、成熟期等，並比較其變異情形。成熟後，調查株高、穗長、穗重、結實率及分蘖數等並利用下面公式計算求其彼此的相關性。

$$r=\frac{\Sigma(X-\bar{X})\,(Y-\bar{Y})}{\sqrt{\Sigma(X-\bar{X})^2\Sigma(Y-\bar{Y})^2}} \qquad t=\frac{r}{\sqrt{1-r^2}}\sqrt{n-2}$$

3　**染色體之細胞學觀察**：在適當時期採回幼穗，使用 Farmer 氏固定液固定之。固定後保存於70%酒精中。利用塗抹法（Smear method）觀察花粉母細胞在肥厚期及第一中期之染色體變異情形。

## 三、試 驗 結 果

**1 發芽率，發芽勢，死亡率和幼苗高度之變異。**

由表一可看出，各處理區之發芽率，均大大地降低，其降低的程度，因線量及線源不同而異。x 射線 20kr 各處理中，發芽率均在 76%以上。x 射線 40kr 各處理區，其發芽率約在 45～64%左右，約爲前項處理之$\frac{1}{2}$～$\frac{1}{3}$。r 射線 25kr 對臺中 65號和嘉南8號之影響不大，發芽率均在92%以上。但對臺中在來一號和烏尖之影響則很大，只有對照區之25～30%左右。r 射線 50kr 處理，兩蓬萊種只37～42%，只有 r 射線 25kr 處理之一半以下。但兩在來品種，只有 15～22%左右。却爲 r 射線 25kr 處理之 80 %左右，故其影響不像蓬萊種之大。熱中子處理者却呈現相反的現象，$4.9\times10^{13}$處理區發芽率反較$3.6\times10^{13}$處理區爲高。另外（卽第二次試驗）臺中65號利用不同 x 射線量處理者，均無明顯差異。

表一、不同射線及線量對發芽百分率之影響。（第一次試驗）

Table 1. Effect of different radiation treatments on germination rate (1st experiment)

| 發芽率 Germination rate / 品種 Varieties / 處理 Treatment | 臺中 65 號 Taichung No. 65 | 嘉南 8 號 Chianan No. 8 | 臺中在來一號 Taichung native No. 1 | 烏尖 Wu-chian | 播種量（粒） No. of garins seeded |
|---|---|---|---|---|---|
| CK | 96.0 | 90.7 | 88.0 | 83.3 | 150 |
| X-ray 20Kr | 98.0 | 94.7 | 86.0 | 76.0 | 150 |
| X-ray 40Kr | 46.7 | 54.0 | 64.0 | 44.7 | 150 |
| r-ray 25Kr | 92.0 | 93.3 | 26.0 | 20.7 | 150 |
| r-ray 50Kr | 37.3 | 42.0 | 22.0 | 15.3 | 150 |
| Thermal neutron $3.6\times10^{18}$ | 27.3 | 29.3 | 34.0 | 11.3 | 150 |
| Thermal neutron $4.9\times10^{18}$ | 37.3 | 32.7 | 46.7 | 14.0 | 150 |

表一之資料經變方分析結果（如表二）顯示，如上所述之處理間與品種間差異甚大。亦卽表示放射線之處理，可增加變異之幅度。

表二、發芽率之變方分析表（第一次試驗）

Table 2. Analysis of variance for germination rate

| 變因 Variation | 自由度 DF | 平方和 MS | 均方和 SS | F 值 F Value | 理論 F 值 Theoretical F Value |
|---|---|---|---|---|---|
| 品種 Varieties | 3 | 3763.11 | 1254.37 | 7.55** | 3.16—5.09 |
| 處理 Treatment | 6 | 17574.26 | 2929.04 | 17.62** | 2.66—4.01 |
| 機差 Error | 18 | 2991.02 | 166.16 | | |

各種處理對發芽勢之影響極爲明顯，在表三中可看出，除 x 射線 20kr 各處理和臺中65號，嘉南8號 r 射線25kr處理區外，其餘各處理區發芽均延遲。其 x 射線40kr和20kr 間之相差約爲64～82%左右。同時在來稻之影響，似較蓬萊稻大。熱中子處理者，均於二月十六日發芽，較未處理者遲兩天以上。

表三、不同處理對發芽勢之影響

Table 3. Effect of different treatments on germination speed.

| 發芽勢 Germination speed / 品種 Varieties / 處理 Treatment | 嘉中65號 Taichung No. 65 | 嘉南8號 Chianan No. 8 | 臺中在來一號 Taichung native No. 1 | 烏尖 Wu-chian | 播種量(粒) No. of grains seeded |
|---|---|---|---|---|---|
| CK | 96.0 | 90.0 | 82.7 | 71.3 | 150 |
| X-ray 20Kr. | 98.0 | 93.3 | 77.3 | 68.7 | 150 |
| X-ray 40Kr. | 29.3 | 10.7 | 0 | 4.0 | 150 |
| r-ray 25Kr. | 88.7 | 90.0 | 0 | 0 | 150 |
| r-ray 50Kr. | 0 | 16.0 | 0 | 0 | 150 |
| Thermal neutron $3.6\times10^{18}$ | 0 | 0 | 0 | 0 | 150 |
| Thermal neutron $4.9\times10^{18}$ | 0 | 0 | 0 | 0 | 150 |

由表四中可知幼苗死亡率，熱中子處理者，r 射線 50kr 處理之嘉南 8 號、臺中在來一號、烏尖和 r 射線 25kr 處理之臺中在來一號完全死亡之外，其餘各處理之死亡率，除臺中65號 x 射線 40kr 處理者低於對照區外，其餘均高於對照區。但對照區之死亡率亦相當高。此可能爲部份因天冷凍死之故。由實際調查情形看來，臺中65號和嘉南 8 號之幼苗死亡情形，以時間來說，對照區呈常態分佈，其他各區則呈不規則狀。臺中在來一號對照區和 x 射線 20kr 區枯死期分佈於 2 月21～29日。x 射線40kr區則爲 3 月 3 ～ 5 日。烏尖則較早，於 2 月18日。

四、不同處理對死亡率之影響（第一次試驗）

Table 4. Effect of different treatments on lethal seedlings

| 死亡率 Lethal rate / 品種 Varieties / 處理 Treatment | 臺中65號 Taichung No. 65 | 嘉南8號 Chianan No. 8 | 臺中在來一號 Taichung native No. 1 | 烏尖 Wu-chian | 播種量(粒) No. of grains seeded |
|---|---|---|---|---|---|
| CK | 54.2 | 58.1 | 41.7 | 44.8 | 150 |
| X-ray 20Kr. | 73.5 | 50.7 | 75.2 | 64.0 | 150 |
| X-ray 40Kr. | 45.7 | 90.1 | 99.0 | 83.6 | 150 |
| r-ray 25Kr. | 59.4 | 45.7 | 100.0 | 93.5 | 150 |
| r-ray 50Kr. | 83.9 | 100.0 | 100.0 | 100.0 | 150 |
| Thermal neuton $3.6\times10^{18}$ | 100.0 | 100.0 | 100.0 | 100.0 | 150 |
| Thermal neuton $4.9\times10^{18}$ | 100.0 | 100.0 | 100.0 | 100.0 | 150 |

如表五所示，第二次處理之發芽率均在95%以上。各處理之影響不顯著，但死亡率則與第一次處理相同。經過處理者死亡率高，並有線量愈高死亡愈多之傾向。此種傾向，x 射線處理者較 r 射線處理者明顯。

對幼苗高度之影響，在臺中試驗者，處理後抑制幼苗高度自36～87%，其間因處理不同而異。但調查時發現，處理部份苗高降低之原因，爲少數幼苗生育發生障碍，不長高。而大部份則和正常者一樣。但在臺中65號、嘉南 8 號、臺中在來一號和烏尖之 x 射線 40kr 處理區，均發現有一株或兩株，生長特別快者。到 3 月 5 日時，一般只長至10cm左右時，它已長至17～20cm。烏尖和臺中在來一號，除 x 射線 20kr 處理者外，其餘處理，均因生育期中死亡或只成長一、二株。故無法比較。熱中子處理者，發芽後全部死亡。第二次處理（臺北試驗者）其結果如表七所示。處理雖可抑制苗之高度，但各線量間，並無明顯之差異，同時也未因線量之增加而顯現更大效果。但各處理內

之標準機差，却均大於對照區。此卽表示處理後，可增大其變異範圍。

表五、x射線和鈷六十，對水稻臺中65號種子發芽率和死亡率之影響

Table 5. Effects of X-rays and $C_0^{60}$ on seed germination and injury in rice

| 放射線量 Dosage | 種子數 No. of seed | X-射線 X-ray | | 鈷六十 $Co^{60}$ | |
|---|---|---|---|---|---|
| | | 發芽率 Germination rate | 死亡率 Lethal rate | 發芽率 Germination rate | 死亡率 Lethal rate |
| 500 r | 200 | 98 | 54 | 98 | 51 |
| 1,000 r | 200 | 97 | 56 | 98 | 31 |
| 2,000 r | 200 | 97 | 57 | 98 | 43 |
| 4,000 r | 200 | 96 | 62 | 99 | 47 |
| 8,000 r | 200 | 96 | 59 | 99 | 44 |
| 16,000 r | 200 | 96 | 66 | 98 | 46 |
| 24,000 r | 200 | 95 | 77 | 98 | 43 |
| 32,000 r | 200 | 95 | 57 | 99 | 40 |
| CK | 200 | 99 | 17 | 99 | 13 |

表六、不同放射線及線量對苗高之影響（第一次試驗）

Table 6. Effect of different treatments on seedling height (1st experiment)

| 品種 Varieties / 處理 Treatment | | 臺中65號 Taichung No. 65 | | 嘉南8號 Chianan No. 8 | | 臺中在來一號 Taichung native No. 1 | | 烏尖 Wu-chian | |
|---|---|---|---|---|---|---|---|---|---|
| | | 苗高 Seedling ht. cm | 指數 Index | 苗高 Seedling ht. cm | 指數 Index | 苗高 Seedling ht. cm | 指數 Index | 苗高 Seedling ht. cm | 指數 Index |
| CK | | 11.53 | 100 | 11.88 | 100 | 10.07 | 100 | 10.93 | 100 |
| X-ray | 20Kr. | 9.54 | 82.7 | 9.69 | 81.6 | 6.93 | 68.8 | 8.15 | 78.4 |
| | 40Kr. | 7.22 | 62.6 | 5.25 | 44.2 | — | | 9.05 | 87.1 |
| r-ray | 25Kr. | 9.79 | 84.9 | 8.78 | 73.9 | — | | — | |
| | 50Kr. | 4.15 | 35.9 | 4.84 | 40.7 | — | | — | |

表七、x射線和鈷六十對水稻（臺中65號）苗高之影響（第二次處理）

Table 7. Effect of X-ray and $C_0^{60}$ on the seedling height in rice

| 放射線量 Dosage | | 幼苗數 No. of seedling | 指數 % Index | 植株高度 Plant height | | |
|---|---|---|---|---|---|---|
| | | | | 平均高度 Plant height (cm) | 標準機差 Standard error | 指數 % Index |
| X-ray | 500r | 93 | 55.3 | 7.8 | 2.72 | 97.5 |
| | 1,000r | 88 | 42.9 | 8.5 | 2.18 | 106.2 |
| | 2,000r | 86 | 51.7 | 7.6 | 2.37 | 97.0 |
| | 4,000r | 76 | 45.6 | 4.1 | 2.43 | 50.0 |
| | 8,000r | 82 | 49.1 | 7.1 | 2.45 | 90.0 |
| | 16,000r | 68 | 40.8 | 6.9 | 1.94 | 86.2 |
| | 24,000r | 46 | 27.6 | 6.8 | 2.81 | 87.2 |
| | 32,000r | 85 | 51.1 | 7.2 | 2.49 | 90.0 |
| CK | | 166 | 100.0 | 8.0 | 1.17 | 100.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $Co^{60}$ | 500r | 99 | 56.7 | 6.8 | 2.54 | 76.3 |
| | 1,000r | 120 | 68.8 | 8.7 | 2.18 | 97.6 |
| | 2,000r | 115 | 65.9 | 5.1 | | 57.2 |
| | 4,000r | 105 | 60.2 | 5.7 | 2.68 | 63.9 |
| | 8,000r | 113 | 64.8 | 7.4 | 2.02 | 83.1 |
| | 16,000r | 114 | 65.4 | 5.0 | 2.56 | 56.2 |
| | 24,000r | 113 | 64.8 | 6.1 | 2.27 | 68.4 |
| | 32,000r | 120 | 68.8 | 7.1 | 2.19 | 79.6 |
| | CK | | 100.0 | 8.9 | 1.43 | 100.0 |

2 **生育期及成熟期農藝性狀之變異：**

表八、不同處理對不同生育期間之影響（第一次試驗）

Table 8. Effect of different treatments on the growing period (1st. expt.)

| 品種 Varietes | 處理 Treatment | 插秧至抽穗平均日數 Heading period | 抽穗開始至結束日期 Heading date | 抽穗日數 Heading time | 插秧至成熟平均日數 Growing period |
|---|---|---|---|---|---|
| 臺中65號 Taichung No. 65 | CK | 83 | 5月27日～5月30日 | 4 | 117 |
| | X-ray 20Kr. | 84 | 5月30日～6月4日 | 6 | 118 |
| | X-ray 40Kr. | 85 | 5月30日～6月3日 | 5 | 119 |
| | r-ray 25Kr. | 84 | 5月30日～6月3日 | 5 | 118 |
| | r-ray 50Kr. | 90 | 6月10日～6月14日 | 5 | 120 |
| 嘉南8號 Chianan No.8 | CK | 84 | 5月30日～6月3日 | 5 | 118 |
| | X-ray 20Kr. | 84 | 5月31日～6月3日 | 4 | 118 |
| | X-ray 40Kr. | 91 | 6月10日～6月14日 | 5 | 124 |
| | r-ray 25Kr. | 85 | 5月28日～6月8日 | 12 | 119 |
| | r-ray 50Kr. | 87 | 6月7日～6月10日 | 4 | 121 |
| 臺中在來一號 Taichung Native No. 1 | CK | 83 | 5月28日～5月29日 | 2 | 110 |
| | X-ray 20Kr. | 83 | 5月23日～6月5日 | 14 | 110 |
| | X-ray 40Kr. | 91 | 6月12日～6月16日 | 5 | 121 |
| 烏尖 Wu-chian | CK | 82 | 5月27日～5月28日 | 2 | 110 |
| | X-ray 20Kr. | 83 | 5月28日～6月1日 | 4 | 110 |
| | X-ray 40Kr. | 86 | 6月7日～6月10日 | 4 | 116 |
| | r-ray 25Kr. | 86 | 6月7日～6月11日 | 5 | 116 |

由表八所示，放射線處理均呈現有延長插秧至平均抽穗期日數、抽穗日數及插秧成至熟所需日數的現象。插秧至平均抽穗期日數，臺中65號和嘉南8號，各處理延長1～7天。臺中在來一號x射線20kr處理區和對照區相同；x射線40kr處理者則遲8天。烏尖各處理亦延長1～4天左右。抽穗開始至抽穗完畢所需日數，亦略有延遲的現象。嘉南8號r射線25kr和臺中在來一號x射線20kr處理區遲10天以上。其原因爲，此處理內有一、二株遲遲未抽穗之故。而插秧到成熟日數間之差異，因處理之不同而異。一般說來，臺中65號之差異小。嘉南8號除x射線40kr處理遲6天外，其餘各處理差異亦不大。臺中在來一號和烏尖的情形相同。x射線20kr處理者和對照區相同，而x射線40kr處理者則遲6—11天左右。由表中又可得知，處理線量的增加，影響生育也愈大。線源不同，其差異較小。茲將各個體間之變異示如表九。

表九、抽穗期之變異（以對照區平均抽穗期爲準）（第一次試驗）

Table 9. Variation of heading period (1st experiment)

| 品種 Varieties | 處理 Treatment | ** -6 | -5 | -4 | -3 | -2 | -1 | * 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11天以上 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 臺中65號 Taichung No.65 | X-ray 20Kr. | | | | | 7 | | 3 | 11 | 2 | 1 | | 2 | | | 1 | | | 1 |
| | X-ray 40Kr. | | | | | | 2 | 4 | 7 | 2 | 4 | 4 | 1 | 1 | | | | 1 | |
| | r-ray 25Kr. | | | | | 7 | | 22 | | 2 | 1 | 3 | 2 | 1 | | | | | |
| | r-ray 50Kr. | | | | | | | 2 | | | | | | | | | | | 2 |
| 嘉南8號 Chianan No. 8 | X-ray 20Kr. | | | | 2 | 2 | 4 | | 11 | 11 | 8 | 1 | 2 | 2 | | | | | |
| | r-ray 25Kr. | | | | | 2 | 2 | | 23 | 10 | 3 | 6 | 2 | | 1 | | 3 | | |
| | r-ray 50Kr. | | | | | | | 2 | 2 | | | | | 1 | 1 | | | | |
| 臺中在來一號 Taichung Native No.1 | X-ray 20Kr. | 1 | | | | 14 | 5 | 6 | | 2 | | | | | 1 | | | | |
| 烏尖 Wu chian | X-ray 20Kr. | | | | | | | 4 | 15 | 3 | | 1 | | | | | | | |

※對照區抽穗日數爲2—4天。※※單位：天

表十、不同處理對產量構成因素之影響（第一次試驗）

Table 10. Effect of different treatments on yield components (1st experiment)

| 品種 Varieties | 處理 Treatment | 株高 Plant height 高度 Hight (cm) | 株高 Plant height 指數 Index | 分蘖數 No. of tiller 數目 Numher | 分蘖數 No. of tiller 指數 Index | 穗長 Length of head 長度 Length (cm) | 穗長 Length of head 指數 Index | 穗重 Weight of head 重量 Weight (g) | 穗重 Weight of head 指數 Index | 結實率 Fertility (%) 結實率 Fertility | 結實率 Fertility (%) 指數 Index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 臺中65號 Taichung No.65 | CK | 105.0 | 100.0 | 17.7 | 100.0 | 22.5 | 100.0 | 26.1 | 100.0 | 90.3 | 100.0 |
| | X-ray 20Kr. | 104.1 | 99.1 | 16.6 | 93.8 | 16.4 | 72.9 | 22.9 | 87.7 | 45.1 | 49.9 |
| | X-ray 40Kr. | 96.9 | 92.3 | 16.8 | 94.9 | 20.6 | 91.6 | 14.8 | 56.7 | 29.7 | 32.9 |
| | r-ray 25Kr. | 100.5 | 95.7 | 17.5 | 98.9 | 21.8 | 96.9 | 19.2 | 73.6 | 41.2 | 45.6 |
| 嘉南8號 Chianan No. 8 | CK | 115.3 | 100.0 | 15.8 | 100.0 | 24.2 | 100.0 | 33.0 | 100.0 | 74.8 | 100.0 |
| | X-ray 20Kr. | 106.3 | 92.2 | 16.4 | 103.8 | 22.2 | 91.7 | 28.9 | 87.6 | 53.6 | 71.7 |
| | X-ray 40Kr. | 84.3 | 73.1 | 13.5 | 85.4 | 17.4 | 71.9 | 21.3 | 64.5 | 65.2 | 87.2 |
| | r-ray 25Kr. | 105.3 | 91.3 | 15.3 | 96.8 | 22.6 | 93.4 | 19.9 | 60.3 | 40.6 | 54.3 |
| | r-ray 50Kr. | 88.3 | 36.6 | 11.4 | 72.2 | 15.8 | 65.3 | 5.9 | 17.9 | 39.4 | 52.7 |
| 臺中在來一號 Taichung Native No. 1 | CK | 87.0 | 100.0 | 27.3 | 100.0 | 21.3 | 100.0 | 16.0 | 100.0 | 74.3 | 100.0 |
| | X-ray 20Kr. | 79.0 | 90.8 | 35.0 | 128.2 | 21.6 | 101.4 | 21.0 | 131.3 | 35.3 | 47.5 |
| | X-ray 40Kr. | 61.5 | 70.7 | 29.0 | 106.2 | 17.5 | 81.7 | 3.0 | 18.8 | — | — |
| 烏尖 Wu-chian | CK | 131.7 | 100.0 | 21.9 | 100.0 | 19.9 | 100.0 | 13.2 | 100.0 | 49.8 | 100.0 |
| | X-ray 20Kr. | 119.9 | 91.0 | 35.4 | 161.6 | 11.8 | 59.3 | 18.4 | 139.4 | 32.4 | 65.1 |
| | X-ray 40Kr. | 98.0 | 74.4 | 40.0 | 182.6 | 18.0 | 90.5 | 7.5 | 56.8 | — | — |
| | r-ray 25Kr. | 99.5 | 75.6 | 27.5 | 125.6 | 18.0 | 90.5 | 5.5 | 41.7 | 23.7 | 47.6 |

成熟期調查結果如表十所示。不同的處理，對株高顯示不同程度的抑制現象。抑制的程度和線量的多少呈正比。分蘖數中，臺中65號和嘉南8號均呈現減少的傾向。嘉南8號x射線20kr處理者

則增加4%，但臺中在來一號和烏尖處理各區之分蘖數，均比對照區多，增加6～82%左右。尤以x射線處理者增加最多。穗長方面，除臺中在來一號x射線 20kr 處理和對照區外，均呈現抑制情形，其程度爲59～97%。穗重的影響，臺中65號和嘉南8號均減少，減少量與線量成正比，而臺中在來一號和烏尖x射線 20kr 處理區，穗重反比對照區增加約31～39%。其餘處理之穗重則大大地減少。結實率則均比對照區低。除臺中在來一號和烏尖之x射線 40kr 處理區，因全部白穗無法計算外，其他各區，只有對照區之33～87%。

3 **幾種主要性狀之相關性測定：**

利用成熟期各性狀調查結果，計算各種相關之結果爲；穗重和株高之間，臺中65號，嘉南8號臺中在來一號和烏尖等各爲，0.96，0.73，0.84和0.65，且均非常顯著。此表示穗重和株高間有正相關，卽株高愈高者，穗亦愈重；株高和穗長之間的情形，分別爲—0.18，0.96，0.93和—0.06。臺中65號和烏尖雖呈負相關，但並不顯著。因此仍可說嘉南8號和臺中在來一號，株高的增加，促使穗長也增加。臺中65號和烏尖則沒什麼關係；穗長和穗重之間，臺中在來一號和烏尖有正相關，各爲0.98和0.66，臺中65號則爲—0.02，嘉南8號爲—0.003，兩者間，並沒有什麼關係存在，卽因品種之不同而異，且與結實率有關。因放射線的處理，影響結實率，間接也影響了穗重的關係。

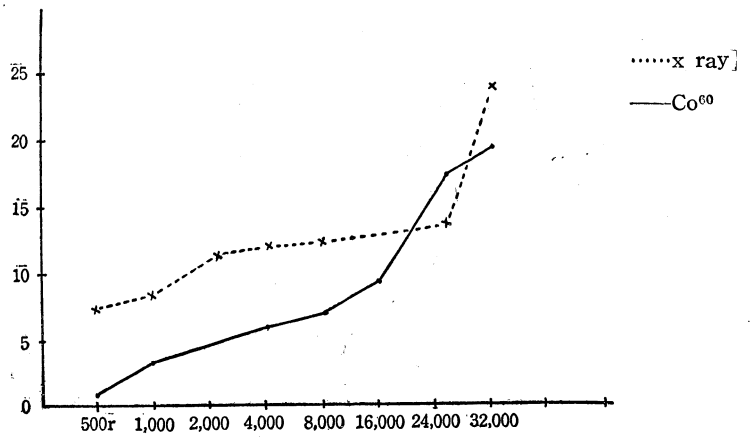
4 **花粉母細胞染色體之變異：**

花粉母細胞經檢鏡結果如表十一所示，發現染色體在分裂期中，有各種各樣之形態。如單價體、双價體、四價體、六價體、染色體橋和斷片等等。而其接合型則有 2Ⅳ+8Ⅱ、1Ⅳ+9Ⅱ+2Ⅰ、2Ⅳ+7Ⅱ+2Ⅰ…等。其中四價體又有環形、鏈形和其他形狀。各接合型當中，以 1Ⅳ+10Ⅱ 型佔大部份，而四價體之形狀中以環形者佔多數。以上所述，兩種處理之情形均相符合。四價體發生之頻度和處理線量之多寡成正比。鈷六十處理者，500r 區只 0.96 %，32,000r處理區則爲18.94%，其餘各處理，分布於其間。x射線處理者在7.33～23.41%之間。以整個四價染色體發生百分率來說，x射線的處理效果大於鈷六十處理者，如圖一所示，平均 17.8r $Co^{60}$ 產生一個四價體，10.9r 射線可產生一個四價體。

表十一、不同放射線量對花粉母細胞染色體之影響

Table 11. Effect of different doses of radiation on chromosomes of P. M. C.

| | | 染色體接合型 (Type of chromosome pairing) | | | | | | 四價染色體之形態 (Shape of quadrivalent) | | | | 觀察數 | 四價體發生率 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2Ⅳ+8Ⅱ | 1Ⅳ+10Ⅱ | 1Ⅳ+9Ⅱ+2Ⅰ | 1Ⅳ+8Ⅱ+4Ⅰ | 2Ⅳ+7Ⅱ+2Ⅰ | 1Ⅳ+7Ⅱ+6Ⅰ | 環形 Ring shape | 鏈形 Chain shape | 其他 the others | 總數 Total | No. of cells observed | Rate of quadrivalent. |
| $Co^{60}$ | 500r | 1 | 7 | 1 | | | | 6 | 1 | 3 | 10 | 104 | 0.96 |
| | 1,000r | 2 | 17 | | 1 | | | 8 | 4 | 10 | 22 | 686 | 3.21 |
| | 4,000r | 2 | 8 | 4 | | | | 9 | 1 | 6 | 16 | 254 | 6.29 |
| | 8,000r | | 22 | 6 | 1 | | 1 | 14 | | 16 | 30 | 429 | 6.99 |
| | 16,000r | 1 | 27 | 6 | 2 | | 1 | 7 | 7 | 25 | 39 | 450 | 8.66 |
| | 24,000r | 5 | 45 | 9 | 1 | | | 15 | 10 | 40 | 65 | 371 | 17.52 |
| | 32,000r | 7 | 34 | 6 | | | | 21 | 12 | 27 | 57 | 301 | 18.94 |
| | Total | | | | | | | | | | | | |
| X-ray | 500r | 3 | 28 | 2 | 1 | | | 11 | 11 | 17 | 39 | 532 | 7.33 |
| | 1,000r | 1 | 5 | 1 | | 1 | | 3 | 4 | 1 | 8 | 98 | 8.16 |
| | 2,000r | | 10 | | | | | 1 | 1 | 8 | 10 | 86 | 11.63 |
| | 4,000r | | 12 | 3 | 3 | | | 11 | 1 | 8 | 20 | 166 | 12.05 |
| | 8,000r | | 21 | 4 | | 1 | | 12 | 5 | 11 | 28 | 227 | 12.33 |
| | 24,000r | | 9 | 2 | | | | 7 | | 8 | 15 | 82 | 13.41 |
| | 32,000r | 6 | 41 | 4 | 1 | 1 | | 45 | 11 | 14 | 70 | 299 | 23.41 |




圖一：不同攻射線量與四價染色體出現率之關係

Fig. 1. Relation between dose of radiation and frequency of chromosomal interchange.

## 四、討論及結論

正如一般所知，植物經放射線處理後，可產生遺傳因子及染色體構造上之變異 (Caldecott 1954, 眞島等 1960, Katayama 1962)，但處理線量過多時，會大大地抑制植株之生長，甚至引起嚴重的死亡（西村1950）。根據謝（1957），眞島等（1961）之報告，處理當代幼苗之死亡率爲22—100%，隨線量之增加而增加。本研究之結果，處理當代幼苗死亡率介於13—100%（第一次試驗爲40～100%；第二次試驗爲13—77%）之間，隨線量之增加而遞增。其抑制種子發芽率和幼苗之生長情形亦同。卽表示，除線量增加，可抑制發芽率外，品種間和放射線種類間亦有差異。另外對染色體引起之變異也相同。此種結果，在大麥 (Caldecott 1954)，小麥（西村 1961），稻（西村 1961，謝1961）燕麥（西村1961）等作物，均有相同的情形。依發芽勢的情形推斷，熱中子處理和x射線40krs，r 射線 50krs 處理者，均有延遲發芽之現象。在 x 射線和 $Co^{60}$ 不同線量處理的情形看來，對種子發芽率之影響力，x 射線似有大於 r 射線之傾向，但差異並不太明顯。但後期的幼苗死亡率，其結果則相反。另根據張和謝（1957），張（1959），黃（1961）之報告指出，放射線處理有抑制幼苗高度之現象，但生育後期之差異則並不明顯。本試驗中，幼苗高度顯示同樣的結果，但生育後期之株高，臺中65號差異不大，嘉南 8 號，臺中在來一號和烏尖三品種則表現有差異，最甚者如臺中在來一號 x 射線 40krs 處理者，其株高只有未處理者之 71%。這可能爲使用線源和品種之不同而有異，在 x 射線和 $Co^{60}$ 處理之情形看來，線量相同處理之結果，x 射線處理者，植株高度，顯著地較 $Co^{60}$ 處理者高。但各線量間却無明顯差異。

花粉母細胞染色體之觀察，在肥厚期 (Diakinesis) 和第一中期，發現有鏈形 (Chain shape) 和環形 (Ring shape) 四價體、染色體橋 (Chromosomal bridge)、斷片 (Segment) 和滯留 (delay)…等種種異常現象。各染色體配對時，亦產生了各種不同的接合型。其中四價體的發生頻度最大，且其頻度和處理線量有密切的關係。此和 Ramiah (1935) Parthasarathy (1938) 謝等 (1959)，Katayama (1963) 等氏發現的情形相同。但變異細胞數却遠較上述諸學者之報告爲少。同時處理效果，亦以 x 射線稍大於 $Co^{60}$。其原因可能爲處理時，平面放置和堆積放置而有差異。但其眞正原因尙待研究。且此結果和 Coldecott (1954) 報告之 r 射線 ($Co^{60}$) 之影響較 x 射線强之結果相反。此除上述原因外，處理方法和放射線能量（半衰期）等不同有關，其實際原因亦待查。而熱中子處理之效果强於 x 射線和 r 射線處理者之情形則和 Sparrow (1961) 之報告相同。

黃（1960）報告，放射線對分蘗數之影響，因品種不同而異。又根據謝（1961）染色體之變異，因品種不同而有統計上之差異。在本研究中，亦有同樣的結果。此即表示品種不同，對放射線的反應亦不同。此點除處理當時種子水分含量和其他環境因子有影響外，可能尙有某種機構支配着。此機構之本質如何？是否與化學物質或遺傳因子有關等等，尙須今後進一步之研究。

據 Oka et al（1958）報告，水稻經放射線處理後，除性狀因子發生變異外，數量因子亦因而發生變異。而其所產生之變異，却有「正」和「負」兩方向。Sparrow（1961）亦在其他植物上證實此點。本研究中，經放射線處理者，分蘗數，株高和抽穗期等變異幅度均較未處理者大。此正與上述情形相同。且此種變異幅度之增大，在育種上可增加選拔的機會。放射線育種在實用上的價值也因而增大。若能更確實地控制着放射線誘致突變的方向。則將爲育種學上，帶來革命性的成就。即處理後能保存原有優良特性，而改變其不同特性。例如，提早優良品種之抽穗期，育成矮性，抗倒伏之系統或抗病强等性狀。在臺灣省農業試驗所，即已在大豆放射線處理後代中，選出了較原親本產量增高8％之品系。在花生的處理後代中，亦已選出了抗銹病强的品種。水稻方面中央研究院和中興大學合作計劃中，亦已選出了矮和抗倒伏之品系（未發表）。此等結果，已給育種者帶來莫大的鼓勵。但要普遍應用，尙須今後繼續之努力。

一般說來，由突變所產生之性狀和其他不良性狀有連鎖關係。如何來打破此種關係而達到育種選拔理想新品系，乃爲育種者今後之目標。此點，在進行育種試驗之前似有先舉行各突變性狀間之連鎖因子分析之必要。關於此點，本研究室，現在進行研究中。

## 五、摘　　要

本試驗在研究水稻經放射線處理後，農藝性狀和花粉母細胞染色體之變異情形，乃利用臺中65號、嘉南8號、臺中在來一號和烏尖之乾燥種子，經x射線、r射線（鈷60）和熟中子處理後，栽培於溫室和一般環境下，觀察其變異情形。

試驗結果顯示處理當代發芽率，死亡率等受放射線之影響，且因線源和線量之不同而異。品種之間亦有相當大之差異。幼苗高度因處理而呈現抑制的現象，成熟期之株高和穗長，亦有相同之結果。分蘗數及穗重，臺中65號和嘉南8號均呈抑制現象；臺中在來一號和烏尖則以x射線20kr處理者，呈促進現象，其他亦呈抑制之情形。各處理區之平均抽穗期和生育日數與未處理者相同或長1～10天左右。但若以個體來說，除大部分較未處理者晚之外，尙有部份則較未處理者早抽穗。因此可說，處理者之變異範圍較未處理者大。換句話說，即表示變異有「正和負」兩方面。處理後代之株高，穗重和穗長之間的相關情形，因品種而異。染色體變異方面，在第一分裂中期，可發現有單價、双價和四價體等。構造上亦可發現有斷片、滯留和產生染色體橋等之變異現象，且其四價體產生之頻度和處理線量成正比。同時，顯示x射線的效果也稍强於r射線處理之效果。

## 參　考　文　獻

1. 張文財　1959　水稻經x光線處理所發生量的性狀之變異（第二報）　中華農學會報新25期。
2. 張文財　1960　水稻經x光線處理後所生突變體之性狀及遺傳（第三報）　中華農學會報新29期。
3. 張天定、謝順景　1957　水稻經x光線處理後所發生之突然變異（第一報）。省農試所，農業研究第七卷第四期。
4. 黃正華　1960　水稻利用x光線和熱中子誘致之可遺傳之變異（英文）　核子科學，第三卷第一期。
5. 謝順景　1959　x線對水稻農藝性狀之影響（第二報）　農業研究　第八卷第二期
5. 謝順景　1961　x線及熱核子對水稻染色體之影響（第四報）　中央研究院植物學彙刊，第二卷第一期。
6. 謝順景、張天定、楊行昌　1959，水色稻染體相互轉產系統之分離，（第三報）農業研究，第八卷第三、四期
7. 眞島勇雄、河合武　1960　稻乾燥種子に對する熱中子およびx線照射の影響。　農學
8. 小室英夫　1931，　x線によりて稻の增收を計り得るやせ。　科學　I(6)：242—244
9. 西村米八、倉上秀雄　1952　x線處理による水稻の突然變異　育種學什誌　3.
10. 片山　平　1961　x線照射後代に生じたイネの遺傳的染色體不對合現象　染色體　48:1591—1601。

11. Coldecott et al 1954. Cytogenetic effects of X-ray and Thermal neutron irradiation on seeds of Barley. Genetics, Vol. 39 No. 2.
12. Coldecott R.S.1955.The effects of X-rays,2-MEV electrons,thermal neutrons,and fast neutiron on dormant seeds of Barley. Annals of the New York Academy of Sciences, Vol. 59.
13. Katayama T. 1962. X-ray induced chromosomal aberration in rice plant, The Jap. Jour. of Genetics. Vol. 38 No. 1.
14. Nishiyama et. al. 1951. Gamma ray-induced Chlorophyll Mutations and Mutation frequencies in Wheat & Oats. The Japanese Journal of Genetics. Vol. 36, No. 5-6:175-183.
15. Oka et. al. 1958 Induced mutation of polygenes for quantitative characters in rice. Jour. of Heredity. Vol. XLIX, No. 1.
16. Ramiah et. al. 1935. Chromosome ring in X-rayed rice. Assoc. Fch. Biology Combatore 2:1-4
17. Sparrow A. H. 1961. Types of ionizing radiation and their cytogenetic effects. Mutation and plant breeding NAS-NAR 891.
18. 臺灣省農業試驗所編印 1963. 大豆新品種 臺農一號R及臺農二號R之介紹

# EFFECT OF X-RAYS, THERMAL NEUTRON AND COBALT 60 ON CHARACTERS AND CHROMOSOMES OF RICE

by

S. T. YEN

## SUMMARY

In order to study the effects of different radiation treatments on agronomic characters and chromsomes, four varieties of rice (both *japonica* and *indica*) were sent to National Genetics Institute of Japan for X-rays and thermal neutron treatments; in the same time, seeds of Taichung no. 65 (*japonica* type) were also treated with X-rays and Cobalt 60 at the National Taiwan University Hospital.

The degree of plant injury in term of rates of germination, lathal seedlings and seedling height was found to be in parallel with the dose of radiations applied. Though, the seedlings growth at the early stage was differently inhibited by different kinds and doses of radiations, but it recovered gradually until maturity.

Except Taichung native no. 1 and Wu-chian which were treated with 20 Krs. of X-rays showed a slight increase in the number of tillers and weight of panicles, others remained to be the same as controls.

The heading dates were varying widly from early to late with 6 and 10 days respectively as it compared with controls. The correlation between plant height, panicle weight and panicle length was also varying from different varieties.

The tetravalents, univalents in the shape of chain and ring and chromosomal bridges were found in the PMCs of $R_1$ plants. The effect of X-rays was found to be stronger than r-rays from Cobalt 60 source in term of rates of chromosome aberration so far the present experiments are concerned.

# EFFECT OF GROWING CONDITIONS ON YIELD AND COMPONENTS OF YIELD IN RICE

by

W. L. CHANG and S. C. YANG*

## INTRODUCTION

Fertilization and spacing have been the problems of great concern to rice growers. Although these problems are not new and actually a considerable amount of work has already been done with regard to these practices, yet they still remain a challenge to the rice workers today. In Taiwan, where rice culture has been gradually moving toward the direction of heavy fertilization and high density of planting so as to further increase the unit production, these problems appear to be of particular significance. Since a number of workers have pointed out that various rice varieties respond differently to various fertility levels and planting densities (Yamada, 1961a; Chang, 1963), it seems necessary that optimum levels of fertility and planting density should be worked out for each commercial variety of rice. Chianung 242 has been among the top three leading commercial varieties in Taiwan and it seems desirable to give first priority to this variety for the solution of these problems. Also related to the problems of fertilization and planting density is the manner or shape of planting which was also shown to play an important role in the growth of rice (Wada, 1949; Ishi, 1957). The effect of planting shape on the characteristics of rice may also be worthwhile to investigate.

In recent years, however, considerable emphasis has been placed on the study of the adaptation response of rice variety to different conditions of fertility and spacing. Rice breeders are particularly interested in developing a new variety which can adapt well to heavily fertilized and closely spaced conditions. Some possible approaches to this end have been discussed by Oka and Lin (1958), and Jennings and Beachell (1964) regarding the response of rice varieties to fertilizers and by Kariya and Yamamoto (1963) regarding the planting density thereof. Plant type of rice adaptable to the tropics was also reviewed by Jennings (1964). The understanding of the relationship between yield and the components of yield in rice under different growing conditions may also be helpful toward throwing some light on the adaptability of rice. The primary purposes of this experiment, therefore, were (1) to evaluate the response of rice to three different growing conditions in terms of yield and the components of yield, and (2) to analyze the relationship between yield and the components of yield in each growing condition.

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## MATERIALS AND METHODS

Two field experiments were conducted in the second crop of 1963 and the first crop of 1964 at Chiayi Agricultural Experiment Station. The dominant soil type of the paddy field used in this experiment is clay loam which is a well drained, moderately dark colored soil with pH value, organic matter and available phosphorus contents ranging from 5.3 to 5.6, 1.60 to 1.75%, and 40 to 65 kilogrms per hectare, respectively.

Chianung 242 was used exclusively in the experiment. It is a *Japonica* variety of the so-called panicle-weight type with large and heavy panicles, which is typical of this variety. The culm of this variety is rather tall, and is therefore susceptible to lodging. However, this variety is noted for its resistance to the rice blast disease (*Piricularia oryzae*) and its high yielding ability.

Three treatments of growing conditions, i.e., fertilizer rate, planting density, and planting shape, were included in the experiment. There were two rates of fertilizers, 80–40–40, and 160–80–80 kg of N, P, K applied per hectare; three spacings, 64, 96, and 128 hills per 3.3 $m^2$; and three shapes of planting, rectangular 1 with row space of 24 cm, rectangular 2 with 27 cm between rows, and square. The experiment was laid out in a split-plot design with rates of fertilizers labeled as the main treatments; planting density, the sub-treatments; and planting shape, the sub-subtreatments. There were five replications in the experiment. Plots were 2.5 m wide and 4 m long, each being equivalent to 1/1,000 hectare. Approximately five seedlings were planted in each hill.

Number of panicles per hill was taken at the full ripe stage by randomly counting 10 hills located at the center of each plot. Number of grains per panicle and weight of 1,000 grains were recorded for each plot based on 20 randomly sampled panicles, one from each hill. Grain yields in kilograms per plot were taken by the standard method. All data thus collected were subjected to the analysis of variance. Simple correlation coefficients between yield and each of its components were calculated for every treatment by using the treatment averages. Coefficients of determination were also calculated so as to show the percentage of yield variation determined by each component.

## EXPERIMENTAL RESULTS

### Treatment Effects

*Effect of fertilizer rate*—The high rate of fertilizers (160–80–80) resulted in more grain yield per hectare than the low one (80–40–40) in both crop seasons (Table 1). The difference of yield between different rates of fertilizers, however, failed to reach a level of significance. The response of grain yield to the increase of fertilizers was more pronounced in the first crop of rice.

The effect of fertilizer levels on the components of yield was manifested by the increase of panicle number per hill and the reduction of the number of well-formed

Table 1. Yield and components of yield of rice variety Chianung 242 under three growing conditions in the second crop of 1963 and the first crop of 1964

| Treatment | Grain yield (kg/ha) | | Panicles per hill | | Grains per panicle | | Weight of 1,000 grains (g) | |
|---|---|---|---|---|---|---|---|---|
| | 2nd. 1963 | 1st. 1964 | 2nd. 1963 | 1st. 1964 | 2nd. 1963 | 1st. 1964 | 2nd. 1963 | 1st. 1964 |
| Fertilizer (NPK applied, kg/ha) | | | | | | | | |
| 80-40-40 | 4,724 | 5,742 | 7.7 | 9.2 | 149 | 116 | 28.9 | 29.5 |
| 160-80-80 | 4,870 | 5,946 | 8.3 | 10.0 | 147 | 115 | 28.6 | 29.1 |
| L.S.D. 5% | NS | NS | NS | NS | NS | NS | 0.3 | NS |
| L.S.D. 1% | — | — | — | — | — | — | — | — |
| Planting density (hills/3.3 m²) | | | | | | | | |
| 64 | 4,715 | 5,765 | 10.0 | 11.7 | 155 | 118 | 28.9 | 29.2 |
| 96 | 4,792 | 5,827 | 7.7 | 9.3 | 148 | 115 | 28.6 | 29.3 |
| 128 | 4,885 | 5,940 | 6.3 | 7.8 | 141 | 112 | 28.7 | 29.4 |
| L.S.D. 5% | NS | 171 | 0.4 | 0.5 | 3 | 4 | NS | NS |
| L.S.D. 1% | — | — | 0.6 | 0.7 | 5 | — | — | — |
| Planting Shape | | | | | | | | |
| Rectangular 1 (row width 24 cm) | 4,736 | 5,758 | 8.0 | 9.5 | 149 | 114 | 28.4 | 29.1 |
| Rectangular 2 (row width 27 cm) | 4,642 | 5,754 | 8.0 | 9.7 | 152 | 117 | 28.9 | 29.3 |
| Square | 5,014 | 6,020 | 8.0 | 9.7 | 143 | 115 | 28.8 | 29.5 |
| L.S.D. 5% | 148 | 171 | NS | NS | 4 | NS | NS | NS |
| L.S.D. 1% | 197 | 227 | — | — | — | — | — | — |

grains per panicle and the weight of 1,000 grains with higher rates of fertilizers (Table 1). The differences between fertilizer levels were not significant among the three components in both crops except that the weight of 1,000 grains in the second crop of 1963 was significant at the 5% level.

*Effect of planting density*—Results showed that grain yield responded positively with the increase of planting densities (Table 1). The effect of planting density on grain yield was significant at the 5% level in the first crop of 1964 where high planting density of 128 hills per 3.3 m² produced 175 kg or more grain per hectare than that of low planting density, i. e., 64 hills per 3.3 m². In the second crop of 1963, however, grain yields did not differ significantly among the different planting densities.

Among other yield components, the number of panicles per hill and the number of grains per panicle decreased significantly with the increase of planting densities in both crops (Table 1). The degree of reduction was similar in both crops for panicle number but it was slightly greater in the second crop than in the first insofar as the number of grains per panicle is concerned. Seed weight was least affected by the treatments.

*Effect of planting shape*—The data obtained for planting shape indicated that within a given planting density, the square shape of planting, with equi-distance of rows and hills, gave the highest yield; while the rectangular shape with row space fixed at 27 cm gave the lowest yield (Table 1). Differences among shapes of planting greatly exceeded the 1% level of significance in both crops.

Shape of planting did not give rise to a great change in seed weight, and panicle number apparently remained unchanged among the treatments in both crops (Table 1). However, the rectangular shape with row space fixed at 27 cm produced more grains per panicle than the other two shapes (Table 1). This difference was significant at the 5% level in the second crop of 1963, but failed to reach a significant level in the first crop of 1964.

*Interactions*—None of the 24 two-way tables are given. Of these only one, i. e., fertilizer rate×planting density for weight of 1,000 grains in the first crop of 1964, was significant at the 1% level. In low fertilizer rate, grain weight decreased as planting density was raised to 96 hills per 3.3 $m^2$ and then increased as planting density reached as high as 128 hills per 3.3 $m^2$; while in high one, the situation was just the opposite. Within a planting density, higher rate of fertilizers reduced weight except for the one with 96 hills per 3.3 $m^2$ in which seed weight was increased with the addition of more fertilizers.

**Relationship Between Yield and the Components of Yield**

Correlation coefficients between yield and each of the three components of yield for each treatment are given in Table 2.

Number of panicles per hill was positively correlated with yield in the second crop under all treatments except rectangular shape 2, while the correlations were mostly negative for the treatments in the first crop except the treatments of 64 hills per 3.3 $m^2$, rectangular shapes 1 and 2, where the correlations were positive. The correlations were significant at the 5% level in the first and second crops of 64 and 96 hills per 3.3 $m^2$, respectively, while in the second crop of 128 hills per 3.3 $m^2$, it was significant at the 1% level.

Number of grains per panicle was negatively correlated with yield in the second crop for all treatments but negatively correlated in the first crop. The correlations were significant at the 5% level in the first crop of both fertilizer rates and significant at the 1% level in the first crop of 96 hills per 3.3 $m^2$ and square shape of planting.

Weight of 1,000 grains was positively correlated with yield in the second crop for all treatments. In the first crop, however, no consistent trends were observed in seed weight among treatments. The correlations in the second crop were significant for all treatments except that of rectangular shape 1 which was not significant. Grain weight was not significantly correlated with yield in the first crop.

Coefficients of determination ($r^2$) for all significant correlatoins showed that about 10 to 32% seed yield variations could be ascribed to the effect of one particular

Table 2. Correlation coefficients and coefficients of determination between yield and components of yield of rice variety Chianung 242 for three growing conditions

| Treatment | Crop season | Yield-panicle/hill | | Yield-grains/panicle | | Yield-grams/1,000 grains | |
|---|---|---|---|---|---|---|---|
| | | r | $r^2$ | r | $r^2$ | r | $r^2$ |
| Fertilizer (NPK applied kg/ha) | | | | | | | |
| 80-40-40 | 2nd. 1963 | +0.151 | 0.023 | −0.262 | 0.069 | +0.446** | 0.199 |
| | 1st. 1964 | −0.139 | 0.019 | +0.370* | 0.137 | +0.275 | 0.076 |
| 160-80-80 | 2nd. 1963 | +0.021 | 0.001 | −0.203 | 0.041 | +0.392** | 0.154 |
| | 1st. 1964 | −0.192 | 0.037 | +0.313* | 0.098 | −0.147 | 0.022 |
| Planting density (hills/3.3 $m^2$) | | | | | | | |
| 64 | 2nd. 1963 | +0.289 | 0.083 | −0.254 | 0.065 | +0.385* | 0.148 |
| | 1st. 1964 | +0.372* | 0.138 | +0.094 | 0.009 | −0.060 | 0.004 |
| 96 | 2nd. 1963 | +0.433* | 0.187 | −0.288 | 0.083 | +0.468** | 0.219 |
| | 1st. 1964 | −0.265 | 0.070 | +0.539** | 0.291 | +0.111 | 0.012 |
| 128 | 2nd. 1963 | +0.493** | 0.243 | −0.059 | 0.004 | +0.369* | 0.136 |
| | 1st. 1964 | −0.159 | 0.025 | +0.341 | 0.117 | +0.095 | 0.009 |
| Planting shape | | | | | | | |
| Rectangular 1 (row width 24 cm) | | | | | | | |
| | 2nd. 1963 | +0.229 | 0.052 | −0.183 | 0.033 | +0.294 | 0.087 |
| | 1st. 1964 | +0.226 | 0.051 | +0.086 | 0.007 | +0.268 | 0.072 |
| Rectangular 2 (row width 27 cm) | | | | | | | |
| | 2nd. 1963 | −0.155 | 0.024 | −0.139 | 0.019 | +0.523** | 0.273 |
| | 1st. 1964 | +0.051 | 0.003 | +0.729 | 0.078 | −0.279 | 0.078 |
| Square | 2nd. 1963 | +0.055 | 0.003 | −0.139 | 0.019 | +0.563** | 0.317 |
| | 1st. 1964 | −0.162 | 0.026 | +0.540** | 0.292 | +0.058 | 0.003 |

* Significant at the 5% level. The d.f. was 43 for fertilizer and 28 for both planting density and planting shape.
** Significant at the 1% level.

component of a given treatment. Small values of coefficients of determination were obtained for correlations which were not significant.

## DISCUSSION

The results of this experiment demonstrate that further increase of yield in rice can be expected by increasing fertlizers and planting densities. However, differences between fertilizer rates and among planting densities failed to reach a significant level, indicating that rice varieties available at present may not be sensitive enough in its responsiveness to addition of fertilizers and increased planting densities. Actually, Chang (1963) has already pointed out that the varietal response to nitrogen was generally poor. Since the existing commercial rice varieties have been developed without paying attention to their responsiveness to growing conditions during the process of selection, it seems natural that these varieties are rather poorly equipped

with this ability, which has since become so important in recent years. A similar trend seems to prevail also in other crop varieties. Gotoh and Osanai (1959a) observed in wheat that lines selected from widely spaced planting yielded better than those from closely spaced one. Rumbaugh (1963) also reported that selection indices based upon yield component data obtained from spaced nurseries may not accurately portray the yield potentials of genotypes in solid planting of alfalfa.

It was observed that high levels of fertilizers increased leaf size and stimulated tillering, thus producing much more foliage. Close spacing also caused the same effect. The combination of heavy fertilization and close spacing, therefore, produced more internal foliar shading and lowered light transmission rate. It seems, therefore, reasonable to suggest that the insignificant effects of added fertilizers and increased planting density on grain yield may be attributable to increased mutual shading of rice plants. Yamada (1961b) concluded that under heavily fertilized and closely spaced condition, sufficient penetration of light is prerequisite to higher yield response. Tanaka (1963) also demonstrated that mutual shading increases at higher levels of nitrogen and that this mutual shading reduced the effect of the nitrogen. Generally, carbohydrate synthesis slackens, respiration increases, and grain yields are reduced when foliar shading increases (Jennings, 1964). It is, therefore, suggested that in the future breeding program, emphasis should be placed on selecting individual plants or lines, among other desirable characters, with short, sturdy straw; and erect, small, thick, and dark-green leaves as suggested by Jennings and Beachell (1964). It would also be profitable, as indicated by the correlation coefficients, that new varieties should have heavy grains in the second crop and more grains in the first one, if they are to be adaptable under heavily fertilized and closely spaced conditions. For varieties to yield more under high planting densities in the first crop, high tillering capacity seems indispensable.

Methods of breeding varieties for fertilizer and density responsiveness have been a matter of great concern to rice breeders in recent years. Oka and Lin (1958) suggested that if rice varieties with high fertilizer response are to be selected, culture of hybrid population with a high dose of fertilizer is effective for the purpose. However, Gotoh and Osanai (1959b) reached just the opposite conclusion in wheat. They concluded that to select high yielders with tolerance to heavy fertilizer applications, selection should be made under low fertility condition. In selecting rice varieties adaptable under high planting density, Kariya and Yamamoto (1963) suggested that the best method may be conducting the selection in high planting density on the basis of line means. The issue, however, is still unsettled and further investigation is necessary.

At the present time, growing rice under heavily fertilized and closely spaced conditions, maximum yield seems attainable by arranging various cultural practices in such a way so as to enable those characters which are in close association with yield to reach maximum development. This approach seems to be of particular

significance for rice culture in Taiwan since the practice of heavy fertilizing and close spacing has already gained wind, but new varieties with best fertilizer and density responsivenss are not yet developed.

Correlations between yield and its components were generally of small magnitude although some of them were significant even at the 1% level. The results seem to indicate that factors other than these three components of yield may also be in operation. The coefficients of determination indicate that they could account for no more than 10 to 32% of the variations in seed yields. Matsubayashi (1963) included percentage of rippened grains as the fourth component of yield. Shibata (1964) added three more components to the yield of rice, namely, heading date, maturity date and number or days from heading date to the date when half of the plants in plots are completely prostrated.

It is of interest to note that square shape of planting gave, so far, the highest yield, while rectangular 2, the lowest. Since square shape has equal distance both between rows and between hills within rows, while rectangular 2 has wider space between rows (27 cm) than between hills within a row, it seems to indicate that low yielding ability of the latter planting shape may be due primarily to the early competition between hills at the early stage of growth. Ishi (1957) reported that square shape enables rice plants to tiller early, and provides more space for young tillers to absorb nutrients so that they can be well established at the early stage of growth. Wada (1949) also suggested that when sufficient fertilizers are available for rice plants, square shape of planting can best serve the purpose. Based on the results of this experiment, and also on the findings of these two workers, it appears probable that better yield could be expected in heavily fertilized and closely spaced paddy field, especially in the second crop, if the rice plants were transplanted in square shape. Incidentally, the trends of association between yield and the components of yield in square shaping were similar to those of high fertilizer rate and high planting densities.

## SUMMARY

The effects of 2 fertilizer rates, 3 planting densities, and 3 shapes of planting on the growth of rice conducted in the second crop of 1963 and the first crop of 1964 at Chiayi Agricultural Experiment Station are reported.

Grain yields increased with increasing fertilizers and planting densities. The increase of yields was more pronounced in the first crop of rice. Differences in yields between fertilizer rates as well as among planting densities were not significant except in planting density of the first crop, 1964. Square shape of planting outyielded the other two rectangular shapes, a difference greatly exceeding the 1% level of probability in both crop seasons.

Number of panicles per hill slightly increased with added fertilizers, decreased significantly with increasing planting densities and remain almost unchanged among

planting shapes. Number of grains per panicle decreased slightly with added fertilizers, decreased significantly with increasing planting densities. Rectangular shape with row space of 27 cm significantly increased grains per panicle in the second crop. Seed weight was least affected by the treatments.

Seed weight was significantly correlated with grain yield in the second crop for fertilizer rates, planting densities, square shape and rectangular shape 2 (row space 27 cm). Grain number per panicle was significantly associated with grain yield in the first crop for fertilizer rates, high planting density, and square shape of planting. Panicle number per hill was significantly correlated with grain yield in the second crop for high planting density (96 hills/3.3 $m^2$) and in the first crop for low planting density. Coefficients of determination showed that about 10 to 32% of seed yield variations could be ascribed to the effects of yield components.

## LITERATURE CITED


(1) Chang, T. T. (1963): Yield component studies. Ann. Rep. Int'l Rice Res. Inst. 30-33.
(2) Gotoh, K. and S. Osanai, (1959a): Efficiency of selection for yield under different densities in a wheat cross. Jap. J. Breeding. **9**:7-11.
(3) Gotoh, K. and S. Osanai, (1959b): Efficiency of selection for yield under different fertilizer levels in a wheat cross. Jap. J. Breeding. **9**:173-178.
(4) Ishi, K. (1957): Effect of planting shape on the growth of rice. Agr. and Hort. **32**:615-616.
(5) Jennings, P. R. (1964): Plant type as a rice breeding objective. Crop Sci. **4**:13-15.
(6) Jennings, P. R. (1964): and H. M. Beachell. Breeding rice for nitrogen responsiveness. Symposium on the Mineral Nutrition of the Rice Plant. IRRI.
(7) Kariya, K. and T. Yamamoto. (1963): Planting density and selection method in rice plant. Jap. J. Breeding. **13**:25-30.
(8) Matsubayashi, M. (1963): *Theory aud Practice of Growing Rice*. Fuji LTD., Tokyo. 502 pp.
(9) Oka, H. and K.M. Lin. (1958): Variation and selection for fertilizer response in hybrid population of rice. Jap. J. Breeding. 8:163-168.
(10) Rumbaugh, M. D. (1963): Effects of population density on some components of yield of alfalfa. Crop. Sci. **3**:423-424.
(11) Shibata, K. (1964): Application of statistical genetics on the breeding of self-pollinated crops. Recent Advancement of Breeding. **5**:3-13.
(12) Tanaka, A. (1963): Mutual shading in relation to nitrogen response. Ann. Rep. Int'l Rice Res. Inst. 45-46.
(13) Wada, E. (1949): Paddy management. Agr. and Hort. **24**:329-332.
(14) Yamada, N. (1961a): Planting density and yield of rice. I. Agr. and Hort. **36**:13-18.
(15) Yamada, N. (1961b): Planting density and yield of rice. II. Agr. and Hort. **36**:311-315.

# 生育環境對稻谷產量及其構成因素之效果

張萬來　楊遜謙

## 摘　要

本文係報告嘉義農業試驗分所在民國52年第二期作及53年第一期作舉辦施肥量，栽植密度及方式對水稻產量與其構成因素效果之試驗結果。

稻各產量隨施肥量及栽植密度之提高而增加，以第一期作產量爲最。但處理間差異，除53年第一期作栽植密度外，均未達顯著水準。栽植方式間產量差異均極顯著，尤以正方形植者，產量最高。

每株穗數多寡與施肥量形成正比，但與栽植密度成相反現象。至於栽植方式則未見有何影響。每穗粒數因增肥，密植而行遞減，惟行距27公分之長方形植，似有增加趨勢。生育環境對千粒重之影響，極度輕微。

第二期作水稻之千粒重，在施肥量，栽植密度及行距27公分之長方形植等處理，概與產量呈顯著正相關。第一期作水稻之每穗粒數，則施肥量，密植（每坪96株）及正方形植等處理下，亦與產量成顯著之正相關。在第二期作密植及第一期作疏植狀況下，穗數與產量之相關達顯著水準。決定係數指出約有10至32%之產量變異，直接受此等與產量有顯著相關之構成因素所支配。

# 耐旱性稻種臺農選1號及2號之育成

林　清　秀

## 一、緒　言

本省之稻作改良，經不斷的努力，已育成有許多優良品種，但此等品種，大部份適應於平地及有充分灌溉水量之水田，如在缺乏灌溉之情形下，則此等品種，對旱害之抵抗力甚弱，生育受阻碍，而影響稻谷產量。

查本省水田，非全部分佈於有灌溉充分區域內，尚有爲數頗多之稻田分佈於農林邊際丘陵地及靠山區域之起伏山坡地或現有大小灌溉水利設備未端等之缺水不良環境地帶，雨量分佈不均，對稻作耕種上，較爲困難，如爲期增加今後之糧食產量，對此等缺水稻田之稻作改良，必須重視。

本報告根據以上之前提所育成之優良耐旱性品種之有關試驗成績資料，加以分析整理之結果，謹爲介紹，以供參考，本研究蒙所長徐永泉博士惠予指教，試驗成績資料之統計分析及整理，承許東暉先生及邱善美先生協助，試驗進行時，承各地方有關機關協助，敬此併致謝忱。

## 二、臺農選1號及2號之育成經過及特性

民國41年在本所，就 Baritol 之稻品種以系統分離選拔，然後繼續純化培育六代，至民國43年成爲一個定系統，其詳細系統圖及主要特性如下：

（A）新育成品種系統圖

Baritol→農旱 41 號（民國41年）—┬→農旱 1 號（粳）（民國43年）→命名爲臺農選 1 號（民國53年）
　　└→農旱 2 號（糯）（民國43年）→命名爲臺農選 2 號（民國53年）

（B）新育成品種主要特性

| 品種名稱 | 類型 | 期別 | 稈長 | 葉色 | 稈尖色 | 芒有無 | 有效分蘗 | 每穗粒數 | 粒型 | 穗長 | 千粒重量 | 晚粒性 | 成熟性 | 耐旱性 | 耐濕性 | 耐肥性 | 抗稻熱病 | 碾米率 | 米質 | 適應性 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 公分 | | | | | 粒 | | 公分 | 公分 | | | | | | | | | |
| 臺農選壹號 | 粳 | I | 105 | 淡綠 | 淡黃 | 有 | 10 | 115 | 長稃圓形(大) | 20.0 | 30.0 | 難 | 早 | 强 | 强 | 强 | 稍强 | 79.5 | 中上 | (1)宜於中北部缺水看天田以插秧栽培及於旱田以直播栽培等。 |
| | | II | 96 | 〃 | 〃 | 有 | 9 | 105 | 同 | 19.0 | 30.0 | 難 | 早 | 强 | 强 | 强 | 稍强 | 79.2 | 中上 | |
| 臺農選貳號 | 糯 | I | 106 | 淡綠 | 淡黃 | 有 | 10 | 118 | 長稃圓形(大) | 20.5 | 30.0 | 難 | 早熟 | 强 | 强 | 强 | 稍强 | 79.3 | 中上 | |
| | | II | 98 | 〃 | 〃 | 有 | 6 | 108 | 同 | 19.5 | 30.0 | 難 | 早熟 | 强 | 强 | 强 | 稍强 | 79.0 | 中上 | |

## 三、臺農選1號及2號之品種耐旱性檢定試驗

期探究新育成品種之抗旱能力强弱程度起見，初步先在水田以育苗插秧方法栽培並設經常灌溉區，壹個月後斷水區及半個月斷水區等 3 處理，以臺中65號爲對照，舉行比較試驗，以便觀察調查水田缺水供應下之抗旱性及旱害預防能力等茲將試驗結果列表如下：

表1　新育成品種耐旱性檢定試驗成績（自民國45—46年）

| 年期 | 試驗處理別 | 調查要項 / 供試品種 | 插秧日期 | 收穫日期 | 生育日數 | 草高 | 公頃產量 | 生產指數 | 摘要 |
|---|---|---|---|---|---|---|---|---|---|
| | | | 月日 | 月日 | 日 | 公分 | 公斤 | % | |
| 民國四五年 | 第一期作 經常灌溉區 | 臺農選1號 | 3.20 | 6.26 | 97 | 105.3 | 3240.0 | 100 | |
| | | 臺中65號 | 3.20 | 7.16 | 117 | 98.7 | 3484.0 | 100 | |
| | 壹個月後斷水區 | 臺農選1號 | 3.20 | 6.28 | 99 | 104.7 | 3036.6 | 93.7 | |
| | | 臺中65號 | 3.20 | 7.19 | 120 | 89.8 | 2438.8 | 70.0 | |
| | 半個月後斷水區 | 臺農選1號 | 3.20 | 6.30 | 101 | 102.0 | 2787.2 | 86.0 | |
| | | 臺中65號 | 3.20 | 7.22 | 123 | 62.5 | 1916.2 | 55.0 | |
| | 第二期作 經常灌溉區 | 臺農選1號 | 3.20 | 10.28 | 90 | 97.9 | 2700.0 | 100.0 | |
| | | 臺中65號 | 7.30 | 11.12 | 104 | 95.0 | 2934.0 | 100.0 | |
| | 壹個月後斷水區 | 臺農選1號 | 7.30 | 10.30 | 92 | 96.8 | 2520.0 | 93.3 | |
| | | 臺中65號（CK） | 7.30 | 11.15 | 107 | 84.2 | 2160.0 | 77.0 | |
| | 半個月後斷水區 | 臺農選1號 | 7.30 | 10.30 | 92 | 94.7 | 2412.0 | 89.ε | |
| | | 臺中65號（CK） | 7.30 | 11.18 | 110 | 69.7 | 1907.1 | 65.0 | |
| 民國四六年 | 第一期作 經常灌溉區 | 臺農選1號 | 3.21 | 6.27 | 97 | 103.9 | 3030.9 | 100.0 | |
| | | 臺中65號（CK） | 3.21 | 7.17 | 117 | 99.0 | 3348.0 | 100.0 | |
| | 壹個月後斷水區 | 臺農選1號 | 3.21 | 6.28 | 98 | 102.1 | 2820.0 | 93.0 | |
| | | 臺中65號（CK） | 3.21 | 7.19 | 119 | 87.8 | 2648.9 | 79.1 | |
| | 半個月後斷水區 | 臺農選1號 | 3.21 | 6.30 | 100 | 99.5 | 2640.0 | 87.9 | |
| | | 臺中65號（CK） | 3.21 | 7.21 | 121 | 73.6 | 2040.0 | 60.9 | |
| | 第二期作 經幣灌溉區 | 臺農選1號 | 7.30 | 10.29 | 90 | 98.2 | 2796.0 | 100.0 | |
| | | 臺中65號（CK） | 7.30 | 11.12 | 104 | 96,9 | 3120.0 | 100.0 | |
| | 壹個月後斷水區 | 臺農選1號 | 7.30 | 10.30 | 91 | 95.4 | 2640.0 | 94.4 | |
| | | 臺中65號（CK） | 7.30 | 11.16 | 108 | 83.2 | 2298.0 | 73.6 | |
| | 半個月後斷水區 | 臺農選1號 | 7.30 | 11. 2 | 94 | 88.9 | 2496.0 | 89.2 | |
| | | 臺中65號（CK） | 7.30 | 11.20 | 112 | 74.8 | 1986.0 | 63.6 | |
| 二年平均 | 第一期作 經常灌溉區 | 臺農選1號 | | | 97.0 | 104.5 | 3135,45 | 100.0 | |
| | | 臺中65號（CK） | | | 117.0 | 98.8 | 3416.00 | 100.0 | |
| | 壹個月後斷水區 | 臺農選1號 | | | 98.5 | 103.4 | 2928.30 | 93.3 | |
| | | 臺中65號（CK） | | | 119.5 | 88.8 | 2543,85 | 74.4 | |
| | 半個月後斷水區 | 臺農選1號 | | | 100.5 | 100.7 | 2713,60 | 86,0 | |
| | | 臺中65號（CK） | | | 122.0 | 66.1 | 1978.10 | 57.9 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 二年平均 | 第二期作 | 經常灌溉區 | 臺農選1號 | | | 90.0 | 98.0 | 2748.00 | 100.0 |
| | | | 臺中65號（CK） | | | 104.0 | 96.0 | 3019.00 | 100.0 |
| | | 壹個月後斷水區 | 臺農選1號 | | | 91.5 | 96.1 | 2580.00 | 93.8 |
| | | | 臺中65號（CK） | | | 107.5 | 83.7 | 2229.45 | 73.8 |
| | | 半個月後斷水區 | 臺農選1號 | | | 93.0 | 91.8 | 2454.60 | 89.3 |
| | | | 臺中65號（CK） | | | 111.0 | 65.0 | 1946.55 | 56.0 |

附註：上表生產指數欄之數字，係表示經常灌溉區各供試品種之產量（生產指數爲100%）與其他處理試驗區之產量比較之增減比率，由本試驗成績分析結果，顧示臺中65號自揷秧後斷水晒乾期間愈延長，其產量愈減少，卽就半個月後斷水區與經常灌溉區之產量比較，半個月後斷水區之產量，一期作僅等於57.9，二期作僅等於56%而已，兩者相差達40%左右，惟臺農選1號，同一試驗區之產量比較兩者相差僅爲10—15%而已，此顧示該新品種，之耐旱性，較臺中65號爲强。

## 四、臺農選1號及2號之地方試驗作成績

本試驗係選定下記海拔高度及各種自然環境和土質等不同之旱田（看天田）爲試驗地，試驗設計採用隨機區組法，3重複，行長4公尺，行距25公分，每品種種植10行，小區面積10平方公尺，以大畑早生爲對照，採用直播栽培方法，擧行比較試驗。試驗成績，以變方分析法，決定其差異顯著性，其詳細結果，擧列如表3，4，5，6等各表：

表2 試 驗 地 點

| 試驗地點 | 標高 | 處數 | 摘要 |
|---|---|---|---|
| 士林鎭社子 | 10公尺 | 1 | 淡水溪下流沿岸之缺水休耕地，冲積砂質壤土 |
| 萬里鄉中幅村 | 150 | 1 | 海拔150公尺丘陵地山坡旱田粘質壤土 |
| 石碇鄉烏塗村 | 250 | 1 | 海拔250公尺，低山地區山坡看天田，砂質粘壤土 |
| 園縣楊梅鎭伯公岡 | 200 | 1 | 臺地，休耕看天田，紅壤土 |

表3 民國49—50年第一期作各試驗地品種產量表（公斤/公頃）

| 試驗地別 | 品種別 / 重複 | 臺農選1號 | 臺農選2號 | 農林19號 | 農林20號 | 臺南2號 | 東陸1號 | 大畑早生（對照） |
|---|---|---|---|---|---|---|---|---|
| 士林鎭社子 | 1 | 5850.0 | 2874.0 | 2694.0 | 2568.0 | 2706.0 | 2656.0 | 2616.0 |
| | 2 | 2832.0 | 2874.0 | 2670.0 | 2580.0 | 2700.0 | 2664.0 | 2646.0 |
| | 3 | 2826.0 | 2856.0 | 2682,0 | 2628.0 | 2730.0 | 2642.0 | 2664.0 |
| | 平均 | 2836.0 | 2868.0 | 2682.0 | 2592.0 | 2712.0 | 2654.0 | 2642.0 |
| 萬里鄉中幅村 | 1 | 2560.0 | 2592.0 | 2430.0 | 2331.0 | 2427.0 | 2352.0 | 2424.0 |
| | 2 | 2526.0 | 2580.0 | 2424.0 | 2340.0 | 2436.0 | 2376.0 | 2424.0 |
| | 3 | 2570.0 | 2586.0 | 2412.0 | 2352.0 | 2418.0 | 2382.0 | 2418.0 |
| | 平均 | 2552.0 | 2586.0 | 2422.0 | 2341.0 | 2427.0 | 2370.0 | 2422.0 |
| 楊梅鎭伯公岡 | 1 | 2334.0 | 2424.0 | 2172.0 | 2178.0 | 2256.0 | 2211.0 | 2313.0 |
| | 2 | 2400,0 | 2394.0 | 2160.0 | 2166.0 | 2256.0 | 2202.0 | 2316.0 |
| | 3 | 2382.0 | 2400.0 | 2139.0 | 2208.0 | 2232.0 | 2214.0 | 2304.0 |
| | 4 | 2372.0 | 2406.0 | 2157.0 | 2184.0 | 2248.0 | 2209.0 | 2311.0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 石碇鄉烏塗村 | 1 | 2640,0 | 2644.0 | 2400.0 | 2343.0 | 2385.0 | 2328.0 | 2454.0 |
| | 2 | 2610.0 | 2646.0 | 2346.0 | 2316,0 | 2382.0 | 2364.0 | 2466.0 |
| | 3 | 2622.0 | 2640.0 | 2352.0 | 2286.0 | 2364.0 | 2346.0 | 2465.0 |
| | 平均 | 2624.0 | 2650.0 | 2366,0 | 2315.0 | 2377.0 | 2356.0 | 2465.0 |
| 各試驗地平均 | 1 | 2596,0 | 2637.5 | 2424.0 | 2355.0 | 2443.5 | 2394.0 | 2452.0 |
| | 2 | 2592.0 | 2623.5 | 2400.0 | 2350.5 | 2443.5 | 2401.5 | 2463.0 |
| | 3 | 2600.0 | 2620.5 | 2396.0 | 2368.5 | 2436.0 | 2396.0 | 2463.0 |
| | 平均 | 2596.0 | 2627.0 | 2406.6 | 2358.0 | 2441.0 | 2397.0 | 2460.0 |

表4　各試驗地品種產量差異比較

（a）土林鎮社子（民國49—50年一期作）

| 品種 | 臺農選2號 | 臺農選1號 | 臺南2號 | 農林19號 | 東陸1號 | 大畑早生 | 農林20號 |
|---|---|---|---|---|---|---|---|
| 產量 | 2868.0 | 2830.0 | 2712.0 | 2682.0 | 2654.0 | 2642.0 | 2562.0 |

（b）萬里鄉中幅村（民國49—50年一期作）

| 品種 | 臺農選2號 | 臺農選1號 | 臺南2號 | 農林19號 | 大畑早生 | 東陸1號 | 農林20號 |
|---|---|---|---|---|---|---|---|
| 產量 | 2586.0 | 2552.0 | 2427.0 | 2422.0 | 2422.0 | 2370.0 | 2341.0 |

（c）楊梅鎮伯公岡（民國49—50年一期作）

| 品種 | 臺農選2號 | 臺農選1號 | 大畑早生 | 臺南2號 | 東陸1號 | 農林20號 | 農林19號 |
|---|---|---|---|---|---|---|---|
| 產量 | 2406.0 | 2372.0 | 2311.0 | 2248.0 | 2209.0 | 2184.0 | 2157.0 |

（d）石碇鄉烏塗村（民國49—50年一期作）

| 品種 | 臺農選2號 | 臺農選1號 | 大畑早生 | 臺南2號 | 農林19號 | 東陸1號 | 農林20號 |
|---|---|---|---|---|---|---|---|
| 產量 | 2650.0 | 2624.0 | 2465.0 | 2377.0 | 2366.0 | 2356.0 | 2315.0 |

註 ——實線爲5%顯著標誌
……虛線爲1%顯著標誌

表5　民國49—50年第二期作各試驗地品種產量表

| 試驗地點 | 品種別 / 重複 | 臺農選1號 | 臺農選2號 | 農林19號 | 農林20號 | 臺南2號 | 東陸1號 | 大畑早生（對照） |
|---|---|---|---|---|---|---|---|---|
| 士林鎮社子 | 1 | 2460.0 | 2514.0 | 2340.0 | 2310.0 | 2376.0 | 2274.0 | 2340.0 |
| | 2 | 2457.0 | 2484.0 | 2310.0 | 2301.0 | 2340.0 | 2274.0 | 2310.0 |
| | 3 | 2484.0 | 2502.0 | 2316.0 | 2286.0 | 2367.0 | 2292.0 | 2358.0 |
| | 平均 | 2467.0 | 2500.0 | 2322.0 | 2299.0 | 2361.0 | 2280.0 | 2338.0 |
| 萬里鄉中幅村 | 1 | 2454.0 | 2484.0 | 2230.0 | 2136.0 | 2256.0 | 2100.0 | 2298.0 |
| | 2 | 2442.0 | 2466.0 | 2160.0 | 2130.0 | 2232.0 | 2088.0 | 2304.0 |
| | 3 | 2442.0 | 2469.0 | 2172.0 | 2112.0 | 2235.0 | 2112.0 | 2307.0 |
| | 平均 | 2446.0 | 2473.0 | 2184.0 | 2126.0 | 2241.0 | 2100.0 | 2303.0 |
| 石碇鄉烏塗村 | 1 | 2418.0 | 2463.0 | 2256.0 | 2136.0 | 2256.0 | 2076.0 | 2295.0 |
| | 2 | 2430.0 | 2460.0 | 2232.0 | 2082.0 | 2283.0 | 2070.0 | 2250.0 |
| | 3 | 2448.0 | 2436.0 | 2232.0 | 2157.0 | 2292.0 | 2094.0 | 2280.0 |
| | 平均 | 2432.0 | 2453.0 | 2240.0 | 2125.0 | 2276.0 | 2080.0 | 2275.0 |
| 楊梅鎮伯公岡 | 1 | 2088.0 | 2082.0 | 2040.0 | 1938.0 | 1932.0 | 1848.0 | 1956.0 |
| | 2 | 2252.0 | 2082.0 | 1980.0 | 1914.0 | 1944.0 | 1860.0 | 1938.0 |
| | 3 | 2049.0 | 2064.0 | 1950.0 | 1908.0 | 1920.0 | 1872.0 | 1962.0 |
| | 平均 | 2063.0 | 2076.0 | 1990.0 | 1920.0 | 1934.0 | 1860.0 | 1952.0 |
| 各試驗地平均 | 1 | 2335.0 | 2385.7 | 2216.5 | 2130.0 | 2205.0 | 2074.5 | 2222.0 |
| | 2 | 2345.5 | 2373.0 | 2170.5 | 2106.7 | 2199.0 | 2073.0 | 2202.0 |
| | 3 | 2335.5 | 2367.7 | 2167.5 | 2115.7 | 2205.0 | 2092.5 | 2226.0 |
| | 平均 | 2352.0 | 2375.5 | 2184.6 | 2115.8 | 2203.0 | 2080.0 | 2217.0 |

表6　民國49—50年第二期作各試驗地品種產量差異比較

（a）士林鎮社子

| 品種 | 臺農選2號 | 臺農選1號 | 臺南2號 | 大畑早生 | 農林19號 | 農林20號 | 東陸1號 |
|---|---|---|---|---|---|---|---|
| 產量 | 2500.0 | 2467.0 | 2361.0 | 2338.0 | 2322.0 | 2299.0 | 2280.0 |

（b）臺北縣萬里鄉中幅村

| 品種 | 臺農選2號 | 臺畸選1號 | 大畑早生 | 臺南2號 | 農林19號 | 農林20號 | 東陸1號 |
|---|---|---|---|---|---|---|---|
| 產量 | 2473.0 | 2446.0 | 2303.0 | 2241.0 | 2184.0 | 2126.0 | 2100.0 |

（c）臺北縣石碇鄉烏塗村

| 品　種 | 臺農選2號 | 臺農選1號 | 臺南2號 | 大畑早生 | 農林19號 | 農林20號 | 東陸1號 |
|---|---|---|---|---|---|---|---|
| 產　量 | 2453.0 | 2432.0 | 2276.0 | 2275.0 | 2240.0 | 2125.0 | 2080.0 |

（d）桃園縣桃桃鎮伯公岡

| 品　種 | 臺農選2號 | 臺農選1號 | 農林19號 | 大畑早生 | 臺南2號 | 農林20號 | 東陸1號 |
|---|---|---|---|---|---|---|---|
| 產　量 | 2076.0 | 2063.0 | 1990.0 | 1952.0 | 1934.0 | 1920.0 | 1860.0 |

註 ——實線爲5％顯著標誌
　 ……虛線爲1％顯著標誌

## 五、臺農選1號及2號品種區域試驗成績

本試驗選定旱田，採用直播方法栽培，試驗設計以隨機區組法，3重複，行長4公尺，行距25公分，每品種10行，小區面積10平方公尺，對照品種爲大畑早生，經變方分析法測定，其差異顯著性，結果如表7，8，9，10。

表7　民國51—52年第一期作區域試驗品種產量表

| 試驗地 | 試驗區別 | 臺農選1號 | 臺農選2號 | 臺南2號 | 東陸1號 | 大畑早生 | 摘　要 |
|---|---|---|---|---|---|---|---|
| 臺北縣淡水 | 1 | 2630.0 | 2739.0 | 2568.0 | 2462.0 | 2544.0 | |
| | 2 | 2627.0 | 2736.0 | 2556.0 | 2454.0 | 2550.0 | |
| | 3 | 2630.0 | 2742.0 | 2562.0 | 2470.0 | 2553.0 | |
| | 平均 | 2629.0 | 2739.0 | 2562.0 | 2462.0 | 2549.0 | |
| 臺北縣土城 | 1 | 2700.0 | 2874.0 | 2670.0 | 2562.0 | 2568.0 | |
| | 2 | 2706.0 | 2859.0 | 2601.0 | 2559.0 | 2574.0 | |
| | 3 | 2682.0 | 2862.0 | 2628.0 | 2574.0 | 2580.0 | |
| | 平均 | 2696.0 | 2865.0 | 2633.0 | 2565.0 | 2574.0 | |
| 新竹市湳子 | 1 | 2841.0 | 2616.0 | 2544.0 | 2472.0 | 2640.0 | |
| | 2 | 2823.0 | 2640.0 | 2562.0 | 2466.0 | 2610.0 | |
| | 3 | 2844.0 | 2610.0 | 2586.0 | 2493.0 | 2598.0 | |
| | 平均 | 2835.0 | 2622.0 | 2564.0 | 2477.0 | 2616.0 | |
| 臺中縣新社 | 1 | 2610.0 | 2706.0 | 2550.0 | 2496.0 | 2511.0 | |
| | 2 | 2628.0 | 2682.0 | 2532.0 | 2487.0 | 2496.0 | |
| | 3 | 2610.0 | 2700.0 | 2556.0 | 2514.0 | 2508.0 | |
| | 平均 | 2616.0 | 2696.0 | 2546.0 | 2499.0 | 2505.0 | |

表 8　民國51—52年第一期作各試驗地品種產量差異比較

（a）臺北縣淡水

| 品種 | 臺農選 2 號 | 臺農選 1 號 | 臺南 2 號 | 大畑早生 | 東陸 1 號 |
|---|---|---|---|---|---|
| 產量 | 2739.0 | 2629.0 | 2562.0 | 2549.0 | 2462.0 |

（b）臺北縣土城

| 品種 | 臺農選 2 號 | 臺農選 1 號 | 臺南 2 號 | 大畑早生 | 東陸 1 號 |
|---|---|---|---|---|---|
| 產量 | 2865.0 | 2696.0 | 2633.0 | 2574.0 | 2565.0 |

（c）新竹市湳子

| 品種 | 臺農選 1 號 | 臺農選 2 號 | 大畑早生 | 臺南 2 號 | 東陸 1 號 |
|---|---|---|---|---|---|
| 產量 | 2935.0 | 2622.0 | 2616.0 | 2564.0 | 2477.0 |

（d）臺中縣新社

| 品種 | 臺農選 2 號 | 臺農選 1 號 | 臺南 2 號 | 大畑早生 | 東陸 1 號 |
|---|---|---|---|---|---|
| 產量 | 2696.0 | 2616.0 | 2546.0 | 2505.0 | 2499.0 |

註 ——實線爲 5％之顯著標誌
　 ……虛線爲 1％之顯著標誌

表 9　民國51—52年第二期作區域試驗品種產量表

| 試驗地 | 試驗處理 | 臺農選 1 號 | 臺農選 2 號 | 臺南 2 號 | 東陸 1 號 | 大畑早生（對照） | 備註 |
|---|---|---|---|---|---|---|---|
| 臺北縣淡水 | 1 | 2604.0 | 2637.0 | 2352.0 | 2334.0 | 2484.0 | |
| | 2 | 2550.0 | 2682.0 | 2360.0 | 2328.0 | 2448.0 | |
| | 3 | 2586.0 | 2700.0 | 2388.0 | 2358.0 | 2448.0 | |
| | 平均 | 2580.0 | 2673.0 | 2400.0 | 2340.0 | 2460.0 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 臺北縣土城 | 1 | 2694.0 | 2799.0 | 2610.0 | 2498.0 | 2540.0 |
| | 2 | 2643.0 | 2814.0 | 2586.0 | 2490.0 | 2500.0 |
| | 3 | 2682.0 | 2784.0 | 2526.0 | 2500.0 | 2580.0 |
| | 平均 | 2673.0 | 2799.0 | 2574.0 | 2496.0 | 2540.0 |
| 新竹市湳子 | 1 | 2604.0 | 2556.0 | 2412.0 | 2274.0 | 2442.0 |
| | 2 | 2598.0 | 2532.0 | 2352.0 | 2274.0 | 2451.0 |
| | 3 | 2601.0 | 2529.0 | 2382.0 | 2292.0 | 2424.0 |
| | 平均 | 2601.0 | 2539.0 | 2382.0 | 2280.0 | 2439.0 |
| 臺中縣新社 | 1 | 2490.0 | 2535.0 | 2334.0 | 2160.0 | 2382.0 |
| | 2 | 2472.0 | 2550.0 | 2340.0 | 2220.0 | 239.04 |
| | 3 | 2472.0 | 2562.0 | 2364.0 | 2280.0 | 2421.0 |
| | 平均 | 2478.0 | 2549.0 | 2346.0 | 2220.0 | 2399.0 |

表10　民國51—52年第二期作各試驗地品種產量差異比較

（a）臺北縣淡水

| 品種 | 臺農選2號 | 臺農選1號 | 大畑早生 | 臺南2號 | 東陸1號 |
|---|---|---|---|---|---|
| 產量 | 2673.0 | 2580.0 | 2460.0 | 2400.0 | 2340.0 |

（b）臺北縣土城

| 品種 | 臺農選2號 | 臺農選1號 | 臺南2號 | 大畑早生 | 東陸1號 |
|---|---|---|---|---|---|
| 產量 | 2799.0 | 2673.0 | 2574.0 | 2540.0 | 2496.0 |

（c）新竹市湳子

| 品種 | 臺農選1號 | 臺農選2號 | 大畑早生 | 臺南2號 | 東陸1號 |
|---|---|---|---|---|---|
| 產量 | 2601.0 | 2539.0 | 2438.0 | 2382.0 | 2280.0 |

（d）臺中縣新社

| 品種 | 臺農選2號 | 臺農選1號 | 大畑早生 | 臺南2號 | 東陸1號 |
|---|---|---|---|---|---|
| 產量 | 2549.0 | 2478.0 | 2399.0 | 2346.0 | 2220.0 |

註 ——實線爲5％之顯著標誌
註 ……虛線爲1％之顯著標誌

## 六、討論與結論

所謂稻作的耐旱性，係指稻在生育期中，對土壤缺水及久旱等所發生被害的抵抗力，關於此種特性，對稻谷產量，有何影響，據本研究各種試驗資料加以分析檢討如下：

(1) 影響耐旱性强弱差異之因素

影響稻作耐旱性强弱之因素，有多種多樣，據嵐嘉一及高橋道太郎等諸氏之研究報告及本試驗有關資料綜合分析結果，概可畜列如下：

（A） 決定於作物細胞溶液之濃度及膠質物之量，全部被乾燥硬化之抵抗力的强弱如何。

（B） 關於作物體內水分蒸散防止作用强弱之因素。

（C） 作物根系之長短，影響耐旱性差異之因素。

作物根系之長度，較長及粗强者，其伸長力較强，容易慢延伸長至土壤較深地帶，而向該地帶吸收地下水分，以補充生育之需，如作物根系之長度較短及軟弱者，其伸長深度有限，且在表土淺地帶蓄積之地下水分亦較少，所以在表土蓄積有限水分若被吸收或蒸散完了時，無法再行補給，因此，根部較短品種，其耐旱性較弱。

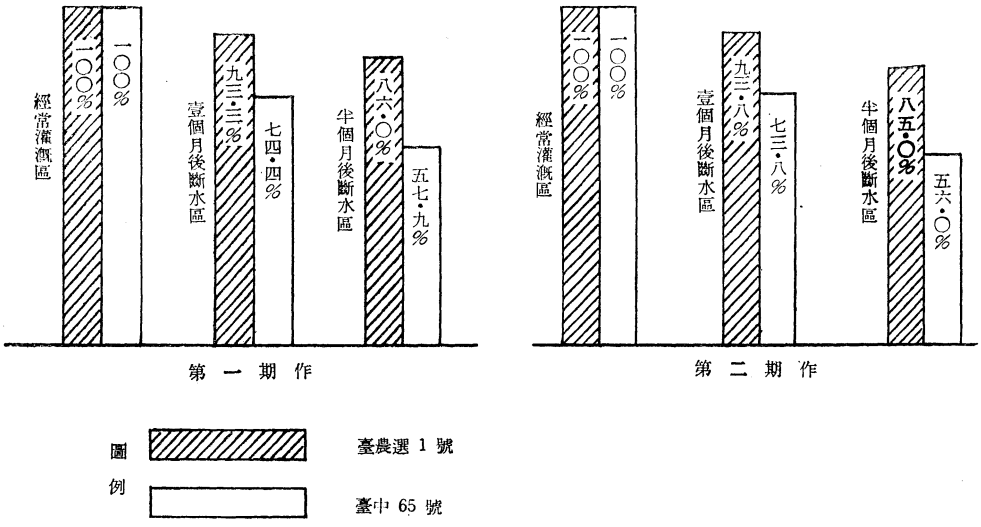
（d） 生育期間之長短影響耐旱性差異之因素

在缺水地區，生育期間比較長之品種，於生育期間中，遭受缺水乾旱之被害的機會較多，因此所發生旱害之程度，較爲嚴重，惟生育期間較短之品種，其被害之機會較少，故所發生之旱害程度亦較爲經微，因此，可資明瞭生育期間之長短，影響耐旱性差異之程度。

(2) 在田間斷水晒乾處理與產量之變化

據第一項之試驗，卽在水田揷秧栽培及斷水晒乾試驗之成績分析結果，供試品種中，臺中65號因隨斷水晒乾期間之延長，其產量愈減少，卽就經常灌溉區與半個月後斷水區之產量比較，一期作係100：57.9 二期作係100：56，其比率相差，各達40%餘之多惟臺農選 1 號，在同一試驗區之產量比較，一期作係100：86，二期作係100：86，二期作係100：85，其比率相差，僅爲 10—15 %而已（請參閱下圖），由此可資明瞭稻作品種間的耐旱性與產量有很大的關係。

圖 1 各種斷水處理及其產量差異比較




(3) 據地方試作及區域試驗，分析結果，各供試品種間之產量，各有不同，本試驗係在旱田直播栽培之狀況下進行試驗，僅靠天然下雨爲唯一灌溉水源，併無行人工灌溉，如此，可知該新育成品種實具有耐旱性之特質。

## 七 摘 要

(1) 臺農選1號及2號，係爲臺灣省農業試驗所，由 Baritol 之稻種以純系分離育成的耐旱早熟及耐肥抗病性較强之新品種。

(2) 臺灣選1號及2號，據表1之試驗成績分析結果，水稻臺中65號因隨斷水晒乾期間之延長，其生育不良，產量愈減少，惟臺農選1號其差異甚少，此可資明瞭生育上其需水量較水稻爲少，又據表3，5，7，9等之試驗成績觀之，該試驗係於旱田（畑）以直播栽培，而生育期間中，僅靠天然下雨爲唯一灌溉水源外，並未行人工灌溉，惟其生育及產量甚佳，由此可資證明該兩新品種係宜於缺水地帶栽培的抗旱優良新品種。

(3) 關於臺農選1號及2號之耕種上，在播種插秧期，未發生缺水之看天田，宜採用育苗插秧方法栽培，惟在播種插秧期已發生缺水之看天田，宜採用直播方法栽培，以防缺水水田休耕，以利增產之效果。

(4) 此兩新品種栽培上，不忌任何土質，就中在砂質壤土，輕粘質壤土及腐植土等表土較深之土壤栽培，可發揮較高之生產效果。

(5) 據本試驗成績分析結果，稻作品種間的耐旱性，影響產量差異甚大，故爲期本省缺水地區的稻作增產及地盡其用，今後應加强推行抗旱品種之直播栽培及研究現有水稻品種間之耐旱性。

## 參 考 文 獻

(1) 嵐嘉一，高橋道太郎（1951）作物育種の基礎と實際 P32—33
(2) 中山兼德（1964）農業及同藝之第39卷第9號 P1372—1376水稻の畑栽培
(3) 林清秀（1959）臺灣看天田的稻作改良研究（第一報）農業研究第八卷第二期
(4) 林清秀（1961）臺灣看天田的稻作改良研究（第二報）農業研究第十卷第四期
(5) 川上桂作（1919）日本農業社發行，特殊研究水陸稻增收法
(6) 川上三郎（1925）東京養賢堂發行實驗稻作栽培學
(7) 武田總七郎（1929）明文堂發行實驗稻作新說
(8) 渡邊，佐佐木孝司，伴野達也（1965）富民協會發刊，水稻の直まき栽培。

# THE BREEDING FOR DROUGHT RESISTANT RICE VARIETIES, TAINUNG SELECTION NO. 1 AND NO. 2

By

C. S. LIN

## SUMMARY

The breeing for drought resistant varieties has been considered to an effective method for improvement of rice yield in weather-depend paddy field in Taiwan.

In order to attain this purpose, mass selection for drought resistant lines, with an upland rice named Baritol (*japonica* type) was started at Taiwan Agricultural Research Institute in 1952.

Two desiaable lines, one being non-glutinous, the other glutinous were seleted in 1955, The selected lines were subjected for the test of drought resistance, yield and adaptability for ten yeare. In 1964, the two new strains were formally named as Tainung Sel. No. 1 and No. 2 with approvement of Taiwan Provincial Department of Agriculture and Forestory of Taiwan Provincial Government.

From the results of previous experiments, it was proved that, these varieties can stand heavey water shortage, therefore suitable to cultivate on weather-depend paddy field of montaneous region. The direct sowing method for this kind of paddy is recommended, while transplanting is recommended for ordinary paddy field.

Further, the new varieties gave good yield wehn planted in soild of deep surface layer or light texture such as sandy loams.

# 水稻品種產量對氮肥之反應及期作不同之差異

楊 方 平　陳 源 泉

## 一、緒　言

本省之水稻種植面積，數年來總是在74至77萬多公頃之間，民國52年則僅73萬多公頃，種植面積之擴展已很困難，故必須提高單位面積之產量以增加生產。單位面積產量能够達到最高，需要供給適量之肥料，過多或不足均不能發揮其生產力。本省對於水稻之施肥量試驗做得不少，但均採用某一兩個品種爲材料，而用較多之品種比較品種間對肥料之反應則缺乏資料。本省水稻之平均施肥量，據報告民國48年之氮、磷、鉀三要素施用量每公頃爲89—34—22公斤，以氮素用量言，已達到一般使用之標準量，再增加則不能爲一般品種所接受。今後之水稻栽培，將趨向多肥密植之制度，故品種改良之重要工作，爲育成對肥料反應强之品種，根據其耐肥程度施用肥料。筆者爲尋求對肥料反應强之品種，俾供育種選擇親本之參考，曾探討若干推廣栽培及新育成之蓬萊稻品種，在一般施用之標準氮肥量，及增半量與增倍量之氮肥處理，對於產量之反應，以及在第一期作及第二期作之不同氣候條件之差異情形，爰將結果整編，俾供參考。

本報告整理時承農藝系主任謝順景博士之鼓勵與細心賜正，謹此誌謝。

## 二、試驗材料及方法

本試驗所用之水稻，爲現在普遍栽培及若干新育成之粳稻品種（蓬萊稻），計臺北301號，臺北305號，臺北306號，新竹56號，新竹58號，臺中65號，臺中178號，臺中179號，臺中181號，臺南1號，臺南3號，高雄27號，高雄68號，農試21號，臺農38號等15品種，各品種分設三種不同之氮肥用量，即標準氮肥區，增半量氮肥區，增倍量氮肥區三種處理。標準氮肥區爲現在一般施用之氮肥數量，每公頃氮素80公斤，磷酸60公斤，鉀素50公斤，增半量或增倍量之氮肥區，除氮素增加外，磷鉀之用量均與標準區同。

本試驗爲民國51年第一期作及第二期作在本所舉行，田間排列採用裂區設計（Split Plot Design），氮肥用量爲主區，品種爲副區，每小區（副區）面積5平方公尺，種植5行，行長4公尺，行株距25×20公分，每叢5苗。一期作在3月8日移植，二期作在8月13日移植，氮肥用硫酸銨，磷肥用過磷酸鈣，鉀肥用硫酸鉀，施用法爲一般慣行之表面施肥，即以半量之硫酸銨及全量之過磷酸鈣及硫酸鉀，於整地時施爲基肥，尚餘半量之硫酸銨，則分在第一次及第二次中耕除草時施爲追肥。

## 三、試驗結果及討論

1. 供試品種在不同氮肥用量之產量及其分析：各供試品種在三級氮肥用量之穀粒產量，由各重複綜加平均，化算公頃公斤，列如第1表，並將各處理之產量，以變方分析法測驗其差異，結果列如第2表。

表 1　各供試品種在不同氮肥用量之穀粒產量

| 品種 | 第一期作 | | | | | 第二期作 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 標準氮肥區 | 加半量氮肥區 | 加倍量氮肥區 | 平均 | 百分數 | 標準氮肥區 | 加半量氮肥區 | 加倍量氮肥區 | 平均 | 百分數 |
| 臺北 301 號 | 5,145 | 4,620 | 3,595 | 4,453 | 101.8 | 3,245 | 3,205 | 3,185 | 3,212 | 98.0 |
| 臺北 305 號 | 5,360 | 4,970 | 4,280 | 4,870 | 111.3 | 3,630 | 3,595 | 3,575 | 3,600 | 109.9 |
| 臺北 306 號 | 5,115 | 4,855 | 4,370 | 4,780 | 109.3 | 3,595 | 3,180 | 3,245 | 3,340 | 101.9 |
| 新竹 56 號 | 4,435 | 4,655 | 3,880 | 4,323 | 98.9 | 3,465 | 3,515 | 3,415 | 3,465 | 105.7 |
| 新竹 58 號 | 4,995 | 4,535 | 4,160 | 4,563 | 104.3 | 3,330 | 3,035 | 2,800 | 3,025 | 93.2 |
| 臺中 65 號 | 4,870 | 4,620 | 3,630 | 4,373 | 100 | 3,090 | 3,255 | 3,485 | 3,277 | 100 |
| 臺中 178 號 | 5,080 | 4,795 | 4,155 | 4,677 | 106.9 | 3,455 | 3,550 | 3,015 | 3,340 | 101.9 |
| 臺中 179 號 | 4,730 | 4,395 | 3,435 | 4,187 | 95.7 | 2,743 | 2,800 | 2,555 | 2,700 | 82.4 |
| 臺中 181 號 | 4,895 | 4,735 | 3,695 | 4,442 | 101.6 | 3,085 | 3,340 | 2,610 | 3,012 | 91.9 |
| 臺南 1 號 | 4,450 | 4,250 | 3,389 | 4,027 | 92.1 | 3,385 | 3,275 | 3,200 | 3,287 | 100.3 |
| 臺南 3 號 | 5,330 | 4,765 | 3,780 | 4,625 | 108.2 | 3,195 | 3,145 | 3,110 | 3,150 | 96.1 |
| 高雄 27 號 | 4,800 | 4,745 | 3,820 | 4,455 | 101.8 | 3,285 | 3,155 | 3,160 | 3,200 | 97.7 |
| 高雄 68 號 | 4,360 | 4,410 | 3,260 | 4,010 | 91.7 | 3,385 | 3,320 | 3,120 | 3,275 | 99.9 |
| 農試 21 號 | 4,885 | 4,510 | 3,350 | 4,248 | 97.1 | 3,275 | 3,355 | 3,425 | 3,352 | 102.3 |
| 臺農 38 號 | 4,550 | 4,425 | 3,720 | 4,232 | 96.8 | 3,430 | 3,340 | 3,200 | 3,324 | 101.4 |

註：產量單位公頃公斤

表 2　供試品種及不同氮肥用量之產量變方分析

A. 第一期作

| 變因 | 自由度 | 平方和 | 均方 | F 值 | 理論 F 值 5% | 理論 F 值 1% |
|---|---|---|---|---|---|---|
| 區集 | 3 | 524,566.1 | 174,855.4 | | | |
| 氮肥用量 | 2 | 9,976,043.3 | 4,988,021.6 | 10.04** | 5.14 | 10.92 |
| 機差 (a) | 6 | 2,979,912.2 | 496,652.0 | | | |
| 品種 | 14 | 2,750,960.3 | 196,497.2 | 6.17** | 1.83 | 2.33 |
| 氮肥×品種 | 28 | 892,026.4 | 31,858.1 | 0.58 | 1.60 | 1.94 |
| 機差 (b) | 126 | 6,892,547.2 | 54,702.8 | | | |
| 總數 | 179 | 24,016,055.5 | | | | |

B. 第二期作

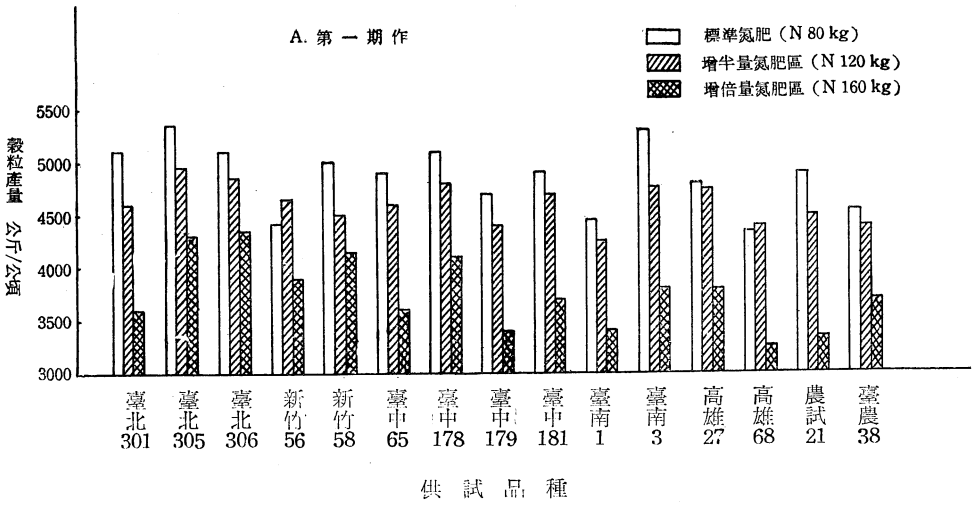
| 變因 | 自由度 | 平方和 | 均方 | F 值 | 理論 F 值 5% | 理論 F 值 1% |
|---|---|---|---|---|---|---|
| 區集 | 3 | 2,154,512.8 | 718,170.9 | | | |
| 氮肥用量 | 2 | 219,921.1 | 109,960.5 | 2.18 | 5.14 | 10.92 |
| 機差 (a) | 6 | 302,812.2 | 50,468.7 | | | |
| 品種 | 14 | 1,827,157.8 | 130,511.2 | 5.99** | 1.83 | 2.33 |
| 氮肥×品種 | 28 | 659,428.9 | 23,551.0 | 1.08 | 1.60 | 1.94 |
| 機差 (b) | 126 | 2,743,000.0 | 21,769.8 | | | |
| 總數 | 179 | 7,906,832.8 | | | | |

由表 1 結果，供試各品種之產量，均以第一期作爲高，而在不同之氮肥用量，不論第一期作或

第二期作，除了極少數之品種在增施氮肥區之產量稍有增加外，大部份之品種均較標準氮肥區之產量爲低，尤其是第一期作相差更大。由各試驗處理之產量變方分析結果，氮肥用量（主區）之F值，第一期作之差異極顯著，表示氮肥用量對產量有顯著之差異，但第二期作F值差異不顯著，可知二期作氮肥用量多少對產量之效應不如第一期作之大。至於供試各品種產量之差異，第一期作與第二期作結果相同，F值均達極顯著之程度，各供試品種間之生產力確有高低之差異。但品種與氮肥用量之交感作用，則一期作及二期作均未達顯著程度，由此結果，可知各品種產量對氮肥之反應差異不大。

2. 品種不同對氮肥反應之差異：本試驗所用之標準氮肥量，每公頃80公斤（合硫酸銨400公斤），爲一般試驗場所施用數量。各品種產量對增施氮肥用量之反應，其交感作用雖未達顯著程度，但由品種在不同氮肥用量之產量比較，及其差異百分數之分佈頻度可窺其大概。

圖1　供試品種在不同氮肥用量之產量比較



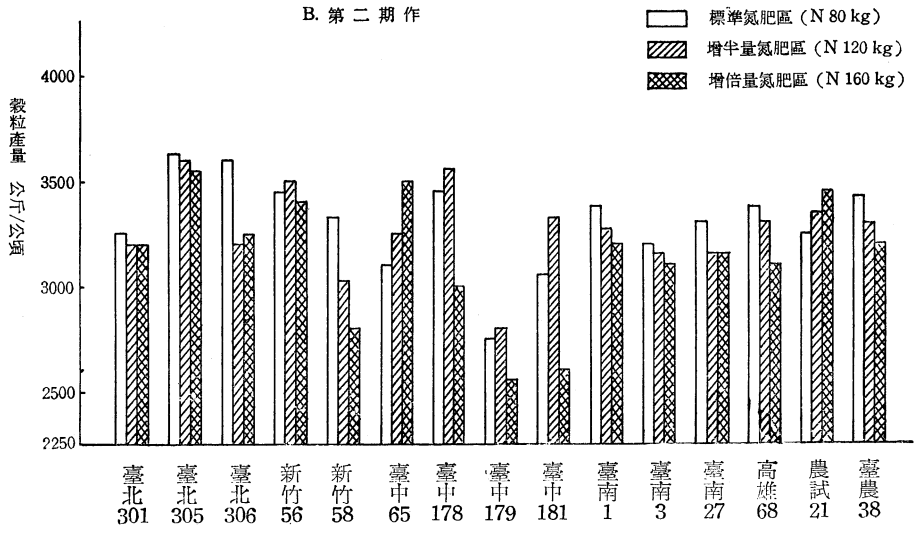



表3　供試品種增施氮肥對產量增加或減低之頻度分佈

| | 第一期作 | | | | | | | 第二期作 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 增產 1—5% | 減低 1—5% | 減低 5—10% | 減低 10—15% | 減低 15—20% | 減低 20—25% | 減低 25—30% | 增加 1—5% | 增加 5—10% | 減低 1—5% | 減低 5—10% | 減低 10—15% |
| 增半量氮肥區 | 高雄68<br>新竹56 | 高雄 27<br>臺農 38<br>臺中181<br>臺南 1 | 臺北306<br>臺中 65<br>臺中178<br>臺中179<br>臺北305<br>農試 21<br>新竹 58 | 臺北301<br>臺南 3 | | | | 新竹 56<br>臺中179<br>農試 21<br>臺中178 | 臺中 65<br>臺中181 | 臺北305<br>臺北301<br>臺南 3<br>高雄 68<br>臺農 38<br>臺南 1<br>高雄 27 | 新竹 58 | 臺北306 |
| 增倍量氮肥區 | | | | 新竹 56 | 臺北306<br>新竹 58<br>臺中178<br>臺農 38 | 臺北305<br>高雄 27<br>臺南 1<br>臺中181 | 高雄 68<br>臺中 65<br>臺中179<br>臺南 3<br>臺北301<br>農試 21 | 農試 21 | 臺中 65 | 臺北305<br>臺北301<br>新竹 56<br>臺南 3<br>高雄 27 | 臺南 1<br>臺農38<br>高雄68<br>臺北306<br>臺中179 | 臺中178<br>臺中181<br>新竹 58 |

第一期作在增施半量氮肥區，只有二個品種增加產量，其餘各品種之產量均減低，其減低百分數分佈在1—10%之間。在增施倍量氮肥區，全部之品種均爲減產，其減低程度分佈在10—30%之間。故第一期作品種產量對氮肥之反應差異很大。其中新竹56號對氮肥反應較强，在增半量氮肥區，產量尙增加5%左右；而在增施倍量氮肥區，其減產之程度仍爲最低。

第二期作各品種產量對氮肥之反應，在增施半量氮肥區，各品種產量之分佈，由增加1—10%至減低1—15%，增加產量者佔6個品種。在增施倍量氮肥量，其增產或減產之範圍，仍與增施半量氮肥區相似，只增產之品種數減少。故第二期作增施氮肥對各品種產量之增減程度，其差異不如第一期作之大。其中對氮肥反應較强之品種爲新竹56號，農試21號，臺中65號，尤其是臺中65號及農試21號，在增倍量氮肥區仍是增加產量之品種。

供試品種在不同期作對氮肥之反應，品種間似有差異，新竹56號第一期作及第二期作在增半量氮肥區均爲增產，在增倍量之氮肥區均爲減產，證明其對氮肥之反應程度一、二期作相似，但農試21號及臺中65號第一期作在增半量及增倍量氮肥區，其產量減低之程度很大，但第二期作不論在增半量或增倍量氮肥區均爲增產，尤其是臺中65號，其增產程度達5%及12%。

3. 增施氮肥對產量之效應及期作之差異：水稻對氮素之需要有一定限度，適量之施用可使產量達到最高，超過則產量受到影響，但土質及氣候之環境不同具有很大之影響力。本試驗以氮素每公頃80公斤爲標準，增施對產量之效應，由表2之變方分析結果，第一期作F值達極顯著之程度，但第二期作則未達顯著水準，可知第一期作氮肥施用量對水稻產量有顯著之差異，第二期則差異較少。據本所之水稻密植與施肥量試驗，其氮肥用量與本試驗同，第一期作氮肥用量對產量差異大，氮素增施產量均減低，第二期作則差異小，與本試驗之結果相符合。本試驗氮肥用量不同之產量差異，由各供試品種綜加平均，列如第4表比較之。

表 4　氮肥施用量對水稻產量之差異

A. 第一期作

| 氮肥用量 | 平均產量（公斤/公頃） | 差異 | | 百分數 |
|---|---|---|---|---|
| 標準氮肥區 | 4,866.7 | | | 100 |
| 增半量氮肥區 | 4,619.0 | 247.7 | | 94.9 |
| 增倍量氮肥區 | 3,767.0 | 1,099.4** | 851.7* | 77.4 |

L.S.D5%=623.4 1%=944.4

B. 第二期作

| 氮肥用量 | 平均產量（公斤/公頃） | 差異 | | 百分數 |
|---|---|---|---|---|
| 標準氮肥區 | 3,302.6 | | | 100 |
| 增半量氮肥區 | 3,267.7 | 34.9 | | 98.9 |
| 增倍量氮肥區 | 3,140.0 | 162.6 | 127.7 | 95.1 |

由上表結果，不論第一期作或第二期作，均以標準氮肥區之產量最高，而增施半量或增倍量之處理，其平均產量均減低。第一期作增施半量氮肥減低約 5 %，增施倍量則相差20%左右。第二期作增施半量氮肥相差 1 %，增施倍量區相差約 5 %。本試驗標準氮肥每公頃80公斤，爲本所及本省大部份試驗場所採用之標準量，在本試驗內其產量達到最高，增加至 120 公斤，其產量已減低，可見現在推廣栽培之品種，大部份都不能接受 120 公斤之氮素，但第二期作因爲氣候環境不同，增加到 120 公斤，其產量相差極少，故第二期作對氮肥之效應較第一期作爲差，其適宜之施用量，似不能與第一期作同。

## 四、結論及摘要

本試驗採用現在推廣栽培之蓬萊稻15品種，用三種不同氮肥用量，即每公頃氮素 80 公斤，120 公斤及 160 公斤，探討各品種對氮素肥料反應。田間試驗採用裂區設計，氮肥用量爲主區，品種爲副區，重複四次，所得結果如下：

1. 供試各品種之產量，經變方分析結果，一期作及二期作F值均極顯著，品種間產量確有差異。品種與氮肥用量之交感作用，一期作及二期作 F值均未顯著，各品種產量對氮肥反應之差異並不大。

2. 各品種產量對氮肥反應之差異，一期作較二期作爲大；一期作氮素 120 公斤之處理，只新竹56號之產量增加，高雄68號與標準區（N 80公斤）相若，其餘各品種之產量均減低，其減低範圍在1—10%。氮素 160 公斤之處理，各品種產量均減低，其減低範圍由 10—30% 。但第二期作氮素120公斤之處理，各品種產量由增加1—10%至減低1—15%。在氮素160公斤處理，其增產或減產之範圍仍與120公斤處理相同。其中臺中65號，農試21號，新竹56號，臺中181號，臺中 179 號對氮肥反應較强，尤其是臺中65號及農試21號，在160公斤之氮肥仍是增加產量。

3. 氮肥用量對產量之差異，一期作極顯著，二期作不顯著。由各品種平均結果，一期作氮素80公斤之處理產量最高，與120公斤之處理差異未顯著（增加 5 %），與160公斤之處理差異極顯著（增加23%）。二期作亦以氮素80公斤之處理產量最高，但與120公斤及160公斤之處理差異極少。故現在一般推廣栽培之品種，在第一期作大部份不能接受 120 公斤之氮素，但第二期作之效應較低，似可耐受稍多之數量，但適當用量應由試驗探討。

## 五、參考文獻

1. 臺灣省政府農林廳：臺灣農業年報　民國53年版
2. 臺灣省農業試驗所：水稻密植與施肥量試驗　民國49--51年年報
3. 張德慈（1961）：今後臺灣水稻品種改良之芻議　中華農學會報新第36期
4. 張德慈：今後提高水稻產量之途徑（油印本）　民國50年
5. 謝全份（1957）：耕鋤深淺施肥量及施肥法對水稻產量之影響　農業研究第7卷第3期
6. 張守敬、曾憲鼎（1953）：臺灣水稻肥料三要素試驗報告　農業研究第1卷第1期
7. 張守敬、曾憲鼎、步焕昇（1948）：臺灣省水稻三要素適量試驗結果檢討　農業試驗所彙報第7號

# STUDIES ON THE VARIETAL DIFFERENCE OF NITROGEN FERTILIZER RESPONSE TO THE YIELD OF RICE

By

F. P. YOUNG AND Y. C. CHEN

## SUMMARY

1. In order to study the effect of different nitrogen fertilizer levels on the yield of rice, 15 popularly cultivated ponlai varieties were planted under three fertilizer levels i.e. 80, 120 and 160 kg per hectare. Spilit plot design in which fertilizer was treated as main plot and variety as sub-plot with four replications was employed.

2. The grain yield was found to differ from different varieties; but the varietal difference in fertilizer response was not so prominent in view of insignificant interaction between variety and fertilizer level.

3. In the first crop, Hsinchu No. 56 and Kaoshung No. 68 gave the higher yield than control but all other varieties showed 1 to 10% decrease in grain yield in the plot applied with 120 kg of nitrogen. Varieties in 160 kg showed 10 to 30% reduction in yield.

In the second crop, Taichung No. 65, Nungshi No. 21, Hsiuchu No. 56, Taichung 181, Taichung No. 179 gave the higher yield than control, while other varieties showed 1 to 10% decrease in the plot applied with 120 kg of nitrogen fertilizer. In 160 kg plot, except Nungshi No. 21 and Taichung No. 65 which showed a little increase, all other varieties showed different degree of reduction in grain yield. From these results, it is inferred that the nitrogen response to the yield of respective variety in the first crop is more prominent than that of the second crop.

4. The highest average yield was found in control (N 80 kg) in the first crop; same is true in the second crop though not so conspicuous. It is concluded that an addition application of nitrogen fertilizer up to 160 kg seemed to be not able to increase the yield in the first crop. However, it is effective in the second crop. Further studies are needed to determine the standard amount of nitrogen fertilizer for second crop.

# 水稻尿素肥料分施試驗

楊　遜　謙

## 一、前　言

本省水稻氮素肥料向以硫酸銨爲主，尿素應用甚少。自1964年設立在苗栗之尿素工廠開始生產大量的尿素肥料，足供本省自給。唯本省農民尚不習慣於尿素之施用，其原因卽對尿素用法未盡了解，似爲效果較硫酸銨差，致歷年來尿素肥料未被重視。目前一般農家化學肥料多用爲追肥或當基肥，用在土壤表面，如用尿素更易流失。李等(1957)、(1960)指出尿素肥料若以深層施肥，與土壤混合均勻，其產量並不比硫酸銨爲差。換句話說，卽施用尿素肥料，基肥應以全層施肥，追肥則排乾田水，在中耕時盡量翻入土壤中，二、三日後再灌水，卽肥分流失較少。又尿素爲中性肥料，連用不像硫酸銨在土壤中遺留有害作物之硫酸根。鹽谷（1949）及橋本（1954）亦謂尿素肥料在酸性老朽田施用，其效果較硫酸銨佳，因此尿素肥料只要用法適當對土壤無損並且可提高產量。本省年來水稻耕作制度已逐漸邁向重肥密植之趨勢，過去一般施肥法必使水稻倒伏而產量減低。張(1964)謂水稻肥料分施可使水稻不倒伏而增加產量，故尿素肥料若應用分施法，其效果可能較佳。本省已能供應大量尿素肥料，但目前對尿素有關試驗尚少，應加强研究改善合理之施用法，配合尿素之生產，取代硫酸銨之地位，以節省外滙。作者有鑑於此，於民國53年第一期作及第二期作設計尿素肥料分施法試驗，爰將結果篇成報告，藉供同道之參考。本試驗進行時，得劉邦淵君、林三枝小姐二位全力協助，文成又蒙張主任萬來剴切硃正，謹此致謝。

## 二、試驗方法

1. 供試品種：嘉農242號。
2. 田間設計：隨機區集法，重複八次，小區面積 4×2.5公尺合 $\frac{1}{1000}$ 公頃，栽培距離 25×20 公分，每株 5 支苗，基肥在插秧前深施土壤中，追肥在排水後配合中耕除草，但在第三次中耕除草後卽排乾水後施用。
3. 施肥量公斤/公頃：第一期作N80P40K40，第二期作以配合重肥改爲N100P50K50。

## 三、試驗設計

本試驗分爲六處理

A. CK硫酸銨標準法半作基肥，半作追肥插秧後I期30日 II 期20日施用。

B. 尿素½基肥，½於插秧後I期50日追肥 II 期40日追肥。

C. 尿素½基肥，½於插秧後I期60日追肥 II 期45日追肥。

D. 尿素⅕基肥，⅘ 於插秧後I期30日 II 期20日第一次追肥，⅘I 期 50日 II 期45日作第二次追肥。

E. 尿素½插秧後 7 日第一次追肥，½插秧後I期30日 II 期25日第二次追肥。

F. 尿素¾插秧後 7 日追肥，¼I期30日 II 期20日後追肥，¼I期60日 II 期45日後追肥。

## 四、試驗結果及討論

1. 生育調查表

| 第一期作 | | | | | | | | 第二期作 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 處理 | 生育狀況 | 生育50日 株高 | 生育50日 分蘖 | 收穫時 桿高 | 收穫時 穗數 | 抽穗期 | 生育日數 | 處理 | 生育狀況 | 生育40日 株高 | 生育40日 分蘖 | 收穫時 桿高 | 收穫時 穗數 | 抽穗期 | 生育日數 |
| 1 | 中下 | 45.1 | 11.9 | 104.4 | 9.0 | 5/8 | 101 | 1 | 中 | 86.5 | 10.3 | 123.8 | 10.3 | 9/28 | 65 |
| 2 | 中 | 50.6 | 12.9 | 109.8 | 12.0 | 5/9 | 102 | 2 | 中 | 88.3 | 10.5 | 125.0 | 10.5 | 9/25 | 62 |
| 3 | 中 | 47.2 | 12.0 | 105.0 | 9.2 | 5/8 | 101 | 3 | 中 | 87.4 | 9.9 | 123.7 | 9.3 | 9/27 | 64 |
| 4 | 中 | 47.1 | 11.7 | 114.7 | 10.2 | 5/9 | 102 | 4 | 中 | 86.7 | 11.5 | 124.6 | 10.4 | 9/27 | 64 |
| 5 | 中 | 50.1 | 14.3 | 109.6 | 11.1 | 5/9 | 102 | 5 | 中 | 95.3 | 12.4 | 127.3 | 10.5 | 9/28 | 65 |
| 6 | 中 | 49.1 | 14.4 | 113.5 | 12.0 | 5/9 | 102 | 6 | 中 | 88.3 | 10.7 | 125.0 | 10.1 | 9/28 | 65 |

2. 產量表

| 期作別 | 處理 | I | II | III | IV | V | VI | VII | VIII | 合計 | 平均 | 公頃產量 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 第一期作 | 1 | 4,646 | 4,383 | 4,104 | 3,800 | 4,959 | 5,940 | 4,059 | 4,145 | 36,036 | 4,504.5 | 4,504.5 |
| | 2 | 5,971 | 5,428 | 5,520 | 4,376 | 5,823 | 5,490 | 5,646 | 5,063 | 43,317 | 5,414.6 | 5,414.6 |
| | 3 | 4,697 | 4,450 | 4,275 | 4,136 | 5,048 | 4,590 | 4,011 | 3,612 | 34,819 | 4,352.4 | 4,352.4 |
| | 4 | 5,459 | 5,072 | 4,842 | 5,193 | 6,816 | 5,544 | 5,250 | 5,133 | 43,309 | 5,413.6 | 5,413.6 |
| | 5 | 5,301 | 5,940 | 4,985 | 5,162 | 6,230 | 6,021 | 4,726 | 4,956 | 43,321 | 5,415.1 | 5,415.1 |
| | 6 | 5,879 | 4,867 | 5,255 | 5,499 | 6,300 | 3,934 | 5,612 | 5,979 | 43,325 | 5,415.6 | 5,415.6 |

L. S. D. 5%=512.78　　L. S. D. 1%=688.09

| 期作別 | 處理 | I | II | III | IV | V | VI | VII | VIII | 合計 | 平均 | 公頃產量 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 第二期作 | 1 | 3,204 | 3,540 | 3,195 | 3,083 | 3,708 | 2,520 | 2,658 | 3,940 | 25,848 | 3,231,0 | 3,231.0 |
| | 2 | 3,996 | 3,961 | 3,528 | 3,647 | 3,311 | 3,234 | 3,467 | 3,538 | 28,682 | 3,585.3 | 3,585.3 |
| | 3 | 3,381 | 3,549 | 3,446 | 2,888 | 3,225 | 2,697 | 3,284 | 3,402 | 25,872 | 3,234.0 | 3,234.0 |
| | 4 | 3,393 | 3,694 | 3,196 | 3,253 | 3,195 | 3,304 | 3,564 | 2,848 | 26,447 | 3,305.9 | 3,305.9 |
| | 5 | 4,077 | 3,599 | 3,818 | 2,831 | 3,452 | 5,133 | 3,658 | 3,350 | 29,918 | 3,739.8 | 3,739,8 |
| | 6 | 3,593 | 3,524 | 3,476 | 3,335 | 3,256 | 3,584 | 3,663 | 3,186 | 27,617 | 3,452.1 | 3,452.1 |

3. 稻谷產量分析表

（第一期作）

| 變因 | 自由度 | 平方和 | 均方和 | F 值 |
|---|---|---|---|---|
| 區組 | 7 | 6,154,335 | 879,191 | |
| 處理 | 5 | 10,469,251 | 2,093,850 | 8.15** |
| 機差 | 35 | 8,986,979 | 256,771 | |
| 總計 | 47 | 25,610,565 | | |

8.15>3.59>2.48極顯著

（第二期作）

| 變因 | 自由度 | 平方和 | 均方和 | F 值 |
|---|---|---|---|---|
| 區組 | 7 | 924,694.67 | 132,099.24 | |
| 處理 | 5 | 1,710,323.92 | 342,064.78 | 2.09 |
| 機差 | 35 | 5,715,396.08 | 163,297.03 | |
| 總計 | 47 | 8,350,414.67 | | |

2.09<2.48<3.58不顯著

4. 尿素施用對稻谷產量及其構成因素與主要農藝性狀之影響

| 期作別 | 處理 | 乾谷產量 | | | 產量構成因素 | | | 主要農藝性狀 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 產量(公斤/公頃) | 指數 | 等次 | 穗數 | 一穗粒數 | 千粒重(克) | 生育日數(日) | 株高(公分) | 穗重(克) | 穗長(公分) | 分蘗(支) |
| 第一期作 | 1 | 4,504.5 | 100.0 | 5 | 9.0 | 142 | 28.2 | 101 | 104.4 | 3.9 | 23.9 | 11.9 |
| | 2 | 5,414.6 | 120.2 | 3 | 12.0 | 139 | 28.2 | 102 | 109.8 | 3.8 | 23.4 | 12.9 |
| | 3 | 4,352.4 | 96.6 | 6 | 9.2 | 132 | 29.4 | 101 | 105.0 | 3.8 | 23.7 | 12.0 |
| | 4 | 5,413.6 | 120.2 | 4 | 10.2 | 147 | 28.4 | 102 | 114.7 | 4.1 | 23.2 | 11.7 |
| | 5 | 5,415.1 | 120.2 | 2 | 11.1 | 135 | 28.7 | 102 | 109.6 | 3.7 | 23.3 | 14.3 |
| | 6 | 5,415.6 | 120.2 | 1 | 12.0 | 136 | 29.2 | 102 | 113.6 | 3.7 | 23.1 | 14.4 |
| 第二期作 | 1 | 3,231.0 | 100.0 | 6 | 10.3 | 166.3 | 29.5 | 65 | 123.8 | 4.58 | 24.6 | 10.3 |
| | 2 | 3,585.3 | 111.0 | 2 | 10.5 | 178.7 | 28.4 | 62 | 125.0 | 4.45 | 25.8 | 10.5 |
| | 3 | 3,234.3 | 100.1 | 5 | 9.3 | 160.3 | 30.2 | 64 | 123.7 | 4.53 | 24.1 | 9.9 |
| | 4 | 3,305.9 | 102.3 | 4 | 10.4 | 163.6 | 29.0 | 64 | 124.6 | 4.48 | 24.4 | 11.5 |
| | 5 | 3,739.8 | 115.7 | 1 | 10.8 | 160.1 | 29.3 | 65 | 127.3 | 4.25 | 24.6 | 12.4 |
| | 6 | 3,452.1 | 106.8 | 3 | 10.1 | 161.9 | 29.5 | 65 | 125.0 | 4.51 | 24.6 | 10.7 |

1. 由本試驗所得結果得知，尿素分次施用較硫酸鉀標準使用法，每公頃乾谷量第一期作增產697.8公斤，達15.5%，第二期作增產232.5公斤，達7.2%，依本試驗所得結果似可推翻過去一般認爲尿素肥效，較硫酸鉀爲低之不正確觀念。張1964認爲水稻肥料分施法較慣行法，在第二節以後節間縮短，株高低矮，減少倒伏，稔實率佳，在本試驗中尿素肥效勝過慣行施肥法之原因，似爲尿素分施（即分數次施用）之故。

2. 由產量構成因素之調查結果得知，尿素分施可增產之主要原因，爲每株穗數之增加，而尿素分施不影響生育日數，但株高稍有增加跡象。

3. 根據本試驗所得結果可謂尿素最合理最有效之施用次數，在第一期作以3次，第二期作2次爲佳，惟2次與3次無顯著差異，施用基肥與不施用基肥不影響肥效，每次施用量以早期宜多，而後期漸少較爲安全。

4. 第一期作處理6，第二期作處理5產量最高，每公頃較對照區第一期作增產911.0公斤達20.2%，第二期作增產508.8公斤達15.7%，處理間產量在第一期作極爲顯著，而第二期作亦極接近5%顯著值。

5. 尿素之施用與次數頗有關係，在第一期作因其生育期間較長，以處理6即分施次數3次，最後一次在揷秧後60日施肥，恰好幼穗分化期間，第二期作處理5分2次使用，最後一次在分蘗盛期使用爲佳，按戶刈松尾（1963）指出溫度與施肥頗有關係，本省第一期作初期低溫吸肥力較弱，後期高溫吸肥力較强，因此在初期所施肥料不易吸收，故在幼穗時期追肥效果最大，第二期作在初期高溫，所吸收肥分較多，後期低溫吸收力較弱，似早期施肥爲宜。

6. 本試驗未盡了解之地方尙多，待今後繼續試驗，以探求尿素最合理最有效之施用法。

## 五、摘　　要

1. 尿素肥料分施較硫酸銨肥料可提高產量。
2. 水稻尿素分施次數，第一期作以3次，二期作2～3次。
3. 尿素用作基肥與追肥不影響肥效，但分施量以後期較少爲安全。
4. 尿素施肥次數與時期頗有關係，在第一期作以處理6，第二期作以處理5爲佳。

## 參 考 文 獻

1. 李蘭帝、許新民、林金燦、林國謙（1957），尿素肥料施肥法試驗第1報農業研究第6卷第4期。
2. 李蘭帝、林金標、林國謙、徐水泉（1960）第2報尿素肥料施肥法試驗農業研究第9卷2期。
3. 鹽谷正邦（1949）尿素肥料農業及園藝第24卷8號。
4. 橋本重久（1954）水稻に對する尿素の使ひ方，農業及園藝第29卷10號。
5. 張萬來、楊遜謙（1964）水稻肥料分施與栽植密度對產量，產量構成因子及其他農藝性狀之效果，農業研究第13卷1期。
6. 戶刈義次，松尾孝嶺（1963）稻作講座3朝倉書店。

# EXPEPIMINT ON THE TIMING OF UREA APPLICATION IN RICE

by

S. C. YANG

## SUMMARY

An investigation was carried out in both crops of 1964 at Chiayi Agricultural Experiment Station to evaluate the effect of the timing of urea application on rice. The rice variety Chianung 242 was subjected to the following treatments:

A. Ammonium sulfate. 1/2 applied as a basal dressing, and the balance as a top-dressing at 30 days (1st. crop) and 20 days (2nd crop) after transplanting. (check).

B. Urea. 1/2 applied as a basal dressing, and the balance as a top dressing at 50 days (1st. crop) and 40 days (2nd. crop) after transplanting.

C. Urea. 1/2 applied as a basal dressing, and the balance as a top dressing at 60 days (1st. crop) and 45 days (2nd. crop) after transplanting.

D. Urea. 1/5 applied as a basal dressing, 2/5 as first top-dressing at 30 days (1st. crop) and 20 days (2nd. crop), and 2/5 as second top-dressing at 50 days (1st. crop) and 45 days (2nd. crop) after transplanting.

E. Urea. 1/2 applied as first top-dressing at 7 days after transplanting, and the balance as second top-dressing at 30 days (1st. crop) and 25 days (2nd. crop) after transplanting.

F. Urea. 1/2 applied as first top-dressing at 7 days after transplanting, 1/4 as second top-dressing applied at 30 days (1st. crop) and 20 days (2nd. crop), and the remaining 1/4 as third top-dressing at 60 days (1st. crop) and 45 days (2nd. crop) after transplating.

The total amount of fertilizers used in this experiment was 80, 40, 40, and 100, 50, 50, kg per hectare for N, P, K, at first and second crops, respectively. The plot was 4×2.5 m in size which was equal to 10 $m^2$ or 1/1,000 hectare. Approximately 5 seedlings were transplanted in each hill. The distance between rows was 25 cm while that of hills was 20 cm. The experiment was arranged in randomized blocks with 8 replications. Some important findings are summerized below:

1. When split-applicated, urea could produce bettey yield than ammonium sulfate, the main source of nitrogen fertilizer in Taiwan.

2. Urea fertilizer splitted 3 times in the first crop and 2 to 3 times in the second crop gave the most astisfactory results.

3. Urea fertilizer used either as a basal dressing or top-dressing appeared to be equally effective. However, heavier dosage at the later top-dressing seemed more profitable.

4. There was a close association between the times and the time of urea application. Treatment F in the first crop and treatment E in the second crop produced the highest yield due presumably to applying urea at the critical stages of rice growth namely, the panicle primordia differentiation in the former, and the maximum tillering in the latter.

# 積穀害蟲藥劑防治及藥劑對小白鼠口服試驗

林　　檳

## 前　　言

積穀害蟲在本省加害儲穀之嚴重性，因倉庫未臻理想，以致其孳生繁殖肆害；尤以中南部地區之發生情形更爲嚴重，不論米、穀或雜糧均能爲害。爲求減少米穀儲藏之損失，自從採用靈丹粉劑(Lindane) 混拌積穀儲藏以來收效頗著。惜該藥劑對於部份害蟲未能達到理想之治蟲功效，且今後是否發生害蟲對藥劑產生抗藥性，或有其他原因而未能繼續使用時，則應另行尋覓適當藥劑以代替之。因此，作者自1959年8月至1962年8月曾在室內及倉庫以多種粉劑與靈丹粉劑比較，並經進行該等藥劑對小白鼠口服試驗，茲將3年來所獲結果報告於後，以供同道之參考。

本試驗在倉庫進行試驗時承農復會補助經費，及臺灣省糧食局供借稻穀，在臺北縣之木柵、新店、中和等農會倉庫進行試驗時，各農會倉庫負責人賜予多方協助，謹此致謝。

## 一　室內試驗

### (一)　試驗材料及方法

供試藥劑：

表1.　藥劑種類及濃度

| 藥劑名稱 | 有效成分(%) | 製造廠商 | 試驗濃度 |
|---|---|---|---|
| Malathion | 95 | 美國American Cyanmid Company | 0.2%8ppm(1:250),4ppm(1:500), 2ppm(1:1,000). |
| Premium malathion | 1 | 日本庵原農藥株式會社 | 0.2%10ppm(1:200),8ppm(1:250), 6ppm(1:333),4ppm(1:500). 1%8ppm(1:1,250),6ppm(1:1,666), 4ppm(1:2,500). |
| Alodan | 5 | 德國Farbewrke Hoechst AG. | 2.5%50ppm(1:500),31.2ppm(1:800), 25ppm(1:1000). 5%62.5ppm(1:800),50ppm(1:1,000), 33.3ppmm(1:1,500),25ppm(1:2,000). |
| Bromodan | 5 | 同　上 | 5%62.5ppm(1:800),50ppm(1:1,000), 33.3ppm(1:1,500),25ppm(1:2,000). |
| Lindane | 99.8 | 美國Chemical Insecticide Corporation | 0.2%8ppm(1:250),4ppm(1:500), 2.5ppm(1:800),2ppm(1:1,000). |
| Lindane + Malathion | 0.1 0.1 | 同上廠商出品濃度經自行調配 | 0.2%4ppm(1:500). |
| Alodan + Premium malathion | 2.5 0.2 | | 2.7%67.5ppm(1:400),54ppm(1:500), 36ppm(1:750). |
| Bromodan + Premium malathion | 2.5 0.2 | | 2.7%67.5ppm(1:400),54ppm(1;500), 36ppm(1:750). |
| Lindane + Premium malathion | 0.2 0.2 | | 0.4%8ppm(1:500),5ppm(1:800), 4ppm(1:1,000). |

上表所列粉劑及工業級藥劑，以丙酮將原藥溶解，使用滑石粉稀釋調配試驗所需之有效成分，存於褐色玻璃乾燥器中，以備試用。

供試昆蟲：本試驗所用積穀害蟲，選擇主要發生者，計有穀象、穀蠹、擬穀盜等成蟲三種，均

採自臺北縣木柵鄉農會及臺灣省農工企業股份有限公司基隆粉料廠等倉庫儲藏之穀物中。先行在室內以糙米及玉米分別飼育繁殖之。

試驗材料：本試驗混拌藥劑使用蓬萊糙米及稻穀，在供試前先行篩選，用電扇吹去其中的穀殼及雜物；糙米則裝入10公升細口玻璃瓶，以凡士林塗於瓶蓋蓋緊以防濕氣，再入－5°C 冰箱內冷藏二星期，取出備供試用。冷藏目的，在使附存之害蟲各蟲期全部凍斃，以免混拌粉劑後放蟲，發生檢查時之混亂。

試驗方法：米穀混拌粉劑係選用 3 公升及10公升細口瓶，將米穀與所需比例粉劑倒入瓶內，瓶口用橡皮塞塞緊，以兩手左右上下搖動15分鐘，使其粉劑均勻混合後，倒出各秤 200 克分組四次重複，以供各藥劑毒效試驗用。藥劑殘餘毒效持久性測定者，則將各不同濃度粉劑處理，分別各樣20公斤盛裝入一麻袋，另一袋不混拌任何粉劑供作對照，儲放在室內 28～30°C 定溫環境下（與一般倉儲穀堆中之溫度相似），每隔月一次，自各袋內取出米穀各 200 克，分組三次重複，盛入玻璃筒（口徑9cm高度17cm）內，然後放入上列三種害蟲（成蟲），各約50～200頭，玻璃筒口用細布蓋捆緊，移入29～30°C 定溫箱內，經96、120、144、168小時，各取出檢查一次，將不能動之成蟲撥出，於雙管放大鏡下檢查，其觸角或足仍能彈動者均列入活蟲計算，再放入米穀中繼續定溫飼養至檢查結束爲止，結果計算各組死亡率。

(2) 試驗結果及討論

表 2. 藥劑混拌糙米對積穀害蟲毒效試驗 (1959)

| 藥劑 (dust) | 濃度 (ppm) | 供試蟲數 *Sitophilus oryzae* | 供試蟲數 *Tribolium castaneum* | 接觸時間與死亡率 (%) 96小時 *Sitophilus oryzae* | 96小時 *Tribolium castaneum* | 144小時 *Sitophilus oryzae* | 144小時 *Tribolium castaneum* |
|---|---|---|---|---|---|---|---|
| 0.2% Malathion | 8 | 98 | 99 | 100.0 | 99.8 | 100.0 | 100.0 |
| | 4 | 100 | 100 | 100.0 | 96.2 | 100.0 | 98.5 |
| | 2 | 104 | 98 | 98.3 | 26.9 | 100.0 | 34.5 |
| 0.2% Lindane | 8 | 101 | 75 | 100.0 | 12.4 | 100.0 | 17.8 |
| | 4 | 101 | 101 | 100.0 | 1.9 | 100.0 | 2.5 |
| | 2 | 102 | 99 | 99.0 | 0.6 | 99.8 | 3.5 |
| Check | — | 101 | 98 | 9.2 | 1.3 | 10.6 | 1.7 |
| (L. S. D.) | | | | 5% 30.6 | 1.4 | 5.8 | 16.3 |
| | | | | 1% 41.9 | 2.0 | 7.9 | 22.4 |

表 3. 藥劑混拌糙米對積穀害蟲毒效試驗 (1959)

| 藥劑 (dust) | 濃度 (ppm) | 供試蟲數 *Sitophilus oryzae* | 供試蟲數 *Rhizopertha dominica* | 供試蟲數 *Tribolium castaneum* | 接觸時間與死亡率 (%) 96小時 *Sitophilus oryzae* | 96小時 *Rhizopertha dominica* | 96小時 *Tribolium castaneum* | 144小時 *Sitophilus oryzae* | 144小時 *Rhizopertha dominica* | 144小時 *Tribolium castaneum* |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.2% Malathion | 4 | 50 | 50 | 50 | 100.0 | 52.5 | 89.9 | — | 61.4 | 97.9 |
| 0.1% Malathion+ 0.1% Lindane | 4 | 51 | 52 | 50 | 100.0 | 78.4 | 29.8 | — | 84.0 | 40.6 |
| 0.2% Lindane | 4 | 52 | 50 | 49 | 100.0 | 87.4 | 7.1 | — | 92.5 | 11.2 |
| Check | — | 50 | 50 | 51 | 3.0 | 1.5 | 0.5 | — | 2.1 | 1.5 |
| (L. S. D.) | | | | | 5% 81.9 | 8.1 | 29.1 | — | 18.1 | 8.6 |
| | | | | | 1% 82.3 | 11.6 | 41.9 | — | 26.0 | 12.4 |

表 4. 藥劑混拌糙米殘餘毒效持久性試驗 (1959)

| 藥劑 (dust) | 濃度 (ppm) | 儲藏期間 (月) | 供試蟲數 *Sitophilus oryzae* | 供試蟲數 *Rhizopertha dominica* | 供試蟲數 *Tribolium castaneum* | 接觸時間與死亡率 (%) 96小時 *Sitophilus oryzae* | 96小時 *Rhizopertha dominica* | 96小時 *Tribolium castaneum* | 168小時 *Sitophilus oryzae* | 168小時 *Rhizopertha dominica* | 168小時 *Tribolium castaneum* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2% Malathion | 8 | 1 | 100(100) | 46(49) | 45(50) | 53.5(100.0) | 2.7(50.2) | 8.9(99.0) | 95.0(100.0) | 8.6(61.4) | 24.7(100.0) |
| | | 2 | 100(100) | 49(50) | 50(48) | 19.2(100.0) | 6.1(50.9) | 1.5(97.9) | 67.7(100.0) | 12.7(54.1) | 3.0(100.0) |
| | 4 | 1 | 100(100) | 49(49) | 46(49) | 4.0 (98.2) | 3.9(22.2) | 6.6(84.6) | 26.2(100.0) | 5.8(30.7) | 14.4 (89.2) |
| | | 2 | 100(100) | 48(47) | 48(49) | 4.0 (94.5) | 1.0(10.8) | 0(69.9) | 6.7 (98.3) | 1.5(14.1) | 0 (82.9) |
| | 2 | 1 | 100(100) | 46(38) | 48(49) | 1.0 (74.0) | 1.3 (3.4) | 1.1(14.7) | 1.3 (87.0) | 1.2 (4.1) | 1.5 (23.7) |
| | | 2 | 100(100) | 47(49) | 49(49) | 2.0 (65.7) | 0.5 (2.6) | 0 (4.7) | 4.0 (78.7) | 4.8 (3.6) | 0 (5.7) |
| 0.2% Lindane | 8 | 1 | 100(100) | 46(49) | 49(46) | 98.2(100.0) | 64.2(92.3) | 5.7(14.2) | 100.0(100.0) | 84.9(99.5) | 13.9 (24.5) |
| | | 2 | 100(100) | 49(50) | 49(48) | 88.0 (96.5) | 55.1(90.1) | 3.5 (5.7) | 100.0(100.0) | 67.5(97.1) | 4.6 (6.7) |
| | 4 | 1 | 100(100) | 51(48) | 47(45) | 90.2(100.0) | 52.9(76.2) | 10.6(12.7) | 100.0(100.0) | 72.9(92.2) | 18.7(20.9) |
| | | 2 | 100(100) | 47(49) | 47(44) | 27.7 (70.7) | 29.2(71.2) | 0.5 (3.1) | 45.5 (92.5) | 49.8(88.2) | 1.6 (4.1) |
| | 2 | 1 | 100(100) | 44(49) | 47(47) | 48.0 (90.7) | 25.8(63.2) | 6.3 (2.4) | 69.7 (99.7) | 47.9(75.5) | 7.8 (6.5) |
| | | 2 | 100(100) | 45(48) | 45(48) | 17.7 (56.5) | 13.2(53.0) | 0.5 (3.6) | 51.2 (83.5) | 43.2(61.5) | 0.5 (4.9) |
| Check | — | 1 | 100 | 45 | 49 | 1.0 | 1.8 | 0.6 | 1.3 | 2.5 | 2.2 |
| | | 2 | 100 | 49 | 47 | 2.0 | 0.5 | 0.5 | 1.0 | 0.5 | 1.1 |
| (L. S. D.) | | 1 | 5% 1.4 (1.4) | | | 1.4(58.1) | 13.8(12.1) | 4.6 (60.7) | 1.4 (36.1) | 7.1(11.7) | |
| | | | 1% 2.0 (2.0) | | | 2.0(79.6) | 19.0(16.6) | 6.4 (83.2) | 2.0 (49.5) | 9.8 (16.) | |
| | | 2 | 5% 15.1 (1.4) | | | 1.4(11.2) | 1.9 (9.8) | 10(6 (1.4) | 15.3 (9.0) | 2.2 (1.4) | |
| | | | 1% 20.7 (2.0) | | | 2.0(15.3) | 2.6(13.5) | 14.6 (2.0) | 21.0(12.4) | 3.0 (2.0) | |

註：括弧內之數字係每月進行測定毒效時，以相同粉劑濃度處理糙米後，直接放入相同之害蟲，藉與經儲藏者之殘餘毒效逐漸減少情形之比較。

表5. 藥劑混拌糙米對積穀害蟲毒效試驗 (1959)

| 藥劑 (dust) | 濃度 (ppm) | 供試蟲數 | | | 接觸時間與死亡率 (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 96 小時 | | | 144 小時 | | |
| | | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* |
| 5% Alodan | 50 | 103 | 52 | 50 | 100.0 | 97.8 | 1.0 | 100.0 | 98.5 | 2.0 |
| | 33.3 | 102 | 49 | 50 | 99.7 | 65.5 | 0.5 | 100.0 | 97.0 | 1.0 |
| | 25 | 104 | 49 | 50 | 97.6 | 93.2 | 0.5 | 100.0 | 97.9 | 1.5 |
| Check | — | 104 | 47 | 50 | 4.8 | 23.4 | 1.0 | 10.0 | 38.7 | 1.5 |
| (L. S. D.) | | | | | 5% 5.6 | 28.8 | 1.9 | 1.6 | 1.6 | 2.5 |
| | | | | | 1% 8.0 | 41.5 | 2.8 | 2.3 | 2.3 | 3.7 |

表6. 藥劑混拌糙米殘餘毒效持久性試驗 (1960)

| 藥劑 (dust) | 濃度 (ppm) | 儲藏期間 (月) | 接觸時間與死亡率 (%) | | | |
|---|---|---|---|---|---|---|
| | | | 96 小時 | | 144 小時 | |
| | | | *Sitophilus oryzae* | *Rhizopertha dominica* | *Sitophilus oryzae* | *Rhizopertha dominica* |
| 2.5% Alodan | 50 | 2 | 100.0 | 81.6 | 100.0 | 93.5 |
| | | 4 | 100.0 | 55.3 | 100.0 | 68.8 |
| | | 6 | — | 65.3 | — | 77.1 |
| | | 7 | — | 26.5 | — | 40.8 |
| | 31.3 | 2 | 100.0 | 71.4 | 100.0 | 82.6 |
| | | 4 | 100.0 | 36.7 | 100.0 | 50.0 |
| | | 6 | — | 55.1 | — | 79.2 |
| | | 7 | — | 34.7 | — | 49.0 |
| | 25 | 2 | 85.1 | 18.4 | 100.0 | 41.3 |
| | | 4 | 96.4 | 12.3 | 100.0 | 25.0 |
| | | 6 | — | 20.4 | — | 54.2 |
| | | 7 | — | 0 | — | 10.2 |
| 5% Bromodan | 50 | 2 | 91.5 | 89.8 | 97.7 | 97.8 |
| | | 4 | 100.0 | 66.7 | 100.0 | 81 3 |
| | | 6 | 67·4 | 89.8 | 97.4 | 93.6 |
| | | 7 | — | 91.8 | — | 98.0 |
| | 33.3 | 2 | 87.2 | 93.9 | 97.7 | 97.8 |
| | | 4 | 100.0 | 68.0 | 100.0 | 77.1 |
| | | 6 | 81.4 | 91.8 | 97.4 | 100.0 |
| | | 7 | — | 83.7 | — | 90.0 |
| | 25 | 2 | 85.1 | 75.5 | 97.7 | 87.0 |
| | | 4 | 100.0 | 47.1 | 100.0 | 64.6 |
| | | 6 | 58.1 | 63.3 | 94.7 | 85.4 |
| | | 7 | — | 53.1 | — | 83.7 |
| 0.2% Lindane | 4 | 2 | 70.2 | 38.8 | 83.7 | 69.6 |
| | | 4 | 100.0 | 28.6 | 100.0 | 54.1 |
| | | 6 | — | 40.1 | — | 79.2 |
| | | 7 | — | 42.9 | — | 77.6 |
| | 2.5 | 2 | 57.5 | 55.1 | 93.0 | 93.5 |
| | | 4 | 92.9 | 14.0 | 94.4 | 31.3 |
| | | 6 | — | 30.6 | — | 77.1 |
| | | 7 | — | 20.4 | — | 57.1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Check | — | 2 | 6.0 | 2.0 | 14.0 | 8.0 |
| | | 4 | 44.0 | 0 | 64.0 | 4.0 |
| | | 6 | 14.0 | 2.0 | 24.0 | 4.0 |
| | | 7 | — | 2.0 | — | 2.0 |
| | (L. S. D.) | 2 | 5% 12.6 | 10.1 | 5.8 | 42.6 |
| | | | 1% 17.6 | 13.9 | 8.1 | 58.7 |
| | | 4 | 5% 4.4 | 10.9 | 1.9 | 11.3 |
| | | | 1% 6.1 | 15.0 | 2.6 | 15.6 |
| | | 6 | 5% 16.0 | 14.8 | 4.8 | 9.2 |
| | | | 1% 22.0 | 20.4 | 6.6 | 12.7 |
| | | 7 | 5% 11.0 | 35.5 | 4.9 | 14.1 |
| | | | 1% 15.2 | 48.9 | 6.7 | 19.5 |

表7. Bromodan 混拌糙米對積穀害蟲毒效試驗 (1959)

| 藥劑 (dust) | 濃度 (ppm) | 供試蟲數 | | | 接觸時間與死亡率 (%) 96小時 | | | 144小時 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* |
| 5% Bromodan | 50 | 50 | 50 | 50 | 100.0 | 86.7 | 5.3 | — | 97.7 | 6.4 |
| | 33.3 | 51 | 54 | 50 | 100.0 | 85.7 | 2.1 | — | 97.7 | 2.5 |
| | 25 | 50 | 56 | 50 | 100.0 | 82.1 | 3.5 | — | 93.3 | 4.1 |
| Check | — | 50 | 57 | 50 | 8.0 | 10.3 | 1.0 | — | 13.9 | 2.0 |
| (L. S. D.) | | | | | 5% 1.6 | 1.6 | 5.1 | — | 6.2 | 2.7 |
| | | | | | 1% 2.3 | 2.3 | 7.3 | — | 8.9 | 3.9 |

表8. Premium malathion 混拌糙米對積穀害蟲毒效試驗 (1960)

| 藥劑 (dust) | 濃度 (ppm) | 供試蟲數 | | | 接觸時間與死亡率 (%) 96小時 | | | 120小時 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* | *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* |
| 1% Premium Malathion | 4 | 49 | 48 | 50 | 97.4 | 79.5 | 100.0 | 99.5 | 85.9 | 100.0 |
| 0.2% Malathion | 4 | 48 | 47 | 50 | 77.9 | 42.5 | 97.5 | 84.9 | 48.8 | 100.0 |
| Check | — | 49 | 46 | 50 | 2.1 | 4.7 | 4.9 | 3.1 | 5.3 | 6.3 |
| (L. S. D.) | | | | | 5% 26.2 | 9.2 | 4.7 | 20.9 | 8.2 | 1.9 |
| | | | | | 1% 39.7 | 14.0 | 7.1 | 31.6 | 12.5 | 2.9 |

表9. 藥劑混拌稻穀殘餘毒效持久性試驗 (1961—62)

| 藥劑 (dust) | 濃度 (ppm) | 儲藏期間 (月) | 接觸時間與校正死亡率 (%) 144小時 *Sitophilus oryzae* | *Rhizopertha dominica* | *Tribolium castaneum* |
|---|---|---|---|---|---|
| | 62.5 | 0 | 100.0 | 100.0 | 60.0 |
| | | 2 | 100.0 | 100.0 | 10.5 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |

| | | | | | |
|---|---|---|---|---|---|
| 5% Bromodan | 50 | 0 | 100.0 | 100.0 | 63.0 |
| | | 2 | 100.0 | 100.0 | 26.3 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| | 33.3 | 0 | 100.0 | 100.0 | 40.0 |
| | | 2 | 100.0 | 100.0 | 10.5 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| | 67.5 | 0 | 100.0 | 100.0 | 96.7 |
| | | 2 | 100.0 | 100.0 | 31.6 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| 2.5% Bromodan<br>0.2% Premium Malathion | 54 | 0 | 100.0 | 100.0 | 93.3 |
| | | 2 | 100.0 | 100.0 | 31.6 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| | 36 | 0 | 100.0 | 100.0 | 72.4 |
| | | 2 | 100.0 | 100.0 | 0 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| | 92.5 | 0 | 100.0 | 100.0 | 43.3 |
| | | 2 | 100.0 | 100.0 | 5.3 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| 5% Alodan | 50 | 0 | 100.0 | 100.0 | 40.0 |
| | | 2 | 100.0 | 100.0 | 5.3 |
| | | 6 | 100.0 | 100.0 | |
| | | 10 | 100.0 | 100.0 | |
| | 33.3 | 0 | 100.0 | 100.0 | 40.0 |
| | | 2 | 100.0 | 100.0 | 0 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 97.5 | — |
| | 67.5 | 0 | 100.0 | 100.0 | 96.7 |
| | | 2 | 100.0 | 100.0 | 26.3 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| 2.5% Alodan<br>0.2% Premium Malathion | 54 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 100.0 | 5.3 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| | 36 | 0 | 100.0 | 100.0 | 83.3 |
| | | 2 | 100.0 | 100.0 | 0 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 100.0 | 100.0 | — |
| | 4 | 0 | 100.0 | 100.0 | 36.7 |
| | | 2 | 100.0 | 100.0 | 21.1 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | 96.4 | 100.0 | — |
| 0.2% Lindane | 2.5 | 0 | 100.0 | 100.0 | 20.0 |
| | | 2 | 100.0 | 97.4 | 31.6 |
| | | 6 | 100.0 | 92.9 | — |
| | | 10 | 96.4 | 100.0 | — |
| | 2 | 0 | 100.0 | 100.0 | 20.0 |
| | | 2 | 100.0 | 100.0 | 36.8 |
| | | 6 | 87.5 | 92.9 | — |
| | | 10 | 96.4 | 100.0 | — |
| | 8 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 93.3 | 10.5 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | — | — | — |
| 0.2% Lindane<br>0.2% Premium Malathion | 5 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 93.3 | 10.5 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | — | — | — |

| | | | | | |
|---|---|---|---|---|---|
| 1% Premium Malathion | 4 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 93.3 | 10.5 |
| | | 6 | 100.0 | 100.0 | -- |
| | | 10 | — | — | — |
| | 8 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 97.8 | 92.3 | 82.6 |
| | | 6 | 100.0 | 92.9 | — |
| | | 10 | 50.0 | 65.2 | — |
| | 6 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 79.5 | 63.2 |
| | | 6 | 95.8 | 64.3 | — |
| | | 10 | 28.6 | 52.2 | — |
| | 4 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 51.3 | 23.3 |
| | | 6 | 87.5 | 78.6 | — |
| | | 10 | 25.0 | 52.2 | — |
| 0.2% Premium Malathion | 8 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 100.0 | 94.7 |
| | | 6 | 100.0 | 100.0 | — |
| | | 10 | — | — | — |
| | 6 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 100.0 | 63.2 |
| | | 6 | 100.0 | 92.9 | — |
| | | 10 | — | — | — |
| | 4 | 0 | 100.0 | 100.0 | 100.0 |
| | | 2 | 100.0 | 76.9 | 26.3 |
| | | 6 | 95.8 | 85.7 | — |
| | | 10 | — | — | — |
| (L. S. D.) | | 0 | 5% 0.3 | 2.9 | 13.1 |
| | | | 1% 0.4 | 3.9 | 17.5 |
| | | 2 | 5% 0.3 | 6.7 | 17.1 |
| | | | 1% 0.4 | 9.0 | 21.8 |
| | | 6 | 5% 15.0 | 9.7 | — |
| | | | 1% 20.1 | 13.0 | — |
| | | 10 | 5% 9.9 | 5.8 | — |
| | | | 1% 13.4 | 7.9 | — |

本試驗粉劑與米穀混拌後，於倒出米穀時，雖有部分粉劑飛失，其情形頗與倉庫內拌粉時相似。但放入玻璃筒後每次取出撥動米穀檢查害蟲之生存及死亡時，則均有部份粉劑散失，如放入害蟲與粉劑之接觸時間愈長，其死亡率越高。實際在倉庫使用時，勢必較試驗所得更能保持粉劑原有量，結果當可較優。

1. 0.2% Malathion 及 0.2% Lindane 兩粉劑之毒效除對穀象均爲顯著外，其對擬穀盜及穀蠹各有不同之治蟲效力（表 2～4）。Malathion 粉劑對擬穀盜之毒效雖佳，但其對穀蠹之毒效則較 Lindane 爲差。Lindane 粉劑處理者對擬穀盜並無顯著治蟲效力。再就兩者混合使用比較，其毒效較單獨使用者，僅單方面有增强，但另方面則反而降低。由此可見兩粉劑各具其獨立之毒效，混合後並不能顯示若何增效用（表 3）。

2. 二種粉劑混拌糙米儲藏之殘餘毒效持久性，以Lindane 較 Malathion爲長久；Malathion 8ppm處理糙米經 1 個月儲藏後，對穀象之毒效爲95.0%，但對穀蠹之毒效僅爲8.6%，對擬穀盜爲24.7%，如以2ppm處理者毒效則完全消失。以 Lindane 2ppm 處理儲藏至 2 個月時，對穀象之毒效爲51.2%，穀蠹爲 43.2%，由此，可知 Malathion 似無理想之殘毒治蟲效力，故未合選擇混拌積穀儲藏之取用。

3. Alodan 處理糙米對積穀害蟲之毒效測定，其高低濃度間之毒效差異不顯著，其毒效與 Lindane間亦不顯著；該粉劑除對穀象、穀蠹有顯著之毒效外，對擬穀盜治蟲效力甚差（表 5）。

4. Alodan混拌糙米儲藏之殘餘毒效持久性，其毒效逐月下降情形頗與 Lindane 相接近（表 6）。

5. Bromodan 對積穀害蟲毒效之測定，結果與 Alodan、Lindane 頗相似，僅對穀象及穀蠹均有顯著毒效，對擬穀盜毒效微乎其微（表7）。但以其毒效持久性則較Alodan 及 Lindane爲顯著（表6）。

6. Premium malathion 處理糙米，對積穀害蟲之毒效測定，結果其治蟲效力不論對穀象、穀蠹、擬穀盜均較 Malathion 極顯著（表8）。但其處理經過儲藏後之殘餘毒效持久性甚短，如經2個月儲藏，則毒效逐漸降低，至3個月時已無顯著治蟲效果。

7. 依據上列諸試驗，得知氯化烴劑類之 Bromodan、Alodan、Lindane 等對擬穀盜並無治蟲效力。因鑒於此，故再進行其與Premium malathion混合是否具有增效作用（表9）。經處理稻穀儲藏至10個月，放入害蟲與粉劑之接觸時間均爲144小時，測定殘餘毒效，不論何種粉劑處理均極顯著，各粉劑之使用濃度均可達到治蟲之標準，卽單獨或混合使用對穀象及穀蠹之毒效差異不顯著；但對擬穀盜之毒效，則以與 Premium malathion 混合者較單獨使用之治蟲效果爲佳。Premium malathion 6ppm 處理者，儲藏至2個月時，尙有60%以上之殘毒治蟲效力，其中以含有效成分1%與0.2%觀之（卽低倍與高倍），其對穀象及穀蠹之殘毒效力，則以內含有效低成分使用高倍者，則較高成分低倍者差異顯著，對擬穀盜藥劑間之處理差異不顯著。

8. 自表4、表6與表9觀之，似可獲得證明，卽粉劑處理穀物經過儲藏之殘毒效持久之長短，與處理物對象似有關係，卽以糙米與稻穀，爲供試材料時，雖然在不同時間處理者，但以相同濃度與方法處理後，在經儲藏一定時間，於同一環境下放入害蟲，其殘餘毒性差異十分顯著，卽前者殘毒較後者爲差。換言之，粉劑處理有殼之穀物較脫殼者不但毒效强大，且其殘餘毒效並較持久。

## 二 倉庫試驗

本項倉庫試驗係根據表5、表8所得結果，於1960年8月中旬開始，在臺北縣之新店、木柵、中和等鄉鎭農會倉庫自然環境下進行之。

### ㈠ 試驗材料及方法

供試藥劑：所用藥劑種類，濃度及調配與室內試驗者相同。

試驗方法：將倉庫中之散堆稻穀，各秤120公斤倒於地面，以一定量之粉劑撒佈於穀堆表面，用耙鋤充分混拌後，分盛裝6麻袋，每袋裝20公斤，另6袋不混拌任何粉劑以作對照。然後將各處理6袋疊成一堆，每處農會倉庫共處理84袋，儲藏於倉內自然環境下，每隔月一次，自各種處理之上層提取樣品一袋，作爲檢查單位。檢查方法用篩子，將每袋20公斤稻穀中所有生存及死亡蟲類全部篩出，個別檢查害蟲之種類、生存及死亡蟲數，計算活蟲率。

### ㈡ 試驗結果及討論

表10. 藥劑混拌稻穀儲藏按月檢查之結果　（1960—61）新店、木柵、中和

| 藥劑 (dust) | 濃度 (ppm) | 按月檢查害蟲發生密度 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2個月 | | | 4個月 | | | 6個月 | | |
| | | 害蟲數 | 活蟲率 | 活蟲指數 | 害蟲數 | 活蟲率 | 活蟲指數 | 害蟲數 | 活蟲率 | 活蟲指數 |
| 0.2% Premium Malathion | 10 | 333 | 9.9 | (125.3) 15.0 | 441 | 7.3 | (145.2) 10.6 | 1,139 | 29.3 | (225.8) 41.1 |
| | 8 | 291 | 8.3 | (105.1) 12.5 | 405 | 13.8 | (276.9) 20.2 | 949 | 32.9 | (253.3) 46.1 |
| | 6 | 204 | 25.0 | (316.5) 37.8 | 591 | 43.3 | (855.8) 63.2 | 1,121 | 44.4 | (341.8) 62.2 |
| 2.5% Alodan 0.1% Premium malathion | 52 | 312 | 5.1 | (64.6) 7.8 | 286 | 4.6 | (90.4) 6.6 | 758 | 1.6 | (12.1) 2.2 |
| | 32.5 | 321 | 4.1 | (51.9) 6.1 | 349 | 7.2 | (142.4) 10.4 | 368 | 2.2 | (16.5) 3.0 |
| | 26 | 230 | 12.2 | (154.4) 18.4 | 238 | 8.4 | (168.5) 12.3 | 417 | 4.1 | (31.3) 5.7 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.5% Alodan | 50 | 415 | 5.1 | (64.6) 7.7 | 425 | 6.6 | (131.5) 9.6 | 438 | 2.5 | (19.2) 3.5 |
| | 31 | 254 | 19.7 | (249.4) 29.8 | 472 | 4.7 | (89.5) 6.8 | 445 | 6.7 | (51.9) 9.4 |
| | 25 | 357 | 14.9 | (188.6) 22.5 | 451 | 12.6 | (252.0) 18.4 | 1,302 | 5.8 | (45.1) 8.2 |
| % Bromodan | 100 | 426 | 1.6 | (20.3) 2.5 | 529 | 1.0 | (19.2) 1.4 | 499 | 0.6 | (4.4) 0.8 |
| | 50 | 389 | 1.8 | (22.8) 2.7 | 384 | 2.7 | (52.1) 3.8 | 495 | 0.8 | (6.0) 1.1 |
| | 33 | 360 | 5.8 | (73.4) 8.8 | 385 | 5.2 | (104.1) 7.6 | 394 | 3.6 | (26.9) 4.9 |
| 0.2% Lindane | 2.5 | 355 | 7.9 | (100.0) 11.9 | 378 | 5.0 | (100.0) 7.3 | 624 | 12.9 | (100.0) 18.2 |
| Check | — | 251 | 66.1 | 100.0 | 1,044 | 68.6 | 100.0 | 4,094 | 71.4 | 100.0 |
| (L. S. D.) | | 5% 18.6<br>1% 25.2 | | | | 16.8<br>22.6 | | | 31.1<br>42.0 | |

註：害蟲頭數與活蟲率係稻穀20公斤三處重複之平均指數。
括弧內之數字係指各藥劑間與 Lindane 之比較。

表11. 未處理袋裝稻穀害蟲發生調查

| 儲藏期間 (月) | 害蟲種類 (頭) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Rhizopertha dominica* | *Sitophilus oryzae* | *Tribolium castaneum* | *Laemophloeus ferrugineus* | *Oryzaephilus surinamensis* | *Temebrioides mauritanicus* | *Lophocateres pusillus* | *Tinea granella* | *Sitotroga cerealella* | *Carpophilus obsoletus and Palorus subdepressus* |
| 1 | 5 | 3 | 4 | 13 | 0 | 25 | 1 | 7 | 26 | 0 |
| 2 | 41 | 2 | 9 | 66 | 27 | 1 | 6 | 37 | 61 | 1 |
| 3 | 88 | 6 | 8 | 64 | 11 | 5 | 4 | 12 | 41 | 0 |
| 4 | 563 | 83 | 11 | 168 | 60 | 4 | 4 | 14 | 127 | 0 |
| 5 | 1.375 | 124 | 19 | 203 | 9 | 4 | 14 | 9 | 151 | 1 |
| 6 | 2.820 | 419 | 17 | 428 | 14 | 3 | 42 | 18 | 232 | 1 |
| 總蟲數 | 4,892 | 637 | 68 | 942 | 121 | 42 | 71 | 97 | 638 | 3 |
| 比率 | 65.13 | 8.46 | 0.91 | 12.54 | 1.6 | 0.56 | 0.95 | 1.29 | 8.49 | 0.04 |

註：害蟲數字係對照組之稻穀20公斤中，三處重複之蟲均數。

(1) 就表10，就三處倉庫綜合結果觀之，五種粉劑混拌稻穀儲藏期間之治蟲效果，與對照組差異均極爲顯著。各粉劑三種濃度處理間，則高濃度較低濃度之效果爲佳。四種粉劑經儲藏至6個月與 Lindane 處理者之活蟲率爲標準相比較（指數爲100），以 Bromodan 處理者最佳，Alodan 與 Premium malathion 混合者次之，Alodan 又次之，Premium malathion最差。

(2) 稻穀裝入麻袋儲藏期中，害蟲逐月漸次增加，其可能之原因爲；㈠幼蟲在穀物粒中相繼繁殖，㈡另由倉中之害蟲侵入繁殖所致。其害蟲之種類，除粉蟎及粉茶蛀蟲二種因個體微小，未能列爲調查外，其餘害蟲有11種之多，其中以穀蠹最多佔爲65.13%，角胸粉扁蟲 12.54%，麥蛾 8.49%，穀象8.48%，鋸胸粉扁蟲1.61%，穀蛾1.29%，暹羅穀盜0.95%，擬穀盜 0.91%，大穀盜 0.56%，其他爲倉出尾蟲及姬擬穀盜等佔爲0.04%。

## 三 藥劑對小白鼠口服毒害之觀察

經試驗結果，Bromodan 確實有其獨特之優點，實可供作代替 Lindane 混拌積穀及豆類，以期保護在儲藏期間，免遭受蟲害之損失。唯因該藥劑係混拌於吾人主要糧食，爲安全計，故進行

本項試驗，以明瞭高等動物對 Bromodan 之忍受量。

㈠ 試驗材料及方法

供試藥劑：本試驗所用之粉劑種類、成分及其用量爲：5% Bromodan 100ppm（1：500）、62.5ppm（1：800）、50ppm（1：1000），5% Alodan 100ppm（1：500）、50ppm（1：1000），0.2% Premium malathion 10ppm（1：200）、6ppm（1：333），0.2% Lindane 4ppm（1：500）、2.5ppm（1：800）。

供試動物：試驗所用小白鼠，(Mice) 係在本試驗室飼育繁殖者，飼料將蓬萊糙米經磨粉機粉碎成粉末後加入20%脫脂奶粉給飼之。

試驗方法：供試小白鼠分爲成鼠及幼鼠兩組，其個體大小選擇相等者，以每種粉劑濃度飼給成鼠各三組，幼鼠各七組，每組雌雄各一隻。飼料中混入規定粉劑之用量，每5天配飼一次，每日給飼二次及取換清水一次，另各一組給飼相同飼料不混入任何粉劑作爲對照，分間隔5及10天，各秤體重一次，繼續飼養至試驗結束爲止。

㈡ 試驗結果及討論

12. 四種藥劑混拌飼料對小白鼠成鼠體重之影響 (1961—62)

| 藥劑 (dust) | 濃度 (ppm) | 經過日數及體重 (g) 開始 鼠數 | 開始 體重平均 | 95 鼠數 | 95 體重平均 | 95 增重率 | 189 鼠數 | 189 體重平均 | 189 增重率 | 280 鼠數 | 280 體重平均 | 280 增重率 | 372 鼠數 | 372 體重平均 | 372 增重率 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bromodan | 100 | 6 | 28.1 | 5 | 28.4 | 1.1 | 2 | 29.6 | 4.2 | 2 | 28.3 | — | — | — | — |
| | 50 | 6 | 24.5 | 5 | 27.8 | 13.5 | 3 | 29.2 | 5.0 | 2 | 27.5 | — | 1 | 28.5 | 3.6 |
| Alodan | 100 | 6 | 23.1 | 5 | 28.0 | 21.2 | 3 | 31.1 | 11.1 | 3 | 29.9 | — | — | — | — |
| | 50 | 6 | 32.7 | 5 | 35.4 | 8.3 | 4 | 27.3 | — | 2 | 28.6 | 4.8 | 1 | 29.5 | 3.1 |
| Premium malathion | 10 | 6 | 34.0 | 5 | 31.2 | — | 4 | 29.7 | — | 2 | 28.1 | — | 1 | 29.0 | 3.2 |
| | 6 | 6 | 35.6 | 6 | 36.9 | 3.7 | 4 | 32.4 | — | 2 | 27.4 | — | 1 | 28.5 | 4.0 |
| Lindane | 4 | 6 | 25.1 | 6 | 29.5 | 17.5 | 3 | 29.0 | — | 2 | 27.4 | — | 1 | 28.0 | 1.8 |
| | 2.5 | 6 | 28.8 | 6 | 30.8 | 7.9 | 5 | 30.9 | 0.3 | 4 | 29.6 | — | 2 | 28.0 | — |
| Check | — | 6 | 37.7 | 6 | 47.7 | 265 | 5 | 39.8 | — | 5 | 35.0 | — | 4 | 29.9 | — |

表13. Bromodan 混拌飼料對小白鼠幼鼠體重之影響 (1961—62)

| 藥劑 (dust) | 濃度 (ppm) | 經過日數及體重 (g) 開始 鼠數 | 開始 體重平均 | 63 鼠數 | 63 體重平均 | 63 增重率 | 119 鼠數 | 119 體重平均 | 119 增重率 | 152 鼠數 | 152 體重平均 | 152 增重率 | 217 鼠數 | 217 體重平均 | 217 增重率 | 273 鼠數 | 273 體重平均 | 273 增重率 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bromodan | 62.5 | 14 | 11.1 | 6 | 18.7 | 68.5 | 6 | 24.4 | 30.5 | 5* | 27.4 | 12.3 | 3 | 27.2 | — | 1 | 28.2 | 3.7 |
| | 50 | 14 | 17.3 | 10 | 24.3 | 40.5 | 7 | 28.8 | 18.5 | 7* | 28.8 | 1.0 | 5 | 29.1 | — | 1 | 27.0 | — |
| Check | — | 14 | 14.9 | 11 | 22.7 | 52.3 | 11 | 26.3 | 15.9 | 10* | 27.4 | 4.2 | 7 | 29.2 | 6.6 | 2 | 29.0 | — |

註：* 係產生幼鼠者。

表14. Bromodan 混拌飼料對小白鼠後代體重之影響 (1961—62)

| 藥劑 (dust) | 濃度 (ppm) | 出生經過日數及體重 (g) 30 鼠數 | 30 體重平均 | 60 鼠數 | 60 體重平均 | 60 增重率 | 90 鼠數 | 90 體重平均 | 90 增重率 | 120 鼠數 | 120 體重平均 | 120 增重率 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bromodan | 62.5 | 3 | 13.0 | 2 | 14.5 | 11.5 | 1 | 14.0 | — | 1 | 14.0 | — |
| | 50 | 4 | 11.7 | 4 | 14.7 | 25.6 | 2 | 13.5 | — | 2 | 14.5 | 7.4 |
| Check | — | 6 | 10.3 | 5 | 10.6 | 2.9 | 3 | 13.0 | 22.6 | 2 | 14.0 | 7.7 |

註：本表幼鼠係選自表13中有星號者。

Bromodan 混入飼料對小白鼠之影響，係於1961年3月7日及6月26日開始至翌年3月繼續飼養經6個及1年後，成鼠組已發育成熟，體重不再增加。而以幼鼠發育旺盛體量顯著增加。在長期飼養中，體量之增加或減輕；每因雌鼠受胎後至產生小鼠前，體量有必然漸增現象，但於生產後則顯著減輕，或受氣候變化而致體量變化。在成鼠試驗時，因成鼠年齡恐有不齊，致不論處理組或對照組成鼠均有漸次死亡，且飼藥者似有較早死亡現象，其致死原因或有他病所引起，因限於經費而無法進行病理解剖。

(1) 四種藥劑各分兩種不同濃度飼餵後，成鼠（表12）之致死順序爲；Bromodan 100ppm，Lindane 4ppm，Malathion 10ppm，Bromodan 50ppm，Alodan 100ppm，Alodan 50ppm，Malathion 6ppm，Lindane 2.5ppm。以上供試藥劑之濃度，均超過現行推廣濃度(Bromodan 33ppm及Lindane 2.5ppm)。就此較高濃度對幼鼠似未產生不良之影響（表13）。

(2) 自表13～14與圖1、2，Bromodan 對幼鼠之影響觀之，幼鼠經3個月後發育成熟，各能產生幼鼠，並無任何生長不良現象。該後代幼鼠哺乳期間至開眼，就與母鼠取食之發育情形，自出生後經30天時不分雌雄秤量體重結果，飼餵62.5ppm組體重平均13克，50ppm平均11.7克，對照組平均10.3克，由此似證明飼藥組之發育情形並不較對照組差。然後再將幼鼠與原母鼠給飼含有同等藥量至120天後；各組雖有死亡差異不顯著，但生存者均甚正常。

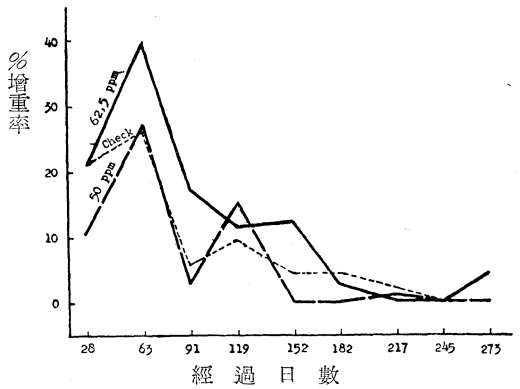



圖1. Bromodan 混飼小白鼠體重之影響

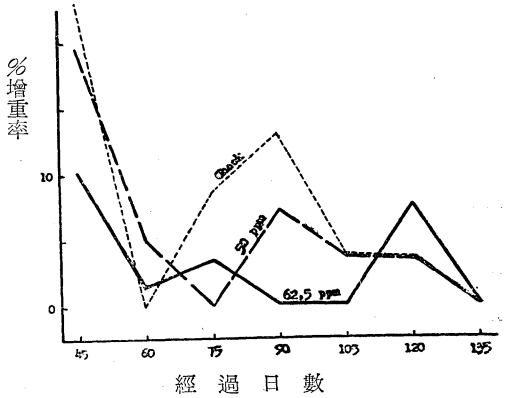



圖2. Bromodan混飼小白鼠對後代體重之影響

關於 Bromodan 對於動物之口服試驗，有德人 Dr. Scholz (Farbwerke Hoechst AG.) 最早未發表之報告，以 Bromodan 有效成分毒死動物試驗，以1g最大口服量可以給 100g 白雌鼠服食，相當於10g/kg的量劑亦無不良反應，同氏於1959年再作試驗，以雄性無色鼠體量在100～130g之間，於40天間飼餵28次，每次1g，該鼠在試驗期間行動正常。並由 Dr. Benoit 檢驗血液及小便數次，並無病理現象，再進行內部病理解剖、於心臟、肺、肝、腎臟、脾臟等器官之組織，並未顯示由於此藥劑試驗而起之任何變化。

## 討論與結論

本省稻穀之儲藏情形，公有倉庫分儲有田賦穀、換肥料穀等係屬公糧者，其他尚有地主寄存穀；私有倉庫則爲商人收購或委託寄存者，其儲藏均爲散堆。至於小農戶則盛裝入麻袋、木箱、鐵筒等儲放於室內。儲藏期間自3個月至10個月以上，且在同一環境下常儲有玉米、豆類、糠類等雜糧，其中發生害蟲種類頗爲單純，但各種之相對密度則有不同。爲防止積穀害蟲之發生，應從儲藏環境澈底改善爲上策，若專靠藥劑治蟲，實難得到治蟲效果。對積穀害蟲之防治，自從採用粉劑混拌稻穀儲藏之方法以後，僅公有儲穀期間較長者實施外，餘者均感麻煩而未使用。且經粉劑處理後藥效減弱時，害蟲再侵入爲害產生後代抗藥性，使將來粉劑無法繼續使用。故應不分儲藏環境或期間之長短，包括一切儲藏雜糧，除米及粉料直接供人食者外，均須全部處理，才能達到全面治蟲效果。

本試驗供試材料選用糙米及稻穀二種，前者可代表雜糧（玉米、小麥等），於與粉劑處理經過儲藏後，取米、穀放入害蟲之溫度均爲 28～30°C 之間，此項溫度與倉庫環境頗爲相似，故此項結果，實可代表一般倉庫之環境。

室內試驗，計有五種粉劑對積穀害蟲之毒效測定，除Malathion粉劑對穀蠹之效力差異，其餘四種粉劑對穀象及穀蠹均有理想之治蟲效果。對擬穀盜以Premium malathion爲最佳，Bromodan、Alodan 及 Lindane 等則對該蟲並無顯著效果；再將該等藥劑與 Premium malathion 混合使用時，效果則顯著。米、穀經處理儲藏後之殘毒性，以 Bromodan 爲最長久， Alodan 次之，Lindane 又次之，Premium malathion 最短。藥劑殘毒性之長短與處理對象有明顯差異，即處理稻穀較糙米爲長久。對藥劑有效成分之選擇，試觀 Premium malathion 1％及0.2％，雖處理濃度（ppm）相同，但以含有0.2％低成分使用高倍數濃度之治蟲效力爲佳。

倉庫試驗，就四種粉劑對積穀害蟲之治蟲效果，以 Lindane 粉劑處理者之活蟲率爲標準，經至6個月儲藏時，以Bromodan 處理間之所佔活蟲率爲最少，Alodan 與 Premium malathion 混合者次之，Alodan 又次之， Premium malathion 者較 Lindane 之活蟲率增多一倍以上。因此，四種粉劑中，除 Premium malathion 使用於倉庫環境，受自然因子之影響，其殘毒性消失較速外，其餘三種均與室內所獲結果頗爲一致。

積穀在儲藏至6個月，對照組中發生之害蟲種類及密度，除粉茶蛀蟲及粉蟎二種各個體較小而未列爲調查外，主要害蟲發生11種，其相對密度；穀蠹65.13％，角胸粉扁蟲12.54％，麥蛾8.49％，穀象8.46％，鋸胸粉扁蟲1.61％，穀蛾1.29％，暹羅穀盜0.95％，擬穀盜0.91％， 大穀盜0.56％， 米露尾蟲及姬擬穀盜 0.04％，其中最主要者僅穀蠹、麥蛾、穀象及大穀盜等四種，但在玉米雜糧中則以擬穀盜常爲主要害蟲。

藥劑對小白鼠口服試驗，以四種粉劑對成鼠經1年繼續飼餵，及對幼鼠飼餵之結果，以 Bromodan 62.5與50ppm 二種不同濃度混入飼料，飼餵9個月結果，對白鼠體重增加率未有顯著差異，其後代於哺乳及生長期飼餵與母鼠相同之藥量，繼續4個月，發育情形頗爲正常。由上所得結果，Bromodan 對積穀害蟲之治蟲使用濃度僅爲 33.3ppm， 且非直接供人食用，故似對吾人健康無影響。

綜合以上結果，對積穀害蟲之防治，以 Bromodan 之治蟲效果較理想可靠，其處理積穀儲藏之殘毒性可維持10個月以上，如稻穀收穫後入倉時， 每千公斤用5％ Bromodan 粉劑0.67公斤（1：1,500倍）混拌儲藏，即可達到治蟲目的，現已在推廣使用中。對玉米雜糧等較易發生擬穀盜者，似應使用2.5％ Bromodan加0.2％ Premium malathion 粉劑混合， 以 1.33 公斤（1：750倍）混拌較易收效，或在雜糧堆面及週圍，每百坪方尺用0.5公斤0.2％ Premium malathion粉劑每經1、2個月噴射一次，更能達到防治擬穀盜治蟲效果。

## 參 考 文 獻


(1) Crech, M. The effect of Thiodan and Alodan on warm Blooded Animals and Insects. pp. 1～19.
(2) 陳德能、梁崇仁1956 靈丹(Lindane)對於鷄鴨及小白鼠口服毒害試驗，中華農學會報(新)：15：78～90。
(3) 梁崇仁、陳德能、林檳1954 臺灣稻穀貯藏之現狀及積穀害蟲爲害損失量之調查，科學農業(8)：34～40。
(4) 梁崇仁、陳德能、林檳1956 靈丹及保粒寧浸孕粉劑防治積穀害蟲倉儲表證試驗，中華農學會報（新）13：66～70。
(5) 林檳，1958 穀象生活習性之觀察，農業研究8(1)：44～54。
(6) 林檳，1958 穀蠹生活習性之觀察，農業研究8(1)：55～66。
(7) 林檳，1960 積穀混拌藥劑貯藏殘餘毒效持久性試驗，農業研究9：24～27。
(8) 林檳，1964 綠豆象藥劑防治試驗，農業研究13(2)：55～59。
(9) 岡田十藏，1936 農林省指定穀蟲防除劑トシテノ硼酸ノ效力二關スル研究，山口農事試驗場特別報告1：1～70。

# CHEMICAL CONTROL OF GRANARY INSECTS AND THE ORAL TEST OF WHITE MICE WITH INSECTICIDES

by

T. LIN

## SUMMARY

The brown rice and grain mixing with insecticides were inoculated with testing granary insects and kept in 28-30°C ready for examination. Malathion was inferior against *Rhizopertha dominica* but remaining chemicals were very effective. Premium malathion was the best for the control of *Tribolium castaneum*, bromodan, alodan and lindane were also effective in testing, however, premium malathion was mixed with any one of them which might increase its effectiveness. The residual effect of mixed grain, bromodan was the longest, alodan and lindane were the next, premium malathion was the shortest. Grain were mixed in the chemicals which were the same active ingredient but in low concentration and high volume seemed more effective.

After six months in storage, the survial rate of insect in our treatment, bromodan was the lowest, alodan combined with premium malathion was the next, alodan or premium malathion was the worst, therefore the lindane, bromodan and alodan were same effective.

After six months in storage, the insects and their population ratio found in the check except the small amount of psocids and flour mites, which were not counted, were *Rhizopertha dominica* Fabricius 65.13: *Laemophloeus ferrugineus* Stephens 12.54: *Sitotroga cerealella* Olivier 8.49: *Sitophilus oryzae* Linne 8.46: *Oryzaephilus surinamensis* Linne 1.61: *Tinea granella* Linne 1.29: *Lophocateres pusillus* Klug 0.95: *Tribolium castaneum* Herbst 0.91: *Tenebrioides mauritanicus* Linne 0.56: *Carpophilus obsoletus* Erichson and *Palorus subdepressus* Wallaston 0.04, *Tribolium castaneum* was the main pest of stored corn.

Oral test of adult and bady mice were fed with four above chemicals with meal over 62.5 and 50 ppm of bromodan in one year. It showed no difference in the increasing of their body wight, its offspring fed with the same dosage as adults for four months the growth rate was normal. According to the above results, 33.3 ppm of bromodan in grain against granary pests showed no influence to the human body but it was not used directly for food.

The results of above testing, bromodan showed the reasonable effectiveness in the control of granary pests, its residual effect could maintain through 10 months, it was the equivalent of 0.67 kg of 5% bromodan mixed in 1,000 kg of grain thoroughtly which was received in extension. However, corn was more susceptible to *Tribolium castaneum* and it had better use 2.5% bromodan in 0.2% premium malathion together, i. e. 1.33 kg of 2.5% bromodan plus 0.2% premium malathion mixed in 750 kg of grain or dusted with 0.2% premium malathion on the surface and outside of grain pile bimonthly would be effective for keeping away the attack of *Tribolium castaneum*.

# 文　獻　介　紹

# ABSTRACTS OF LITERATURE

**一、兩品系四元體小麥之 $F_1$ 中，具有染色體轉座之證明。[Dalal K. C. and K. Sadanaga (1965) Canadian Jour. of Genetics and Cytology VII (1):88～96]**

以中國春小麥之單價體 (Monosomic) 系統，1A 到 7A 和 1B 到 7B 爲母本和二粒小麥 (Triticum dicoccum) 及 T. carthlicum Nevski 爲父本什交（這些父本是轉座異型體），其 $F_1$ 花粉母細胞之期望配對爲：單價體系統×四倍體（正常），2n=35 所有系統均爲 14Ⅱ+7Ⅰ；2n=34 所有系統均爲 13Ⅱ+8Ⅰ。單價體系統×四倍體（互換），2n=35 所有系統均爲 12Ⅱ+1Ⅳ+7Ⅰ；而 2n=34 者 12 系統爲 11Ⅱ+1Ⅳ+8Ⅰ，2系統爲 12Ⅱ+1Ⅲ+1Ⅰ。

根尖細胞和花粉母細胞以特殊的處理方法檢鏡。其結果如下：

2n=35：當父本爲 T. dicoccum 時，第一分裂中期可看到兩種不同之單價體系統。當父本爲 carthlicum 時，所有植株均爲轉座異型體。

2n=34之 $F_1$ 系統 (即 1A-7B)：當 3B 爲母本時，其 $F_1$ 下，發現有單價體。其他的則可分爲四組。即第一組，系統 1A, 2A, 5A-7A, 1B 和 4B-7B。第二組，系統 4A。第三組系統 2B，第四組系統 3A 和 3B。各組中三價體和四價體之發生頻度各不相同。

在中國春小麥單價體系統 3B 之部份同質染色體 (homoeologous chromosome) 3A 和 3B 之不配對，表示這些染色體之親合性是高於部份同質體。但這些染色體之親合性却表現出稍低於同質體，此乃因第一組和第二組之系統內兩染色體包含於轉座內和染色體 3B 是由双親所表現之故。一般正常互交双元體之族羣內同質染色體間之親合性是 100。（嚴盛添）

**二、應用於計算轉座破裂點和幼苗致死性狀間組換值之積算法。[Shands H.(1965) Crop Science 4 (6)：623～625]**

Fisher 和 Balmukand、Immer、Immer 和 Henderson、Allard 把積算法之公式和表格應用於一般 $F_2$ 之計算組換值 (Recombination Value) 和標準機差 (Standard errors)。Jaachim (1947) 提供了計算轉座破裂點和一單一因子對間之連鎖公式和表格。然而當此單一因子對控制着幼苗致死性狀時，便須應用不同之公式和表格了。

由同型轉座系統和具有兩相等部份上帶有幼苗致死因子系統間什交之 $F_2$；其部份不稔性植株即屬異型轉座 (Heterozygous translocation) 和結實良好植株中之一半爲同型正常體及一半之同型轉座體。由於幼苗致死性狀是隱性因子，故有行 $F_3$ 測定之必要。

T 和 N 各用來代表交換和正常因子型植株之染色體；致死因子對則爲 A、a。假定存於兩性間之組換值 P（相斥之情形）有差異，$F_1$ 應爲 TA/Na。$F_2$ 則可產生 TA、NA、Ta、Na 配偶子。其相對之配偶子頻度爲 P/2、1-P/2、1-P/2、P/2。經 $F_3$ 測定後，$F_2$ 之理論頻度如下表：

| 結實率 | | $F_2$ 因子型 | | | 總數 |
|---|---|---|---|---|---|
| | | AA | Aa | aa | |
| 部份不稔 | 理論頻度 | $\frac{2P(1-P)}{4}$ | $\frac{2(1-2P+P^2)}{4}$ | 死亡 | $\frac{2(1-P+P^2)}{4}$ |
| | 觀察頻度 | e | f | | e+f |

| | | | | | |
|---|---|---|---|---|---|
| 結實良好 | 理論頻度 | $\frac{1-2P+2P^2}{4}$ | $\frac{4P(1-P)}{4}$ | 死亡 | $\frac{1+2P-2P^2}{4}$ |
| | 觀察頻度 | g | h | | g+h |
| 總數 | | $\frac{1}{4}$ | $\frac{2}{4}$ | | $\frac{3}{4}$ |

不同 P 值（由0～50）之 $F_2$ 理論頻度百分率（基於總數之$\frac{3}{4}$）計算出一表，可供利用。其標準機差亦由最大近似值法誘導而得之

$$\Sigma(i)=\frac{3(1-2P)^2}{2P(1-P)(1-2P+2P^2)}$$

此試驗中，曾利用大麥同樣之材料，進行，積算法和最大近似值法之比較。後者，確可得到較小之標準機差，但差異並不太大。因此在一般初步和非精確的分析時，均採用積算法，且其計算方便而容易，但積算法仍可被用於稍精細之分析上用。（嚴盛添）

## 三、大麥利用相互交換破裂點的位置研究連鎖和染色體圖之訂定 [Kasha K. J. and C. R. Burnham (1965) Canadian Jour. of Genetics and Cytology VII (1):62～77]

利用具有斑紋(zebra, zb)，缺乏下層小穗花 (absent lower side florets, als)，6 稜 (6-row, V)，芒光滑 (smooth awns, r)，黃色條紋 (yellow stripe, ys)，白苗 (albino seedling, $a_n$ 死亡)，黃化苗 (xantha seedling, $x_s$ 死亡)，無葉舌 (liguleless, $l_i$)，外頴伸長 (elongated outer glumes, e) 等系統間互交。其 $F_2$ 分種兩區各 150 粒。

$F_2$ 和 $F_3$ 之資料，應用多點 (multiple-point) 連鎖研究結果，在大部份的資料中，均可看出第三染色體上之因子排列爲 als-uz-ys-$a_n$-$x_s$。而以往報告中之 e-v-li 則在第二染色體上。至於中心體 (centromere) 之位置和第二、第三染色體圖之訂定，是由染色體交換研究連鎖情形而假設的。

分析結果得知，第二染色體中心體之位置接近 e，而 li 則遠距 v，且均位於染色體之長臂 (long arm) 上。第三染色體中心體之位置和 zb, $x_s$ 非常接近，且亦位於長臂上，而 als 則位於染色體之短臂 (short arm) 上。此種假設，在最近細胞學上證明是正確的。

在斷裂的斷片上，只發現有正常組換值之 4 %的組換值。因此，在標識因子 (marker gene) 和許多相互交換破裂點間之最高組換值，即可代表標識因子和中心體之最大估計距離。換言之，有關連鎖圖的位置，可由相互交換破裂點和中心體中獲得。（嚴盛添）

## 四、陸地棉纖維細度遺傳。[J. O. Ware and D. C. Harrell (1963) Crop Science 3 (2):163～165]

用細度計檢定並分離陸地棉內之粗纖維品系與細纖維品系。金氏細絨乃細纖維之品系；半半棉 (Half and Half) 與佛羅里達綠籽品系乃粗纖維之品系。尤其佛羅里達綠籽品系乃極粗品系。

金氏細絨品系與上述二個粗纖維品系相雜交。將親本，$F_1$，$F_2$ 及回交三世代均行栽植。遺傳試驗之生長期佔四年時期，即 1944–1947. 第一年所建立培育之親本於以後三年均行再種，以供(1)雜交之用(2)回交之用(3)雜交後代紀錄之比較標準之用。

四年光陰內，各品系測定細度之羣體平均表內；自粗至細之限度足以展示美國陸地棉短絨或中絨品系粗細性狀之範疇如何。並可象徵此類限值乃棉作育種分離而獲建立之材料。

雜交後代 $F_1$ 之頻率分組與平均細度平準，顯示出「細度遺傳」屬於「中間遺傳」；但 $F_1$ 之平均值常在親系中間價 (Mid-Value) 之一邊，即靠近粗纖維親本之一旁。

三組 $F_1$ 平均之總平均，若與八組中間親本平均之總平均相比較。其結果顯示出前者常在平準上而略粗。若用細度單位表示，$F_1$ 平均數以 401 單位爲平準；而親本之中數（折衷數）以414 單位爲平準。

兩類雜交之 $F_2$，其植株頻率之分佈曲線，均爲單峯型式；並且分佈模式亦同，此即表示遺傳因子簡單，較之 $F_1$ 分佈模式爲廣濶。

兩類雜交之 $F_2$ 羣體，有頗相近似之平均數值；兩者之平準亦同。$F_2$ 羣體之分佈位置與平均值，均有接近於粗絨親本一方面之趨勢，一如 $F_1$ 之情形。

回交後代情形，顯示粗纖維親本之粗纖維性狀略具顯性作用。但其顯性作用之影響，不足以阻止「回交親本爲細絨品系情形下後代有轉向細絨之傾向」。

金氏細絨與佛羅里達綠籽品系間之回交（無論何種方向），比較金氏細絨與半半棉相回交者（或後代）爲穩定。金氏細絨與佛羅里達綠籽品系回交之羣體，如其回交親本之穩定；但此類移動平均數 (Moved mean) 接近於細絨親本者較少。

總之，金氏細絨與佛羅里達綠籽品系之回交羣體植株分佈率，遮掩了回交親本之分佈範疇。此事足以建議一事；卽無論任何有理想性狀再現之回交結合中，開始選種育種。（孫貽謀）

## 五、紫雲英名稱之歷史考證。[Isao Suetsugu (1960) 北陸農業試驗場報告 1:1～19]

本文乃紫雲英栽培史之一部分。古代名稱考諸古代書籍，現代稱謂則依據日本各府各縣之調查。中國民間俗名則根據日本學者土屋卯平與土屋好次二氏之「中國旅行日誌」(1918)。紫雲英名稱之歷史考證分三方面進行：(a) 植物學上名稱及學名，(b) 中國與隣近區域之名稱與稱謂，(c) 日本名之變遷。

(1) 本草植物學上之名稱，有「翹搖」「碎米薺」等二項。翹搖之名見於本草綱目，最初見於更早之「毛詩草木鳥獸蟲魚疏」(261–303)。至1849 年之「植物名實圖考」，均無所置疑。

「碎米薺」之名，於「大和本草」(1708)認爲正確，但最初記載見於「救荒本草」(1593)。

以上考證結果，本草學上以「翹搖」爲正統名稱。

(2) 歷史上確實記載，而記錄最古之「芥子園畫傳」(1701)，有紫雲英之稱。此項記載在以往文籍中，亦係確實。因爲比較本草上名稱易於理解，所以日本江戶末期直至現在之農學書上記載多用此名稱。原著「芥子園畫傳」乃中國南方畫派之教科書，而爲本草學者所忽視，殊深爲憾。

(3) 學名 Astragalus sinicus L, Astragalus lotoides, Astragalus Sinensis 三者之中，以第一個學名係 Linne 命名爲最古 (1784)，故以 Astragalus sinicus L. 一學名統一之。

(4) 在中國有代表性之名稱，已如上述三則。此外，文獻上有九個異名：如野蠶豆、紅花菜、鐵馬豆、苕（詩）、苕翹、柱夫（爾雅）、搖車（爾雅），米布袋（救荒本草）、花草 (Hua ts'au)。

現代記載如「中國農書」中，稱曰蝴蝶花。但以花草二字通用最廣。浙江江蘇多稱花草。

臺灣稱曰蓮華草或紫雲英；韓國所用漢名爲紫雲英，係由日本傳入。

(5) 英文名爲 Chinese milk vetch, genge, a kind of vetch.

德文名爲 Schmetterlingsblüte

俄文名爲 Coronilla varia

荷蘭文名爲 Bontbloemig kroon kruid

(6) 日本名稱

在百葉集中，有「回具、惠具」、「回個」、「土針」、「須美禮」等名稱，與紫雲英之名稱相當，相互反證各個說法，成爲自古以來萬葉本草學者間之議論對象。檢討各學者主張，考諸「萬葉」以來其他文學書籍，以「回具，惠具」之說爲有力。（孫貽謀）

## 六、柑桔黑星病接種源之探討。[K. C. McOnie (1964) Phytopathology 54: 64～67]

柑桔黑星病猖獗爲害甚厲在南非洲，若無適當保護時，90%以上之果實受害而不符合出口規定。惟有關其發病情形之資料很少，並有許多互相矛盾之地方。一般人認爲柄胞子以及子囊胞子爲本病之接種源，但亦有人主張果皮上之病斑乃由潛伏在小花梗之菌絲侵入而引起。作者曾就下列幾點有關發病情形進行多年

之觀察並認爲柑桔黑星病病原菌之有性世代 *Guignardia citricarpa* Kiely 乃是眞正引起病害之原因。

1. 子囊胞子之存在：——由鏡檢落葉以及胞子採集結果，知悉除八、九、十、三個月外，其他月份均有子囊胞子存在，尤其春雨之後十二月迄翌年正月，空中胞子達到最高量。

2. 不同時期果實套袋之效果：——花開後自九月十八日起至翌年二月二十四日止，於不同時期，以紙袋套果實。結果十一月三日以前套袋之果實很有效地避免受黑星病菌之侵入。又套袋人工接種之成功否定了系統性菌絲侵入之假定。

3. 病原菌侵入發病之垂直分佈；——柑桔黑星病病原菌之無性世代柄胞子帶有粘着性，被認爲藉濺水傳播。爲明瞭在果樹較低位之果實是否被害較重，乃比較樹冠上下部果實之被害情形。結果平均病斑數之比例爲上部 99-64.7 對下部 101-66.4，並無顯著差異。

4. 接種試驗；——以帶有子囊殼之枯葉接種葡萄柚證實子囊胞子可以侵入果實而引起病斑之形成。（劉康鑑）

## 七、馬鈴薯×毒素病於葉部上幾種不同抗毒素病之抑制物質。(W. J. Hooker and W. S. Kim(1962)Phytopathology 52: 688～692)

高等植物葉部之具有抗毒素物質引起人們很大的興趣，因爲此種抗毒素物質可能具有抗病之能力，Duggar 及 Armstrong 於患煙草嵌紋毒素病之商陸 (Phytolacca decandra) 葉部上發現有抑制物質之存在，同時於 *Datura Stramonium*（對馬鈴薯 Y 毒素病免疫）及 geranium 上也發現較少之抑制物質，據渠等之研究結果，馬鈴薯塊莖上無抑制物質之存在。Sill 及 Walter 於研究胡瓜葉部之抑制物質對 Virus 之關係時，闡明在黃化組織中含抑制物質很低而毒素之含量則甚高，同時 *Dianthus barbatus* L 植物上之煙草輪斑毒素病，其抗病植株之抑制物質較易感染及中間性感染植株之含量爲高。Bagnall 等發現將罹病之馬鈴薯及煙草汁液分別加熱後會增進其馬鈴薯毒素病之發病力。

馬鈴薯各品種之葉部汁液中含有對 *Gomphrena globosa* L 之 P VX 毒素之耐性，敏感性及免疫性之抑制物質，其對發病能力之抑制於 20–24°C 時可持續八天之久，一般來說，以毒素及汁液混合接種時其發病最高期爲 2～4天，當馬鈴薯毒素病及葉部汁液以水稀釋時，若其比爲1：1,000 時則其發病力很低。

馬鈴薯×毒素病若用葉部汁液混合後則一分鐘內就失去其發病力，將 *Gomphrena globosa* 先以馬鈴薯毒素病接種而後再以葉部汁液散佈於葉表面時則其對葉部局部病斑之多寡沒有影響。同時於葉部上表皮接種之前先以抑制物質用於葉之下表皮時並不影響病斑之數目。

粗糙之汁液經 7,000 g 之離心機處理後其澄清之上層液抑制因子之含量遠較底層爲高。用低速之離心機處理並於 55°C 加熱十分鐘再第二次予以低速離心處理時則可獲含抑制物質極低之含有物。

目前爲止，任何由馬鈴薯×毒素病處理之結果均無法證明其不同抗病程度之抑制物質在量及質之成份上有何差別。（朱啓魯）

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