鉀肥

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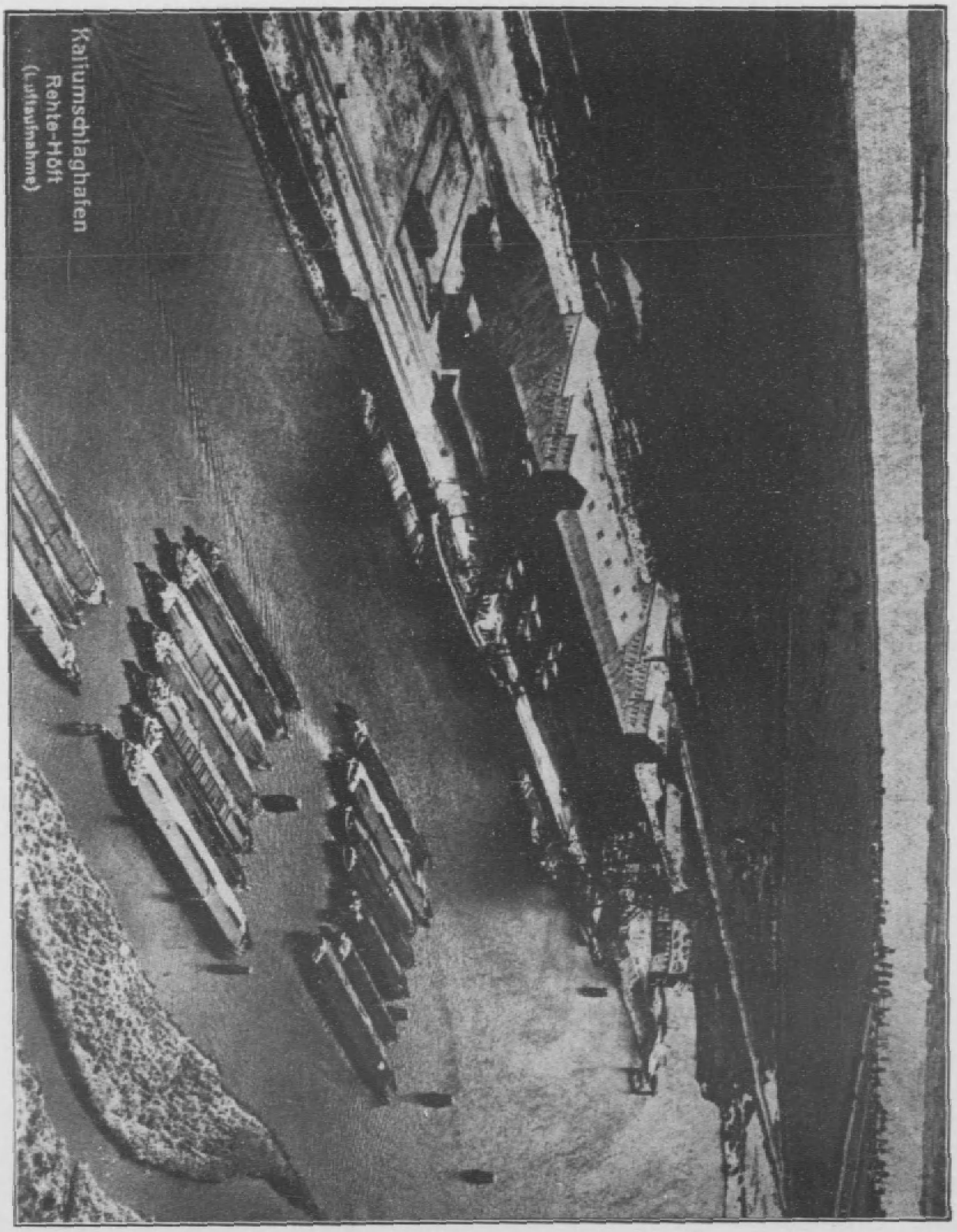
鉀肥運輸港

圖一　鉀肥碼頭之鳥瞰　Fig. 1



Port for shipping Potash

A bird's-eye view of Potash wharf.

引言

上世紀中葉，德國著名農業化學家萊比氏 (Justus Von Liebig)，首先倡言：三種主要植物營養分，必須混合施用，而後始足以保持土壤之肥沃於不敝。所謂三種主要植物營養分，即：氮，燐，鉀是。——此外，鈣之為物，雖非主要，亦屬常需。——不久之後，德國斯旦斯福 (Stassfurt) 附近礦區，當正被採掘礦中岩鹽層之際，竟發現其中含有多量之鉀鹽沉積層，無意中得之，誠大幸事。蓋此一發現，造成德國重要工業中之一之鉀質工業而得到發展；且加施鉀肥後，不特德國之農產品為之增加，即全世界之農產品亦將隨之而受惠不淺也。嗣後因繼續尋求鉀鹽之結果，又在德國中部，及法國阿爾薩斯 (Alsace)，發現許多鉀礦。

鉀鹽層之成因

鉀鹽之成因，學理上概認為海水蒸發所致。有史以前，某一時期曾有洶湧之海水

，汎濫歐洲中部，在幾度漲退之情形下，形成多數湖沼，湖沼之水，復受極度炎熱氣候之蒸發，結晶而成各種鹽類。因鹽類溶解度不同，故沉澱亦有先後：最先沉澱者爲硫酸鈣，其上爲岩鹽，再其上爲硫酸鉀，氯化鉀。經此炎熱氣候，將巨量潴蓄水分蒸發結晶後，必復有一強烈之大陸風時期，吹來一層黏土，堆積其上，遂使此高度可溶性之鹽類，得以不被冲去。其後則因地質之變遷及翻動，鉀鹽層乃被埋入地面下一千至一萬呎之深度。現所開採者，僅係一千至二千呎深度之鉀鹽層。有幾處鉀鹽層，傾斜若馬鞍狀，如第三圖中所示。

鉀鹽之開採

鉀鹽與岩鹽不同：其沉積層較薄，厚不足六呎；開採時須設備大規模之網狀坑道，工作繁複，需費巨大。孔穴係用電機鑽孔器鑽成，然後用電力發動之炸藥炸開。鉀鹽層炸鬆後，裝入輸送器，復裝入小鐵道車中，再由升降機運至製造廠。凡已開採之舊礦穴，孔道等，概以岩鹽及廢中剩餘殘物填塞，蓋預防崩裂，所以保全工人之生命也。

鉀鑛之外景

圖 二　　鐵筋混泥起重機架　　Fig. 2

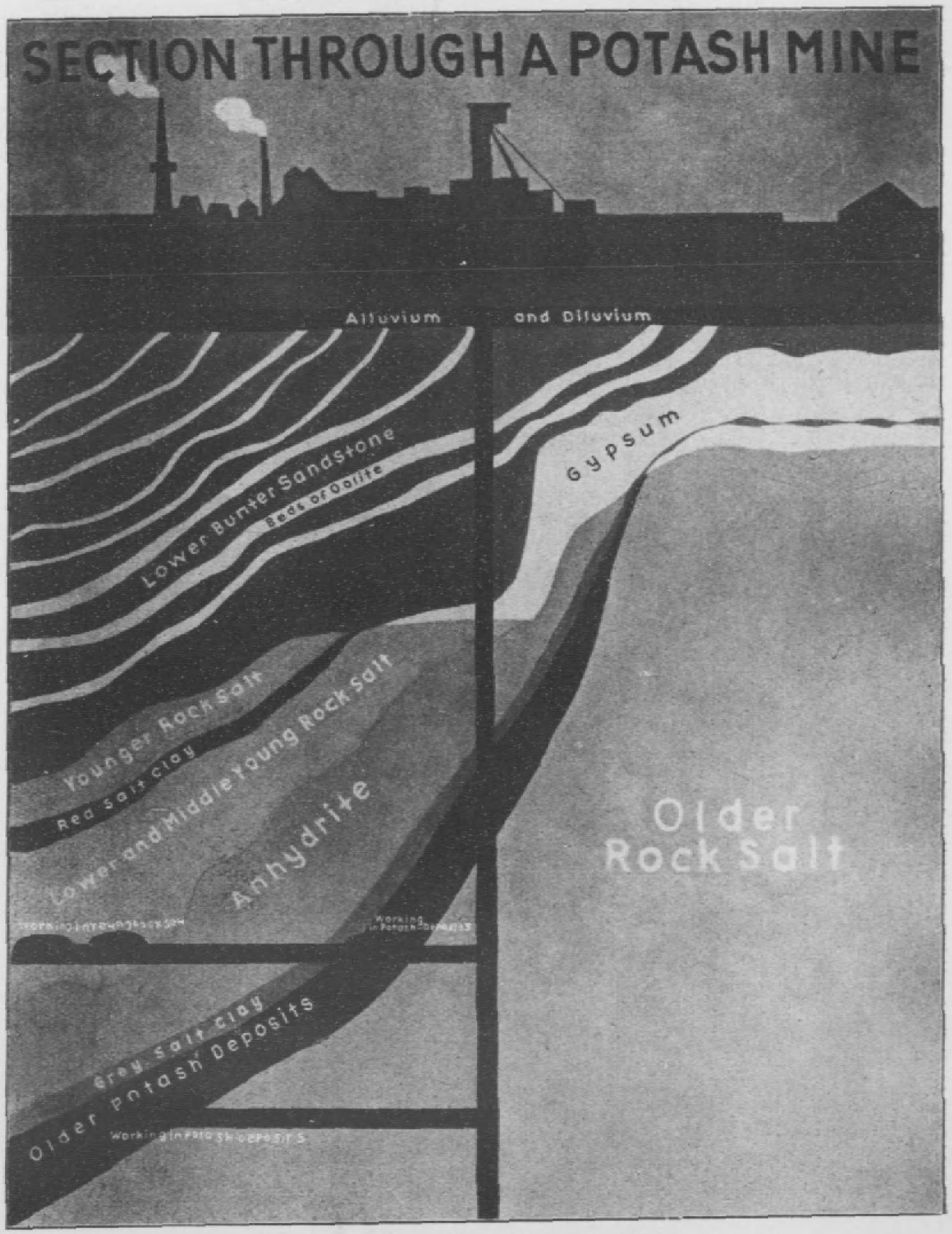
Exterior view of Potash mine

Showing concrete pit-head.

鉀礦之切斷面

此圖係明白指示"馬鞍"式之地質層中含有鉀質礦藏，
並表明鉀鹽爲何在各種不同深度中開採

圖三 Fig. 3



Section through a Potash Mine

The illustration shows clearly the "saddle" formation in the geological strata containing the Potash deposits and explains why the mining of the Potash salts takes place at various depths.

鉀質肥料之製造

製造廠為提煉剛出礦之鉀鹽而設。蓋鉀鹽未經提煉，通常含有氧化鉀(K_2O)僅百分之九至百分之十七，以之輸往遠處國家，極不經濟。煉製氯化鉀，汰除其中不適用於肥料之物質，須用種種化學分析及溶解方法，過程繁複，時間金錢，所費甚大。此種分解方法，係用大桶將熾熱之鉀質溶液，流過鋼槽，迅速轉入眞空冷凝式之傾斜塔或結晶池，使之結晶；然後再移置於旋轉之烘乾器，使其烘乾，乃運入堆藏棧，始告完成。其他鉀質肥料亦須用各種不同之製造分解方法，因限於篇幅，不及備述。

鉀質肥料之種類

硫酸鉀百分之九十，含有氧化鉀百分之四十八(K_2O 48%)。——其大部分係由氯化鉀及基綏立脫(Kieserit即硫酸鎂)中製成。因其中不含「氯」故，最宜供作含有糖質及澱粉質各種植物之肥料，而於菸草，蔬菜，及果類植物，尤為適用。

氯化鉀百分之九十五，含有氧化鉀百分之六十一(K_2O 61%)。——因其會經精煉，

成分極高，故僅宜作高級混合肥料及工業原料之用。倘欲單獨運入中國，須受中國政府規例之管制。

氯化鉀百分之八十，含有氯化鉀百分之五十（K_2O 50%）。——此係最普遍適用之鉀質肥料，成分較高，施用又極經濟。其顏色自白色至灰，紅色不定，其形狀自細粉至粗粒不等。中國之肥料經售商與農民，最初在中國市場上僅與硫酸鉀一種接觸，故其印象中僅知硫酸鉀之形狀，顏色，爲化學肥料之標準，而即以此標準鑑別他種肥料。殊不知化學肥料最重要之點，在於其所含之化學成分；顏色，形狀，實無重視之必要。無如農民固執，欲使其明瞭此義，猶有待於若干時期之解釋與宣傳耳。

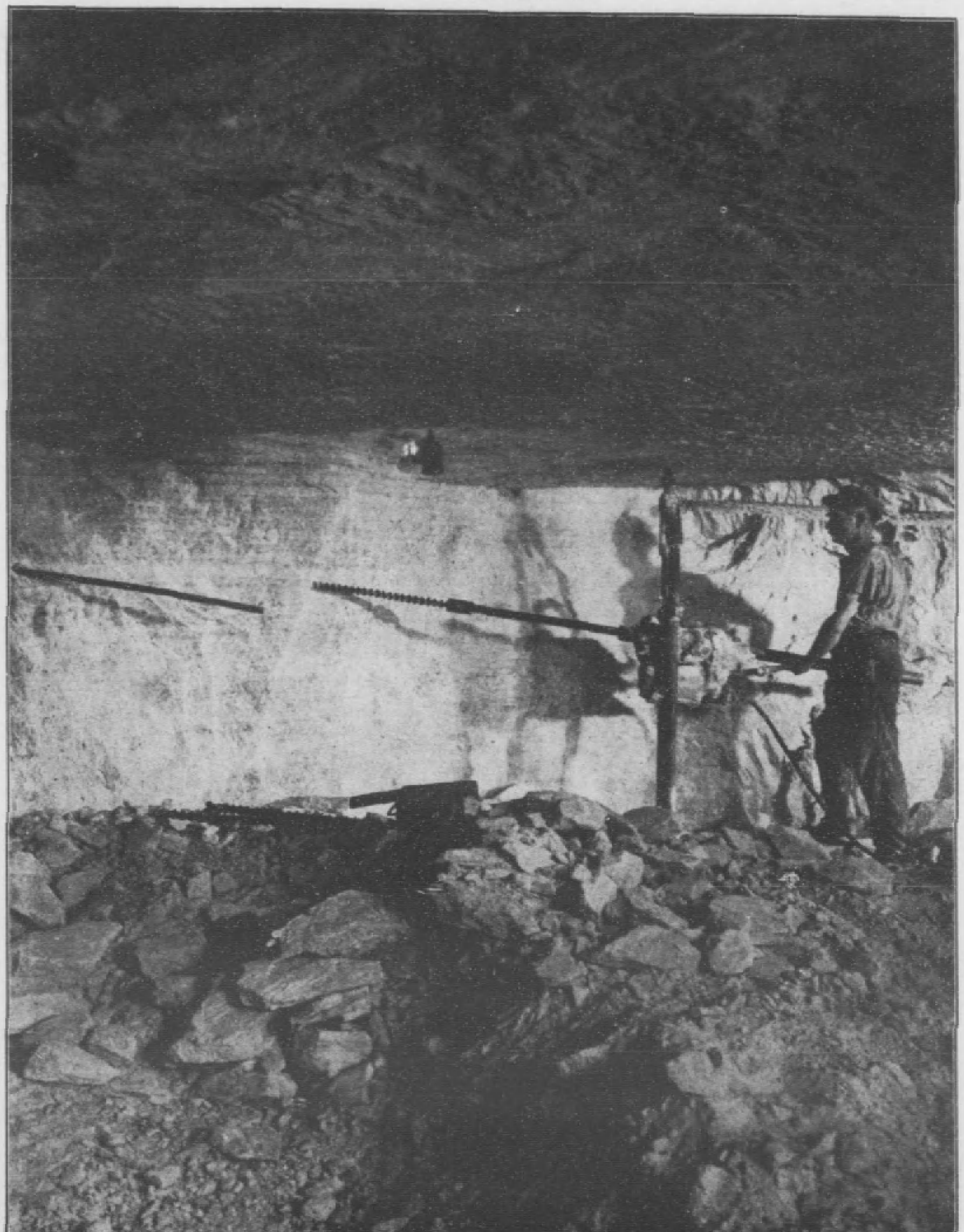
鉀肥百分之四十八，含有氯化鉀百分之三十（K_2O 30%）。——此在美國棉作上施用最多；雖其成分較低，但在中國福建省亦頗風行。其顏色亦自白至紅不定，白色者較受歡迎。

卡尼特（Kainit），係未經製煉之鉀鹽，含有氯化鉀百分之十四至十七（K_2O 14—17%）。——因其成分過低，運費按成分核算，未免太貴，運至遠處殊不經濟也。

電機鑽孔器

開採鉀鹽，須先鑽孔然後炸烈；將火藥彈放置鑽成之穴孔中，

圖 四　　然後藉電燃燒而爆發　　Fig. 4

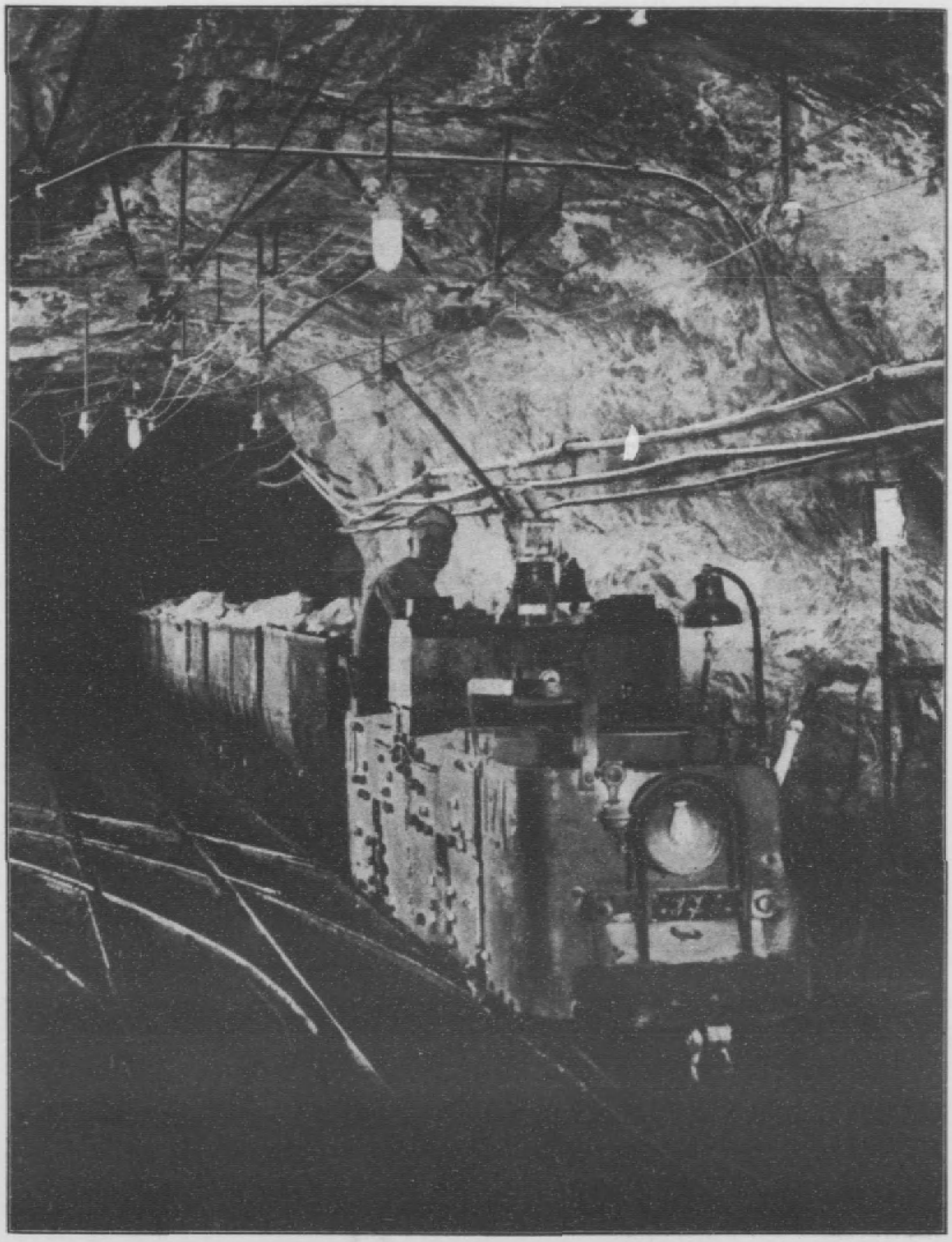


Electric Drilling Machine

Drilling of the Potash salts is carried out prior to blasting. Cartridges are placed in the bore-holes and exploded by means of electrical ignition.

在主要運輸坑道中

圖五　車列之鉀鹽載裝　Fig. 5



In the main transport gallery

A train of trolleys loaded with Potash salts.

鉀質肥料之分配

各主要農業國每年所用鉀質數量，茲列表於后：

一九三六年各主要農業國鉀質消用量（以氧化鉀(K_2O)計算）

德意志	九四九，〇〇〇公噸
美利堅	三三三，〇〇〇公噸
法蘭西	二二〇，〇〇〇公噸
日本	一〇〇，〇〇〇公噸
荷蘭	九二，〇〇〇公噸
英吉利及愛爾蘭	七〇，〇〇〇公噸
比利時	五六，〇〇〇公噸
丹麥	三二，〇〇〇公噸

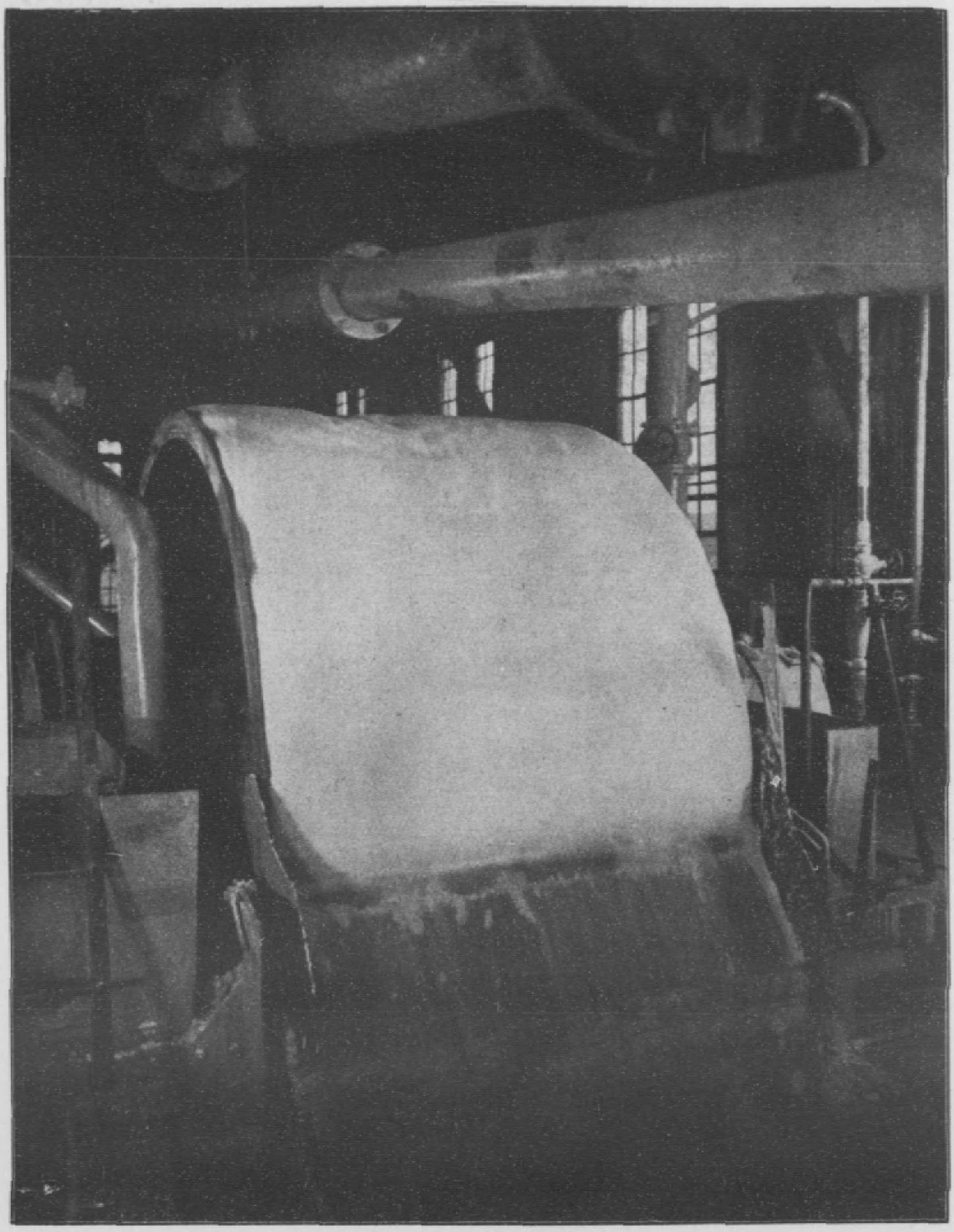
鉀質肥料之銷用，有季節性關係。爲使其適應季節性起見，鉀質肥料製造廠卽在其本廠及主要出口點如：漢堡(Hamburg)，勃利曼(Bremen)，及安得華(Antwerp)等處，各建有極大堆棧。此項堆棧，均具有現代式之最新設備，可參閱照片。（圖一）

鉀質肥料出棧以後，或以「散裝」式裝入鐵道車輛，運往各地；或打包過磅，以特種機器縫口，裝船運往海外。

全球各大海口，均有多量鉀質肥料運到。上舉各出口點之堆棧中，通常堆存鉀質肥料三十萬公噸，每日可輸出一萬二千公噸。

鼓形眞空濾清器

圖 六　　使鉀鹽從原液中分離　　Fig. 6

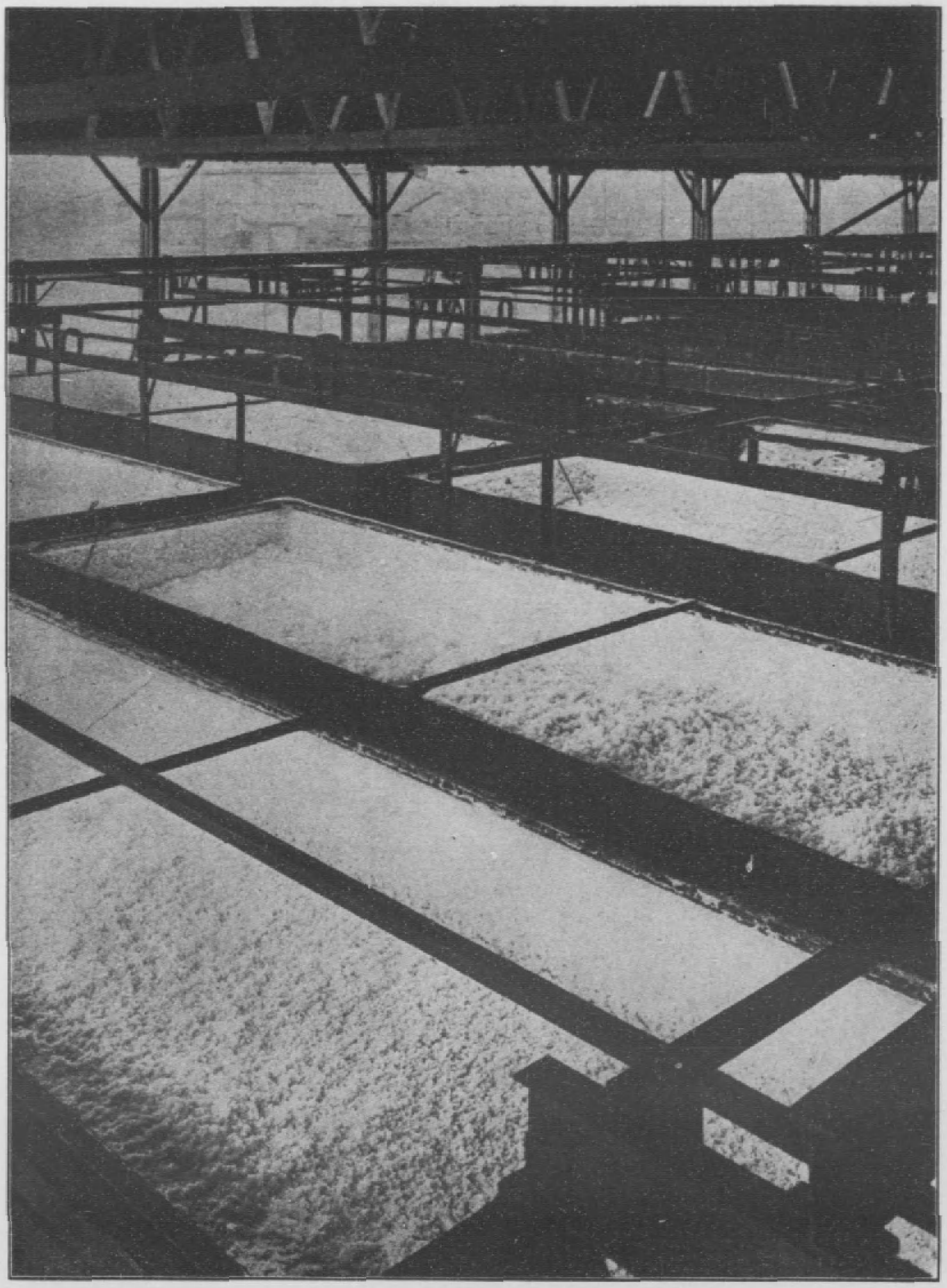


Drum Vacuum Filter

For separating Potash Salt from mother liquors.

結 晶 池

圖 七　當熱溶液冷却時，鉀鹽結晶即在池之邊緣凝成　Fig. 7



Crystallisation Vats

When the hot crude solution cools crystals of Potash salts form on the side of the vats.

鉀質對於農業之重要

無論人類或動植物，若加以化學分析，則除他種元素外，無不含有鉀質元素，惟蓄量不等耳。於此可知鉀質實爲一切生物之必要基礎。苟無鉀質，卽無生命。換言之：如欲確保生物之成長，則鉀質固必不可少也。

營養元素之功能

鉀質以外，尙有二種主要元素，卽：氮質與燐質。對於植物，亦屬絕對必要。此三種元素之功能，對於植物之繁榮滋長，極有關係，由科學方面研究之，要不無深長意義焉。

氮質有發育枝葉及產生蛋白質與醯胺質(Amids)之功能。倘無充分之氮質使植物枝葉得以完美生長，則任何植物均不能結果。換言之：氮質能使植物生長迅速，並使其有茂密之枝葉及深綠之色素。

燐質對於植物之功能，尤以在種子與果實之構成上爲大。蛋白質中亦含有燐質，故對於植物蛋白質之構成，亦極重要。

鉀質爲構成炭水化合物所不可少。此可由事實證明：蓋植物之富於澱粉質與糖質，多半皆與鉀質肥料相呼應也。且經多次之試驗證明：鉀質對於植物根部之發育有特殊之功效，故在亢旱時期，亦能安全渡過，而不受影響。鉀質又能增進植物本體之結構，結果較之不施鉀肥者，有兩種利益：一則防止穀類植物之倒折與果樹枝條之斷折；一則使其組織健壯，而有耐久之品質，可以抗抵病害，不易受蟲類與寄生物之侵襲。因此，尤須注意者：鉀質除增加產量外，更使農產物之品質提高，此固爲現代對於農產物之評價所最重視之點也。

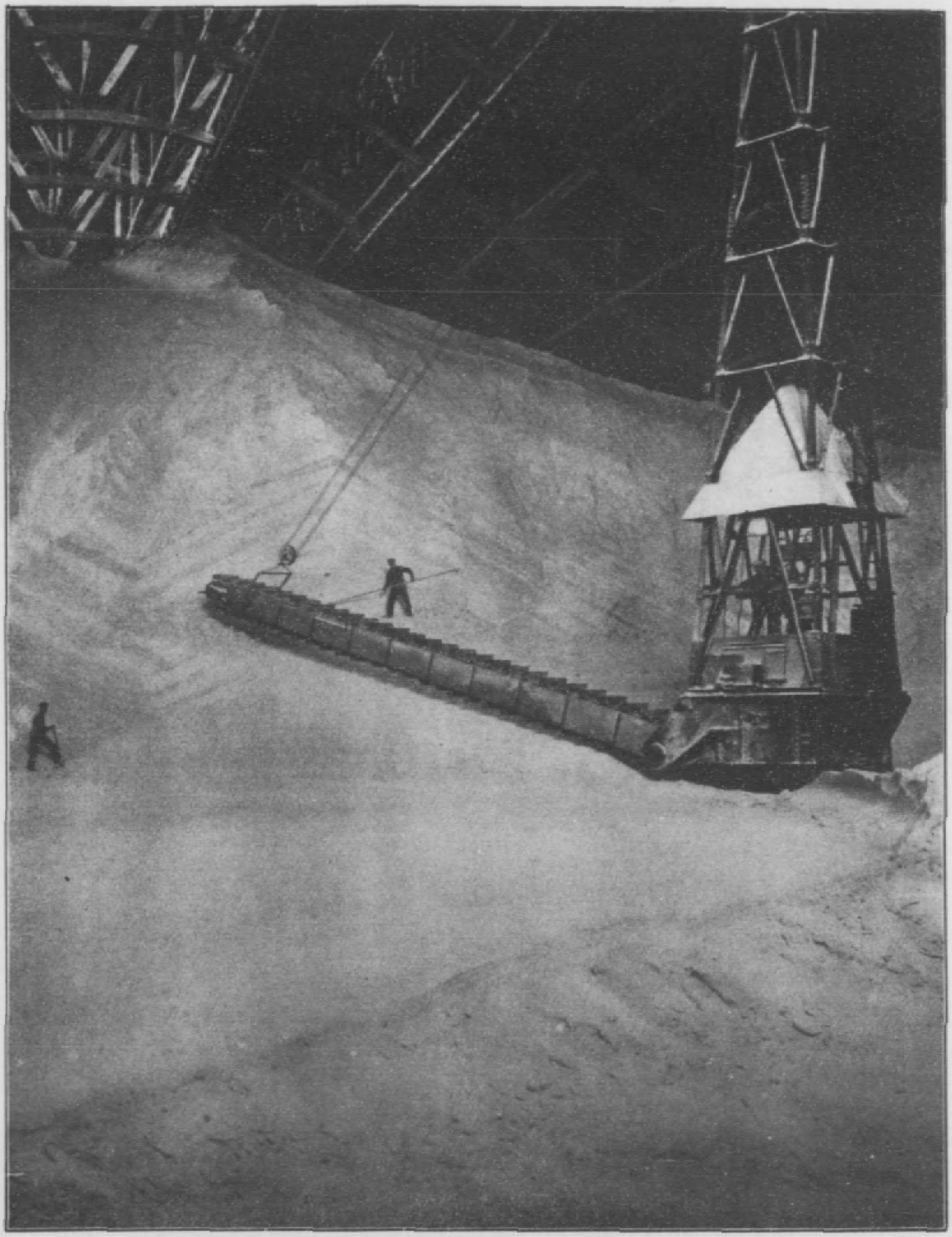
其他元素如鈣，鎂，鐵，硫等，亦皆直接或間接構成植物之一部分，惟因大半土壤中含量尚豐，足資利用，無需再加補充，故在農民觀點上似覺不見其重要耳。

上述各種主要元素，對於植物均各有其功能。故欲使植物正常生長，則非各種元素同時齊備不可；缺其一，其結果必不美滿也。

鉀質肥料堆棧

"蠶形鏟運器"將鉀鹽鏟在溝下之帶形運輸器上，

圖 八　　運至裝貨場及裝袋場　　Fig. 8

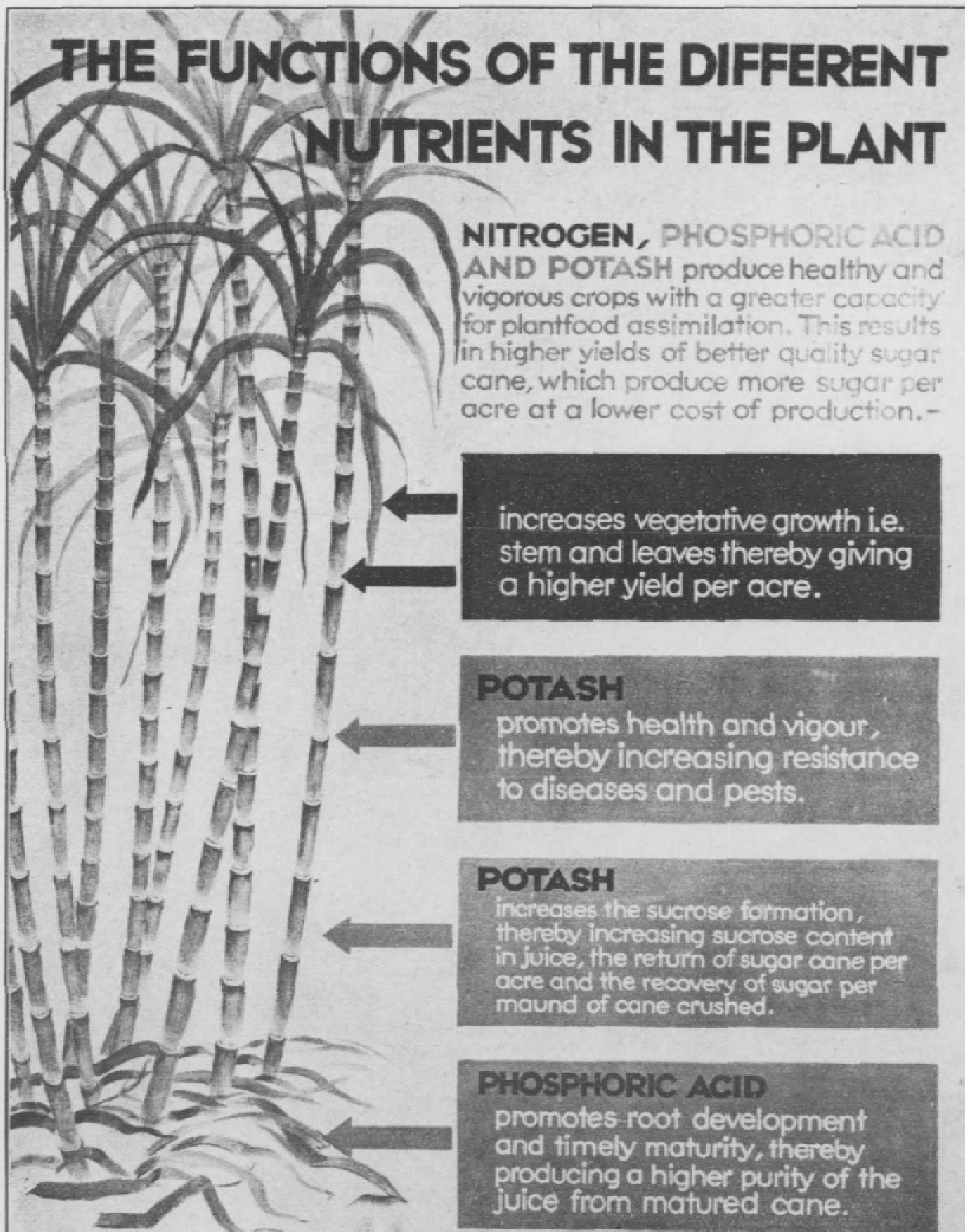


Silo for Manufactured Potash salts

Cater-pillar "Scraper" shovels Potash fertilizer salt on to a belt conveyor below the floor, which transports it to the loading and bagging stations.

各種營養素對於植物之功能

圖 九 Fig. 9



植物營養料缺乏之徵象

或多或少顯明之徵象，表示植物缺乏某種營養料。例如缺乏氮質，表現於植物則爲葉色發黃，生機衰弱。又如缺乏燐質，則開花結實，均受影響。且燐質不充足，將使作物之成熟因之延遲，根部正常之發育受其妨礙。

多數植物從土壤中吸收鉀質，較其他營養料爲多。因此，凡經過長期不斷耕種之土壤，（實際上正如中國所有者！）尤其在天然養料含量本屬極少之鬆質沙土，其鉀質貧乏之危險，尤其重大。在此種土壤耕種之作物，由於缺乏鉀質而使作物生理上所發生之不良徵象，極易顯現。最顯明者厥爲：葉面呈現褐色斑點，葉緣變成褐色而捲曲，營同化炭酸作用最要之因素——葉綠素，其形成過程不能依照正常途徑進行，根部不能充分發育滋長，種子發芽力大爲減低，尤其在作物行將成熟之時，作物整體形狀爲之一變，內部組織因以貧弱，其結果，使作物之收獲量多少受其影響。此處所描述缺乏鉀質之徵象，僅在土壤中所含之鉀質被前期逐年耕種之作物吸收已盡之

極端情形下，方始發現。惟在缺乏鉀質之初期，作物之生產量已將因之而減低，故當缺乏鉀質之徵象已經顯明時，必須隨卽施用適量之鉀質肥料，庶幾可以恢復土壤之肥力。

植物營養料吸收量

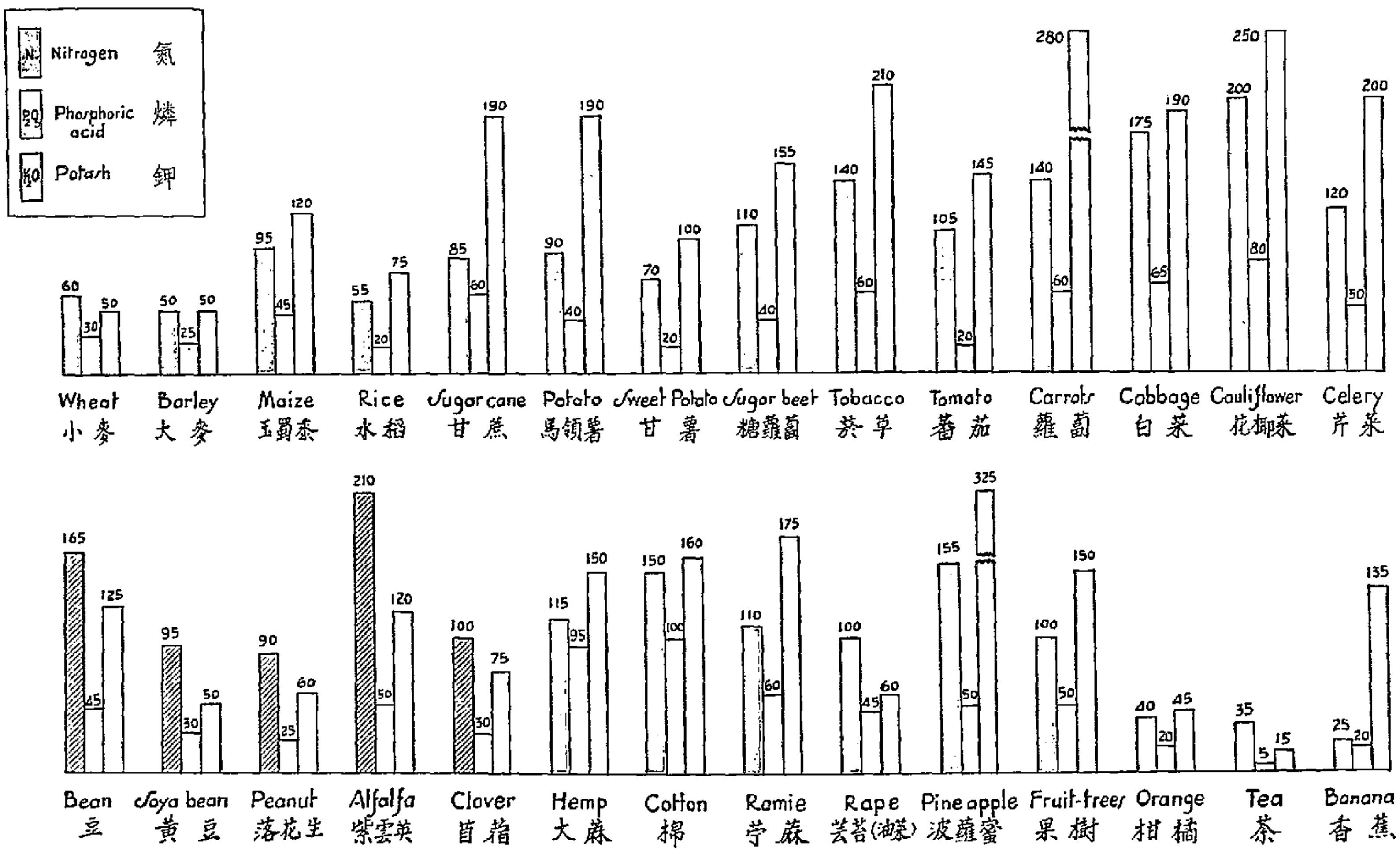
所有植物均需要氮，燐，鉀三種主要元素，已如上述。惟其需要之數量，則各因植物特別需要之不同而有差別。因之，凡枝葉發達之植物，則需要氮質較多；凡蓄積糖質與澱粉質之植物，則需要鉀質更多。如甘蔗，根果，及果樹等植物，尤須特別施用鉀質，但亦不能遺忘氮質與燐質，蓋各種元素均非可以他種元素代替，此項理論，固早爲德國農業化學家萊比氏及全球專家之研究所證實者也。

下頁着色圖表中，表示作物在平均情形之下，從土壤中吸收養料之數量。同時表示，應如何施肥，方得美滿之收成。但有一點極關重要，必須注意，卽施用於作物之養料，必須其在土壤中極易溶解，俾使作物在生長之全時期中得以隨時吸收者。此係最重要之事實，表示除天然肥料之外，在現代農業中，必須兼用人造肥料，因其可以

Amounts of plant-food removed from the soil by Agricultural and horticultural crops in kg ha

農作物從每公頃土壤中吸收養料之公斤數

Fig. 10
圖一〇



Leguminous crops can with the help of the root nodule bacteria draw their supply of nitrogen from the air.

豆科作物能賴其根瘤細菌吸取空中之氮氣。

供給速效之養料故也。

施用人造肥料之必要

中國乃一最完美之農業國。農民本能傾向農業。勤勉刻苦，舉世無匹。而多數行省土壤肥沃，氣候優良，又非他國可與倫比。本此良好基礎，故其農業，在幾世紀前早已極度發達。顧土壤既經長期不斷耕種，勢必漸成貧瘠；而人口增殖，所需食糧日多；自非設法加施肥力，使已感貧瘠之土壤，重新恢復更大之生產能力，實不足以彌補此項缺憾。

無如中國農民不諳科學方法，僅知施用堆肥，人糞尿，豆餅，草木灰等作爲肥料。雖暫時亦足以使土壤恢復某種程度之生產能力，但欲應付當前人口加多，食糧激增之需要，仍覺無濟於事。此種舊式施肥方法，顯屬不克保持土壤肥力。西歐諸國工業，在十九世紀下半期業已發達，農業方面，亦早已採取新式施肥方法，中國如其欲使農產增加，實有借鏡西歐，積極研究或仿效之必要也。

中國政府及有關係之洋商，現已對此進行廣泛之研究，咸認爲欲增加土壤肥力，

解決食糧問題，除施用中國原有之天然肥料外，非兼用人造肥料不可。按天然肥料與人造肥料混合施用，確屬最有價値：前者予土壤以有機質，並使益菌得以生長；後者予土壤以必要而速效之養料，最易使作物吸收，而此最易被吸收一點，尤屬甚關重要者。

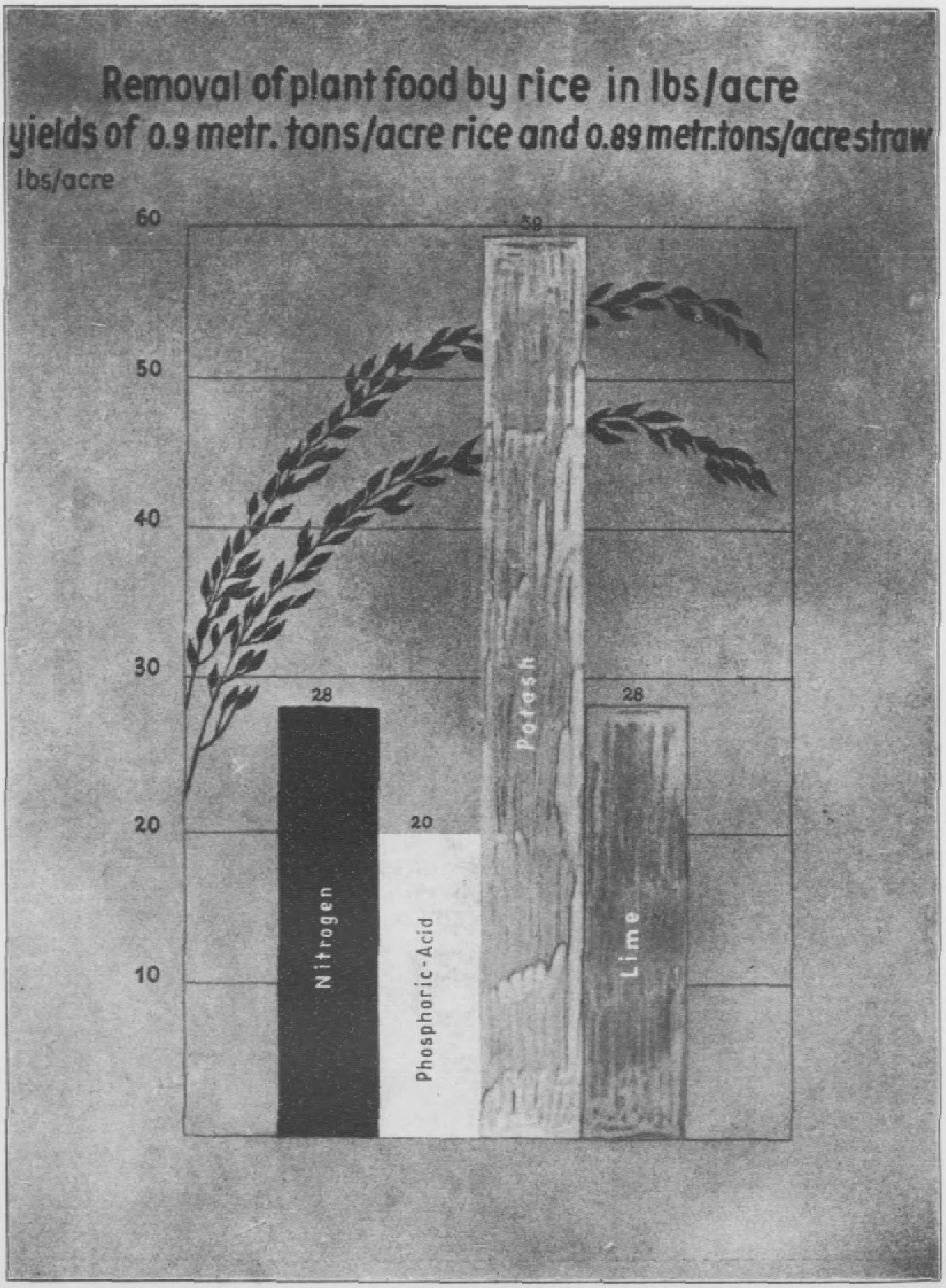
此外必須注意者，蓋大多數土壤對於植物各種營養元素，——尤其對於鉀質，有強大之吸收能力。倘施用鉀質分量太少，卽易引出錯誤，且將立卽被土壤吸收淨盡，而無補於作物。故顯明之鉀肥效力，惟有在土壤吸收鉀質充分飽和而爲作物根部所利用之後，方能看出也。

肥料與優良種子之關係

欲培育優良種子，必須以科學方法利用化學肥料。蓋優良種子，必具備產量豐富，品質良好之條件。而欲栽培此項優良種子，達到被精選之目的，——卽使其能發揮所有能力，產生完美結果，則惟有生長在適當情況之下，供給其必要之養料，方克臻此。且優良作物，對於肥料之吸收力特大，必須有賴於高度之肥力；故施用化學肥料

水稻從每英畝土壤中吸收養料之磅數

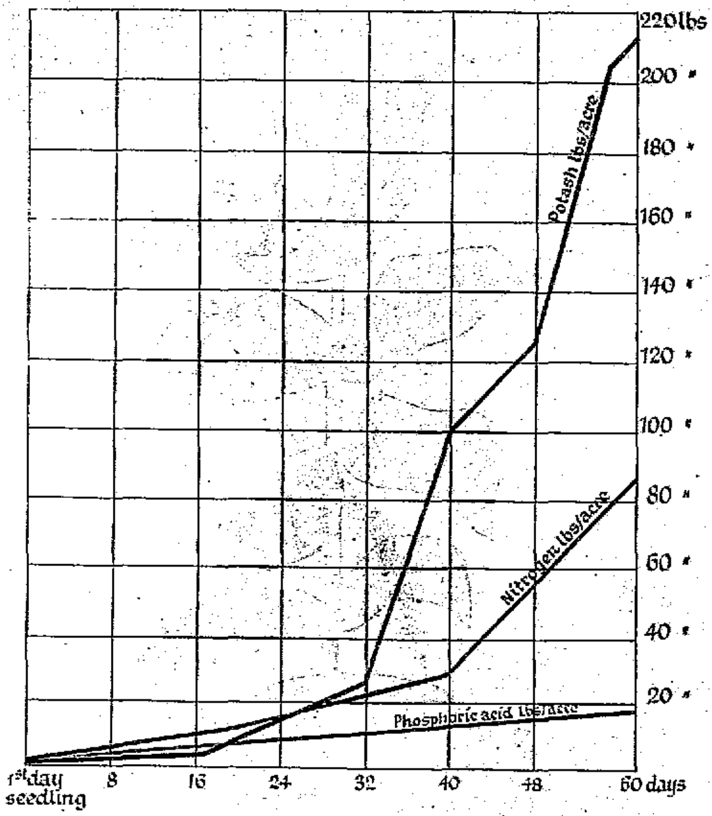
圖 一一 （根据每英畝生產穀 0.9 噸及藁 0.89 噸計算） Fig. 11



菸草從每英畝土壤中吸收養料之磅數

圖一二 Fig. 12

Absorption Of Plant Food By the Tobacco plant



Tobacco needs large amounts of available potash throughout the growing period. High quality can only be obtained by liberal manuring with Sulphate of Potash.

，對於優良作物，較之土種作物，更其重要。如果對於化學肥料之適當施用，稍有疏忽，必將使所有費時耗錢之育種工作，完全失敗。故優良種子之育成，必須與化學肥料之採用，同時並行。

田園試驗

西歐諸國早已進行大規模之研究工作，確定施用三要素之配合比率。中國藉此有所借鑑，自屬便利不少。不過中國土壤作物，有其特殊需要，未必盡同西歐，故研究工作，仍屬重要。駐華鉀質肥料聯合公司爲補充中國之農業機關及試驗場之研究工作起見，歷年來會作出多次試驗與提示。其在中國所作全部工作之詳細報告，自不便一一列舉於此，玆僅將試驗成績表纂列於下。此項表中，可以看出加施鉀肥，確能增加收成；且更可證明：中國之農產，可以在目前施肥方法中，由於加施鉀肥而得到重大增加與改良。

鉀質肥料公司肥料試驗成績表

第一表　甘蔗——廣東　福建

號數	試驗地點	施用肥料(每畝)		加施鉀肥增收量(每畝) 甘蔗	加施鉀肥增收量(每畝) 糖	增收率 甘蔗	增收率 糖
	一九三四年在廣東省試驗						
一	潮安縣烏壽鋪鄉	硫酸錏加鉀肥48%	五〇斤	四,三五八斤		五一·二%	
二	潮安縣烏壽鋪鄉	硫酸錏加氯化鉀	四〇斤	一,四八〇斤		一九·七%	
	一九三五年在廣東省試驗						
三	饒平縣黃岡	硫酸錏加鉀肥48%	六〇斤		六二·五斤		一二·五%
四	揭陽縣曲溪	硫酸錏加氯化鉀	二〇斤		三五·五斤		七·四%
		硫酸錏加氯化鉀	三〇斤		一二〇·五斤		二一·四%
		硫酸錏加氯化鉀	四〇斤		八七·五斤		一八·二%
五	普寧縣貴嶼	硫酸錏加鉀肥48%	五〇斤		一二一·〇斤		三六·八%
六	澄海縣鴻溝鄉	硫酸錏,過燐酸鈣加鉀肥48%	五〇斤		一八〇·五斤		三四·七%

一九三六年在廣東省試驗							
七	揭陽縣曲溪	完全混合肥料（氮一二% 燐八% 鉀四%）加氯化鉀	一八·二斤	一一〇·〇〇斤		一七·一%	
		完全混合肥料（氮一二% 燐八% 鉀四%）加氯化鉀	一六·四斤	一六六·〇〇斤		一二·六%	
一九三七年在福建省試驗							
八	同安縣鼎美	硫酸錏，荳餅加鉀肥48%	五〇斤	一五八·三斤		三四·三%	
九	漳州路口	硫酸錏加鉀肥48%	四〇斤		五二八斤		一四·二%
一〇	漳州新厝鄉	硫酸錏加鉀肥48%	五〇斤		五六〇斤		九·二%
一一	漳州新厝鄉	硫酸錏加鉀肥48%	五〇斤		一，七五〇斤		二九·二%
一九三七年在廣東省試驗							
一二	東莞糖廠第一蔗場	花生餅，完全混合肥料（氮一二% 燐八% 鉀四%）加氯化鉀	一一·八八斤	八五·六斤		一二·五%	
		花生餅，完全混合肥料（氮一二% 燐八% 鉀四%）加氯化鉀	二三·七六斤	八七·七斤		一二·八%	
		花生餅，完全混合肥料（氮一二% 燐八% 鉀四%）加氯化鉀	三五·六四斤	四九·六斤		七·三%	
加施鉀肥後之平均增收量及增收率				九七·一斤	一，七三五斤	一九·〇%	二四·七%

第二表　水稻——廣東　福建

號數	試驗地點	施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
	一九三三年在廣東省試驗				
一	饒平縣龍城	硫酸錏加鉀肥48%	二〇斤	五九·〇〇斤	一〇·〇%
二	潮安縣林邁鄉	硫酸錏加鉀肥48%	二〇斤	一一四·三七斤	二七·〇%
三	潮安縣林邁鄉	硫酸錏加鉀肥48%	二〇斤	四一·二五斤	七·〇%
	一九三四年在廣東省試驗				
四	鶴山縣沙坪	硫酸錏加氯化鉀	一五斤	九五·〇〇斤	二八·〇%
五	鶴山縣木河	硫酸錏加氯化鉀	一五斤	七〇·〇〇斤	一七·〇%
六	鶴山縣木河新村壟	硫酸錏加氯化鉀	一五斤	八〇·〇〇斤	二七·〇%
	一九三六年在福建省試驗				
七	龍溪縣漳州	硫酸錏加鉀肥48%	一六斤	六〇·〇〇斤	一七·〇%
八	海澄縣港尾	硫酸錏加鉀肥48%	二〇斤	七四·〇〇斤	二〇·〇%
九	海澄縣港尾	硫酸錏加鉀肥48%	二〇斤	五五·〇〇斤	一七·〇%
一〇	海澄縣港尾	硫酸錏加鉀肥48%	二〇斤	四七·〇〇斤	一五·〇%
		加施鉀肥後之平均增收量及增收率		六九·五〇斤	一八·五%

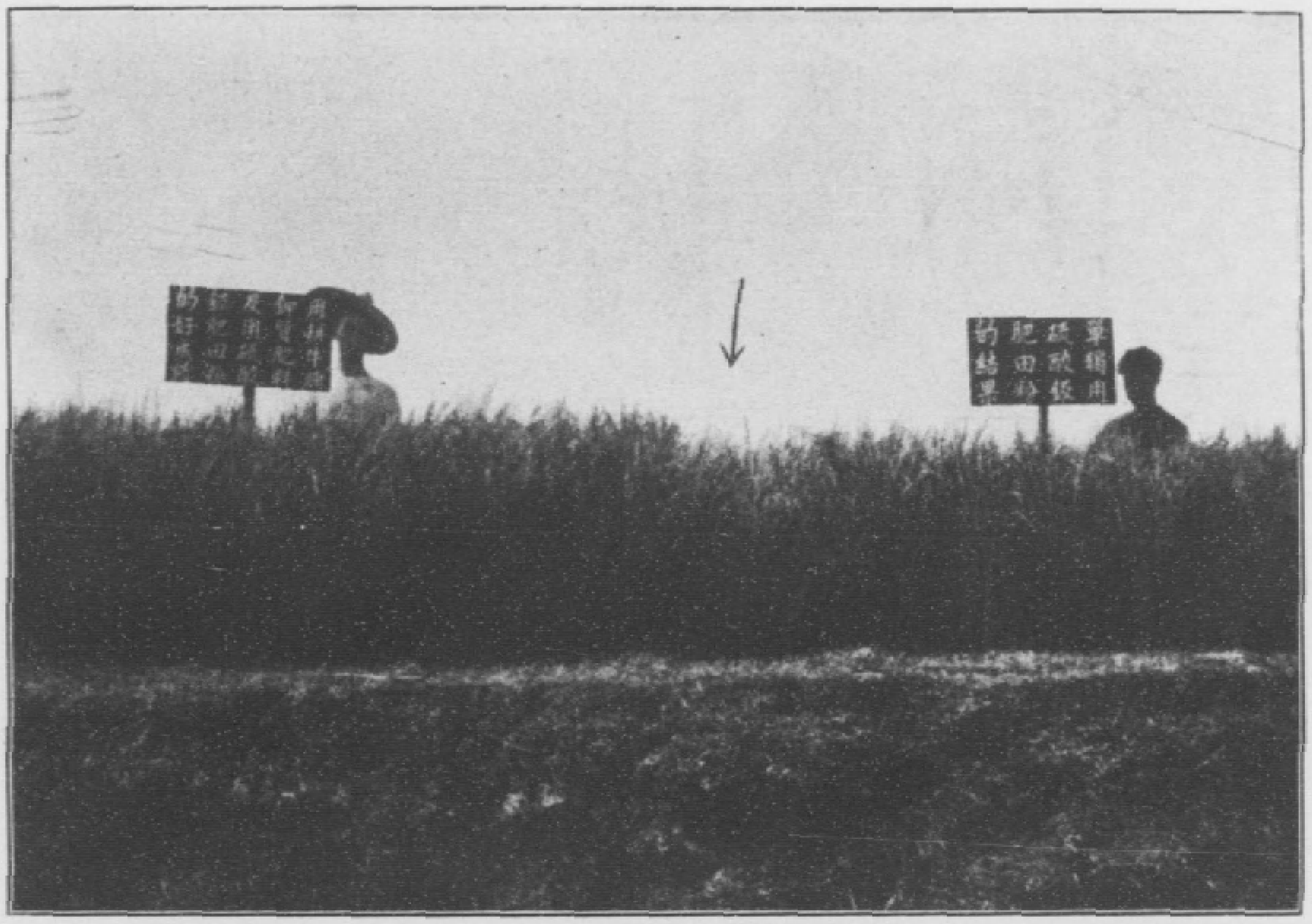
附註　以上試驗成績並未施用燐肥如兼施過燐酸鈣則其增收量當更多此種過燐酸鈣在廣州西村肥田料廠極易購得

水　稻

廣東潮安

WATER RICE EXPERIMENT

圖一三　AT CHAO AN, KWANGTUNG　Fig. 13



NK 氮鉀		N 氮
	Maruring per mow	
35 cat.	Sulphate of Ammonia	35 cat.
20 ,,	Potash Manure 48% KCl	——
535 cat.	*Yield* per mow	421 cat.
	Increase per mow due to Potash	114 cat.
	Percentage increased	27 %
	每畝施肥量	
35 斤	硫酸錏	35 斤
20 斤	鉀肥 48 %	——
535 斤	每畝生產量	421 斤
	加施鉀肥每畝增收量	114 斤
	增收率	27 %

水 稻

江蘇寶山吳淞

WATER RICE EXPERIMENT

圖 一四 AT WOOSUNG, PAOSHAN, KIANGSU Fig. 14

Usual manure 土肥		NPK 氮燐鉀	
	Manuring per mow		
Night soil 114 cat.		Soyabeancake	59 cat.
		Sulphate of Ammonia	28.2 cat.
		Superphosphate	18.8 ,,
		Sulphate of Potash	18.8 ,,
260 cat.	*Yield* per mow		329.12 cat.
	Increase per mow due to NPK Fertilizers		69.12 ,,
	Percentage increased		27 %

	每畝施肥量		
糞尿 114 斤		荳餅	59 斤
		硫酸錏	28.2 斤
		過燐酸鈣	18.8 斤
		硫酸鉀	18.8 斤
260 斤	每畝出產量		329.12 斤
	施用氮燐鉀完全肥料每畝增收量		69.12 斤
	增收率		27 %

第三表　水稻——江蘇　浙江

號數	試驗地點	施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
	一九三一年在江蘇省試驗				
一	常州新閘	荳餅加硫酸鉀	一五斤	一〇〇・〇斤	二〇%
二	常州朱兆园	荳餅加硫酸鉀	二〇斤	一三六・〇斤	二八%
		硫酸鉀	四〇斤	二三五・〇斤	四九%
	一九三三年在江蘇省試驗				
三	松江西門	苜蓿（用作綠肥）加氯化鉀	二〇斤	九〇・〇斤	一八%
	一九三五年在浙江省試驗				
四	餘姚馬渚	硫酸铔，過燐酸鈣加氯化鉀	一〇〇斤	八五・〇〇斤	一八%
		氯化鉀	二〇〇斤	一一〇・〇〇斤	二四%
五	蕭山陸家橋	硫酸铔，過燐酸鈣加氯化鉀	一〇〇斤	六七・〇〇斤	一三%
		氯化鉀	二〇〇斤	七四・〇〇斤	一四%

一九三七年在浙江省試驗

六	黃岩	硫酸錏，過燐酸鈣 加氯化鉀	一〇〇斤	七一・〇〇斤	一二%
		硫酸錏，過燐酸鈣 加氯化鉀	二〇〇斤	九二・〇〇斤	一六%
七	義烏王楊橋村	硫酸錏，過燐酸鈣 加氯化鉀	一五斤	六五・〇斤	一三%

一九三七年在江蘇省試驗

八	青浦	硫酸錏，過燐酸鈣 加氯化鉀	一〇〇斤	六〇・〇〇斤	一〇%
		硫酸錏，過燐酸鈣 加氯化鉀	二〇〇斤	七二・〇〇斤	一二%
加施鉀肥後之平均增收量及增收率				九六・七斤	一九%

波 蘿 蜜

廣州石牌

PINEAPPLE EXPERIMENT

圖 一五 AT SHEH PAI, CANTON Fig. 15

NP 氮燐		NPK 氮燐鉀
	Manuring per mow	
60 cat.	Bone meal	60 cat.
50 ,,	Sulphate of Ammonia	50 ,,
——	Sulphate of Potash	40 ,,
1,234 cat.	*Yield* per mow	1,390 cat.
	Increase per mow due to Potash	156 ,,
	Percentage increased	12.6 %
	每畝施肥量	
60 斤	骨粉	60 斤
50 斤	硫酸錏	50 斤
——	硫酸鉀	40 斤
1,234 斤	每畝生產量	1,390 斤
	加施鉀肥每畝增收量	156 斤
	增收率	12.6 %

柑　橘

廣東江門東街

ORANGE EXPERIMENT

圖 一六　AT TUNG KA, KONGMOON, KWANGTUNG　Fig. 16

NPK 氮燐鉀		N 氮
	Manuring per mow	
35 cat.	Sulphate of Ammonia	35 cat.
35 ,,	Bone meal	——
60 ,,	Sulphate of Potash	——
1,172 cat.	*Yield* per mow	490 cat.
	Increase per mow due to P K fertilizers	682 cat.
	Percentage increased	139 %
4½ kgr.	Weight of 27 fruits	3 kgr.
	每畝施肥量	
35 斤	硫酸錏	35 斤
35 斤	骨粉	——
60 斤	硫酸鉀	——
1,172 斤	每畝生產量	490 斤
	加施燐鉀肥料每畝增收量	682 斤
	增收率	139 %
4½ 公斤	每廿七個柑之重量	3 公斤

第四表 小麥——浙江 江蘇

號數	試驗地點	施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
一九三四年在浙江省試驗					
一	硤石	硫酸錏，過燐酸鈣 加氯化鉀	二〇斤	二七·五〇斤	二三·〇%
二	硤石	硫酸錏，過燐酸鈣 加氯化鉀	二〇斤	三三·七五斤	二八·〇%
一九三五年在江蘇省試驗					
三	上海顓橋	硫酸錏，過燐酸鈣 加氯化鉀	一〇斤	五〇·〇〇斤	一五·〇%
		加氯化鉀	二〇斤	七五·〇〇斤	二二·五%
一九三五年在浙江省試驗					
四	湖州唐下	硫酸錏，過燐酸鈣 加氯化鉀	一〇斤	三一·七〇斤	一六·〇%
		加氯化鉀	二〇斤	三八·〇〇斤	一九·〇%
五	杭縣景方橋	硫酸錏，過燐酸鈣 加氯化鉀	一〇斤	三四·〇〇斤	一三·五%
		加氯化鉀	二〇斤	五二·〇〇斤	二一·〇%

一九三七年在江蘇省試驗					
六	上海浦東陸行	硫酸錏，過燐酸鈣加氯化鉀	一〇〇斤	六六·〇〇斤	一六·〇〇%
		硫酸錏，過燐酸鈣加氯化鉀	二〇〇斤	七〇·〇〇斤	一七·〇〇%
一九三七年在浙江省試驗					
七	金華	硫酸錏，過燐酸鈣加氯化鉀	一〇〇斤	七〇·〇〇斤	三五·〇〇%
		硫酸錏，過燐酸鈣加氯化鉀	二〇〇斤	八四·〇〇斤	四二·〇〇%
八	義烏馬青	硫酸錏，過燐酸鈣加氯化鉀	一〇〇斤	三三·八〇斤	二一·〇〇%
		硫酸錏，過燐酸鈣加氯化鉀	二〇〇斤	三七·六〇斤	二四·〇〇%
加施鉀肥後之平均增收量及增收率				五〇·二七斤	二二·四%

菸　草

山東楊家莊

TOBACCO EXPERIMENT

圖 一七　　AT YANGCHIACHUANG, SHANTUNG　　Fig. 17

Usual manure plus Potash 土肥加鉀肥　　Usual manure 土肥

Manuring per mow

1,000 cat.	Compost	1,000 cat.
100 ,,	Beancake	100 ,,
40 ,,	Sulphate of Potash	——

每畝施肥量

1,000 斤	土糞	1,000 斤
100 斤	荳餅	100 斤
40 斤	硫酸鉀	——

菸 草

山東黃旗堡

TOBACCO EXPERIMENT

圖一八 AT HUANGCHIPU, SHANTUNG Fig. 18

Beancake 荳餅 NPK 氮燐鉀

	Manuring per mow	
1,000 cat.	Beancake	1,000 cat.
——	Complete NPK (9-4-11) mixture	40 ,,

	每畝施肥量	
1,000 斤	荳餅	1,000 斤
——	氮燐鉀(9-4-11)完全肥料	40 斤

第五表 小麥——山東

一九三二年——一九三三年在山東省試驗

號數	試驗地點	施用肥料（每畝）	加施鉀肥增收量（每畝）	增收率
一	平度宅科	土糞二〇〇〇斤加氯化鉀二〇斤	二六・二斤	二一・〇%
二	高密夏莊	土糞二〇〇〇斤加氯化鉀三三斤	三〇・四斤	二〇・〇%
三	高密	土糞二〇〇〇斤加氯化鉀三三斤	七〇・八斤	八一・〇%
四	高密	土糞二〇〇〇斤加氯化鉀二〇斤	二七・〇斤	三五・〇%
五	黃旗堡	土糞二〇〇〇斤加硫酸鉀二五斤	九三・七斤	六八・〇%
六	即墨袁家	土糞一七〇〇斤加硫酸鉀三三斤	六七・五斤	五九・〇%
七	即墨劉家營	土糞一七〇〇斤加硫酸鉀三三斤	一〇一・三斤	二九・〇%
八	即墨流亭	土糞一七〇〇斤，豆餅五〇斤 加氯化鉀 二七斤	六〇・〇斤	三〇・〇%
九	二十里堡黃家	土糞一五〇〇斤加氯化鉀二七斤	九四・五斤	三四・〇%
一〇	二十里堡劉家	土糞一五〇〇斤加氯化鉀二七斤	一〇一・三斤	四二・五%
一一	坊子王家	土糞一五〇〇斤加硫酸鉀二七斤	八五・五斤	六五・五%
一二	即墨城陽	土糞一七〇〇斤加氯化鉀二七斤	一〇八・〇斤	五九・〇%
一三	即墨城陽	土糞一七〇〇斤加氯化鉀二〇斤	五四・〇斤	三一・〇%
		加施鉀肥後之平均增收量及增收率	七〇・八斤	四四・二%

第六表　甘藷——廣東

號數	試驗地點	施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
	一九三二年在廣東省試驗				
一	揭陽曲溪	土肥，硫酸錏加氯化鉀	三〇斤	五三〇・〇斤	三〇・六%
二	潮陽雙荳洋	土肥加氯化鉀	三〇斤	二三八・〇斤	六・八%
	一九三三年在廣東省試驗				
三	潮陽寮前	土肥加氯化鉀	三〇斤	四一〇・〇斤	一六・〇%
四	潮陽金浦	土肥加氯化鉀	三〇斤	六二二・五斤	三一・三%
五	潮陽芒巷	硫酸錏加氯化鉀	三〇斤	三七八・五斤	三一・〇%
六	潮陽後溪	硫酸錏加氯化鉀	三〇斤	三〇六・〇斤	四三・九%
七	潮陽山門	硫酸錏加鉀肥48%	三〇斤	四四三・〇斤	九・二%
八	潮陽山門	硫酸錏加鉀肥48%	三〇斤	四三四・〇斤	八・八%
九	潮陽山門	硫酸錏加鉀肥48%	三〇斤	三五七・五斤	七・九%
一〇	潮安蓬頭	硫酸錏加鉀肥48%	三〇斤	四〇五・五斤	一二・三%
	加施鉀肥後之平均增收量及增收率			四一二・〇斤	一九・八%

菸 草

山東滄口

TOBACCO EXPERIMENT

圖 一九　AT TSANGKOW, SHANTUNG　Fig. 19

NPK 氮燐鉀　　Usual manure 土肥

Manuring per mow

1,000 cat.	Compost	1,000 cat.
100 cat.	Beancake	100 cat.
50 cat.	Complete NPK (8-9-10) mixture	——

每畝施肥量

1,000 斤	土糞	1,000 斤
100 斤	荳餅	100 斤
50 斤	氮燐鉀 (8-9-10)完全肥料	——

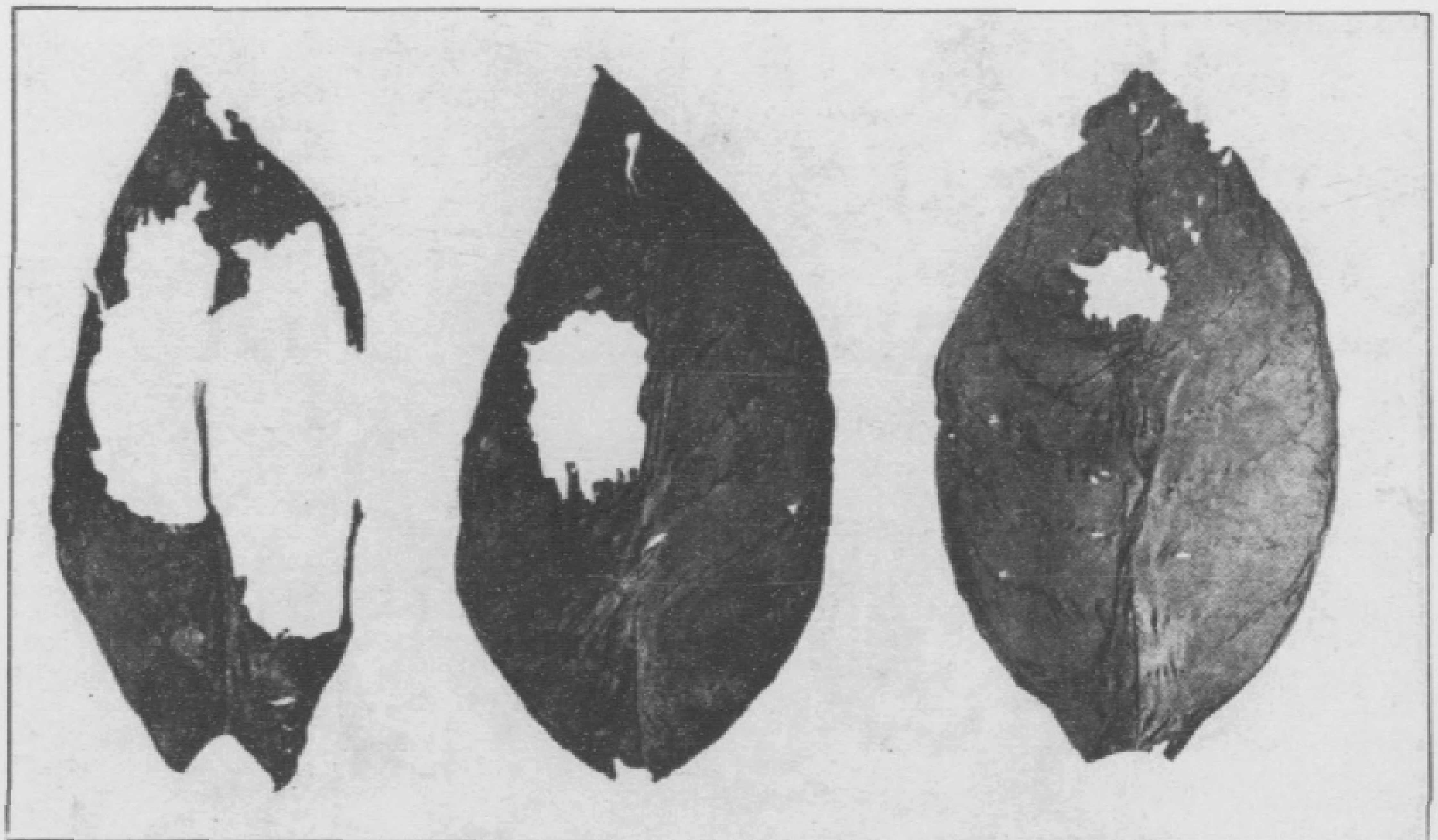
菸葉自燃試驗

左：　吸收適量鉀質
　　　自燃時間 104 秒鐘

中：　吸收少量鉀質
　　　自燃時間 28 秒鐘

右：　缺乏鉀質
　　　自燃時間 12 秒鐘

圖 二〇　　　　　　　　　　　　　　　　　　　　Fig. 20



Burning Test on Tobacco leaf

On left: Sufficient Potash

In centre and on right: Progressive Potash deficiency

Duration of burn in seconds:

on left	in centre	on right
104	28	12

第七表　甘藷——山東

一九三二年在山東省試驗

號數	試驗地點	施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
一	青島唐家口子	土糞一五〇〇斤加硫酸鉀	四〇斤	三三一·〇斤	四五·五%
二	即墨劉家營	土糞一五〇〇斤加硫酸鉀	四〇斤	三二八·三斤	二一·五%
三	平度泰家	土糞一五〇〇斤加氯化鉀	四〇斤	二六二·〇斤	三一·五%
四	青島唐家口子	土糞一五〇〇斤加硫酸鉀	三〇斤	二八九·〇斤	二三·〇%
五	即墨車家溝	土糞一五〇〇斤加硫酸鉀	三五斤	二七七·〇斤	二一·〇%
六	即墨解家營	土糞一五〇〇斤加硫酸鉀	三五斤	六八一·七斤	四二·〇%
七	即墨辛哥莊	土糞一五〇〇斤加硫酸鉀	四〇斤	六〇二·五斤	五二·〇%
八	即墨辛哥莊	土糞一五〇〇斤加硫酸鉀	四五斤	三二九·五斤	三七·五%
九	青島東營	土糞一五〇〇斤加硫酸鉀	四〇斤	七五六·〇斤	三〇·五%
一〇	二十里堡王兒莊	土糞一五〇〇斤加硫酸鉀	四七斤	四六三·〇斤	三三·〇%
一一	二十里堡董家莊	土糞二〇〇〇斤加硫酸鉀	四七斤	三八一·八斤	七〇·〇%

一九三三年在山東省試驗

一二	青島唐家口子	土糞一〇〇〇斤加氯化鉀	四〇斤	五〇五・〇斤	四四・〇%
一三	青島浮山所	土糞一〇〇〇斤加硫酸鉀	四〇斤	五三三・三斤	四四・五%
一四	膠州眼里莊	土糞一〇〇〇斤加氯化鉀	三三斤	三五一・〇斤	三〇・五%
一五	膠州榮村	土糞一〇〇〇斤加氯化鉀	三三斤	四二〇・〇斤	三八・五%
一六	膠州龐家莊	土糞一〇〇〇斤加氯化鉀	三三斤	七四二・五斤	六七・〇%
	加施鉀肥後之平均增收量及增收率			四五三・四斤	三九・五%

甘 藷

廣東汕頭

SWEET POTATO EXPERIMENT

圖 二一 AT SWATOW, KWANGTUNG Fig. 21

N 氮		NK 氮鉀
	Manuring per mow	
400 cat.	Local manure	400 cat.
30 ,,	Sulphate of Ammonia	30 ,,
——	Chloride of Potash	30 ,,
1,730 cat.	*Yield* per mow	2,260 cat.
	Increase per mow due to Potash	530 ,,
——	Percentage increased	30.6 %
	每畝施肥量	
400 斤	土肥	400 斤
30 斤	硫酸錏	30 斤
——	氯化鉀	30 斤
1,730 斤	每畝生產量	2,260 斤
	加施鉀肥每畝增收量	530 斤
	增收率	30.6 %

甘 藷

山東即墨解家營

SWEET POTATO EXPERIMENT

圖 二二　AT HSIEHCHIAYING, TSIMO, SHANTUNG　Fig. 22

Compost plus Potash 土糞加鉀肥		Compost only 土糞
	Manuring per mow	
1,500 cat.	Compost	1,500 cat.
35 ,,	Sulphate of Potash	——
2,308.5 cat.	*Yield* per mow	1,626.8 cat.
	Increase per mow due to Potash	681.7 cat.
	Percentage increased	42 %
	每 畝 施 肥 量	
1,500 斤	土糞	1,500 斤
35 斤	硫酸鉀	——
2,308.5 斤	每 畝 生 產 量	1,626.8 斤
	加施鉀肥每畝增收量	681.7 斤
	增收率	42 %

第八表　馬領薯——山東

號數	試驗地點	施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
	一九三二年在山東省試驗				
一	青島李村	土糞二〇〇〇斤			
		加硫酸鉀	一五·六斤	九六·〇斤	一二·五%
		加硫酸鉀	三一·二斤	三二八·〇斤	四二·〇%
		加硫酸鉀	四六·八斤	四二八·〇斤	五五·〇%
		加硫酸鉀	六二·四斤	六二六·〇斤	八〇·五%
		加硫酸鉀	七八·〇斤	一四七〇·〇斤	一八八·五%
二	青島唐家口子	土糞二〇〇〇斤及荳餅			
		加硫酸鉀	二九·四斤	一〇七三·一斤	三六·〇%
	加施鉀肥後之平均增收量及增收率			六七〇·二斤	六九·一%

第九表　粟及糯粟——山東

一九三三年在山東省試驗

號數	試驗地點	施用肥料（每畝）	加施鉀肥增收量（每畝）	增收率
一	即墨	土糞一〇〇〇斤加氯化鉀二〇斤	六九・五斤	三五・五%
二	坊子	土糞一二〇〇斤，荳餅五〇斤加氯化鉀二〇斤	八一・〇斤	五〇・〇%
三	坊子	土糞一二〇〇斤加氯化鉀二〇斤	一一四・八斤	三九・五%
四	即墨	土糞一〇〇〇斤，荳餅五〇斤加硫酸鉀二〇斤	九八・八斤	四七・〇%
五	即墨城陽	土糞一〇〇〇斤加硫酸鉀二〇斤	四〇・五斤	一二・五%
六	高密夏莊	土糞八〇〇斤加硫酸鉀二七斤	一二一・五斤	三七・五%
七	高密夏莊	土糞八〇〇斤加氯化鉀二〇斤	九四・五斤	三五・〇%
八	高密張嶺	土糞八〇〇斤加硫酸鉀二七斤	一一五・二斤	五二・〇%
九	高密張嶺	土糞八〇〇斤加氯化鉀二〇斤	一一二・五斤	七三・五%

一〇	朱橋	土糞一三〇〇斤加硫酸鉀	三三斤	六七・〇斤	二五・〇%
一一	沙河	土糞一三〇〇斤加氯化鉀	二七斤	五二・三斤	一三・〇%
一二	高密前嶺	土糞八〇〇斤加氯化鉀	三三斤	六四・一斤	二五・〇%
一三	高密吳家莊	土糞八〇〇斤加氯化鉀	二七斤	五一・五斤	四〇・五%
一四	高密毛子屯	土糞八〇〇斤加氯化鉀	二七斤	四〇・五斤	一二・〇%
		加施鉀肥後之平均增收量及增收率		八七・四斤	三五・六%

第十表　高粱——山東

號數	試驗地點	施用肥料（每畝）	加施鉀肥增收量（每畝）	增收率
一九三二年在山東省試驗				
一	即墨	土糞一〇〇〇斤，荳餅五〇斤 加硫酸鉀二〇斤	二四九·七斤	一二七·五%
一九三三年在山東省試驗				
二	龍口黃山館	土糞一五〇〇斤加氯化鉀三七斤	二〇二·五斤	四九·〇%
三	黃縣楊家莊	土糞一五〇〇斤加氯化鉀三三斤	一〇一·二斤	二四·〇%
四	黃縣北馬	土糞一五〇〇斤加氯化鉀二七斤	一八九·〇斤	三〇·〇%
五	高密前嶺	土糞八〇〇斤加氯化鉀三〇斤	八一·〇斤	二一·五%
六	高密前嶺	土糞八〇〇斤加氯化鉀三三斤	四五·〇斤	一八·〇%
		加施鉀肥後之平均增收量及增收率	一四四·七斤	四五·〇%

粟

山東即墨

MILLET EXPERIMENT
AT TSIMO, SHANTUNG

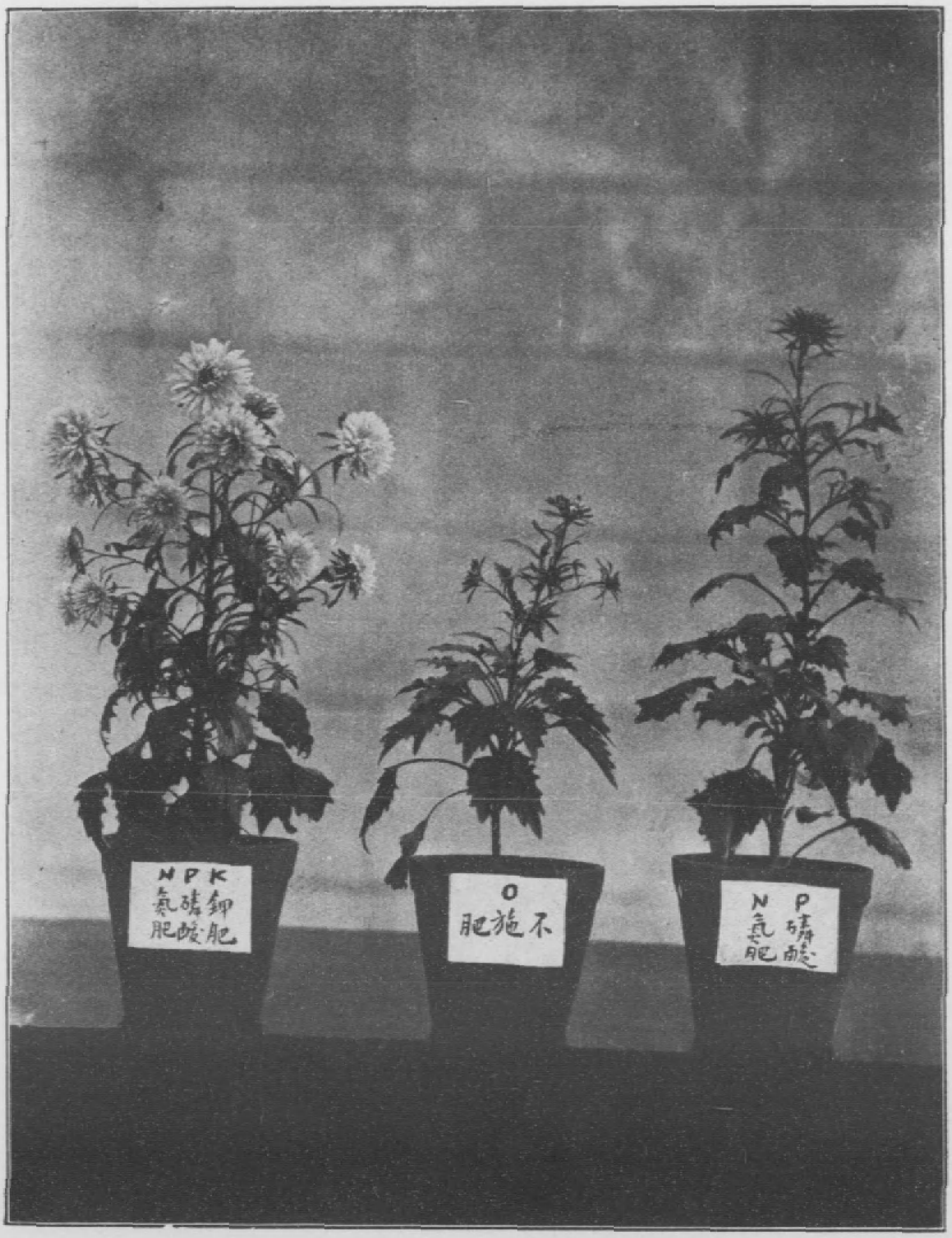
圖 二三　　Fig. 23

Usual manure plus potash 土肥加鉀肥　　usual manure 土肥

	Manuring per mow	
1,000 cat.	Compost	1,000 cat.
50 „	Beancake	50 „
20 „	Sulphate of Potash	——
309.4 cat.	*Yield* per mow	210.6 cat.
	Increase per mow due to Potash	98.8 „
	Percentage increased	47 %
	每畝施肥量	
1,000 斤	土糞	1,000 斤
50 斤	荳餅	50 斤
20 斤	硫酸鉀	——
309.4 斤	每畝生產量	210.6 斤
	加施鉀肥每畝增收量	98.8 斤
	增收率	47 %

菊　花

圖 二四　　CHRYSANTHEMUM (ASTER)　　Fig. 24



第十一表　蔬菜——廣東

號數	試驗地點	施用肥料（每畝）	加施鉀肥增收量（每畝）	增收率
	一九三三年在廣東省試驗			
	大蒜			
一	潮陽縣大宮	硫酸錏加鉀肥48%　三〇斤	五八五·五斤	一九·七%
	薑			
二	潮陽縣	硫酸錏加鉀肥48%　三〇斤	二七七·〇斤	一七·〇%
	一九三四年在廣東省試驗			
	大薯			
三	新會縣江門社院	硫酸錏加氯化鉀　二〇斤	五四五·〇斤	三一·二%
	一九三五年在廣東省試驗			
	萊菔（蘿蔔）			
四	揭陽縣橫清	硫酸錏加鉀肥48%　三五斤	一，五二九·五斤	二八·六%

第十二表　蔬菜——山東

號數	試驗地點	施用肥料（每畝）	加施鉀肥增收量（每畝）	增收率
	一九三二年在山東省試驗			
	黃瓜（胡瓜）			
一	青島唐家口子	土糞五〇〇〇斤，荳餅五〇斤加硫酸鉀二八斤	三，五六四・〇斤	四〇四・〇%
	韮			
二	青島唐家口子	土糞五〇〇〇斤加硫酸鉀二五斤	八七七・五斤	三三・〇%
	玉蜀黍			
三	青島唐家口子	土糞一〇〇〇〇斤，荳餅五〇斤加氯化鉀四〇斤	四〇一・七斤	九二・五%

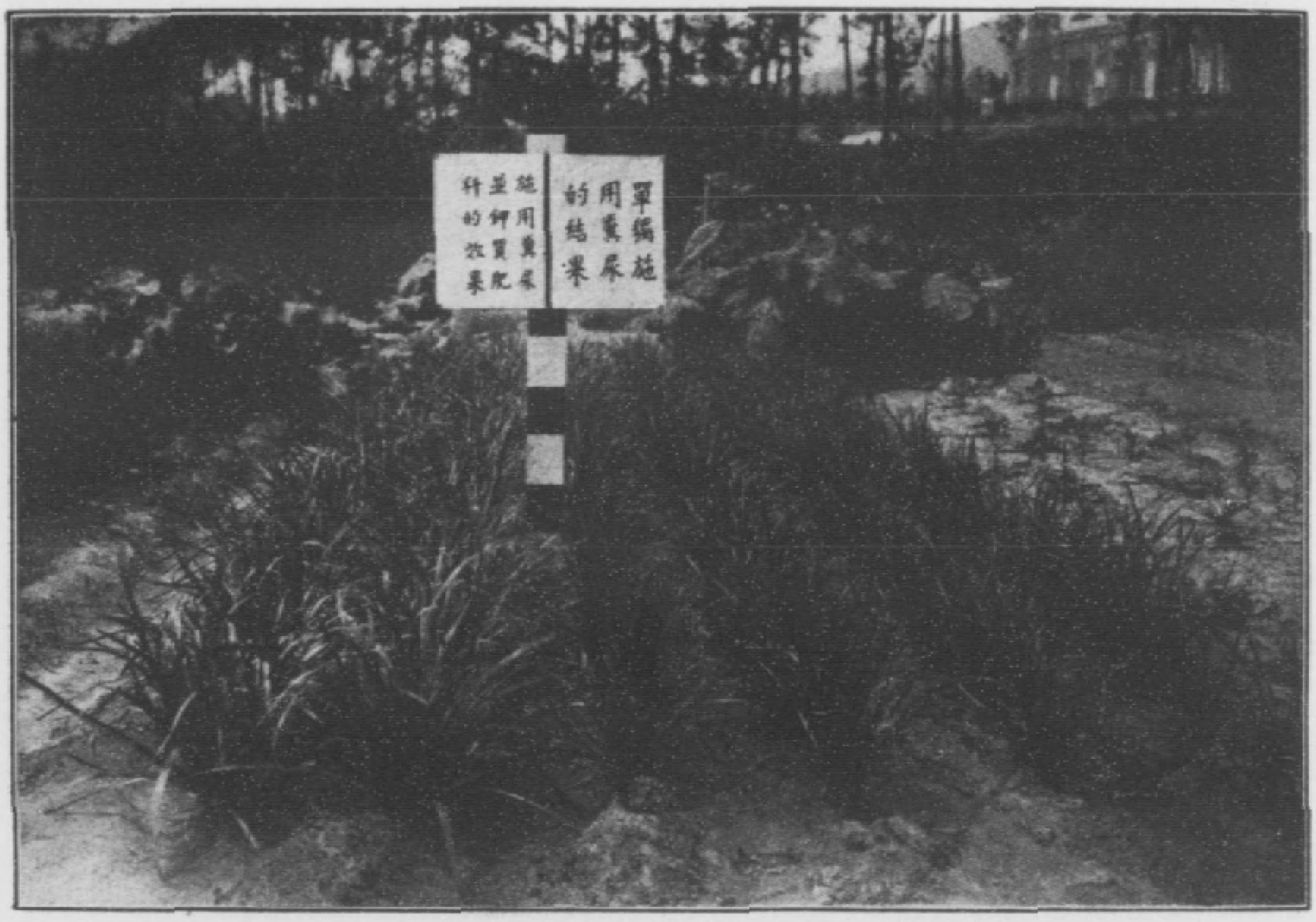
韮

山東青島唐家口子

CHINESE LEEK EXPERIMENT

AT TANGCHIAKOUZE, TSINGTAO, SHANTUNG

圖 二五 Fig. 25



Night soil plus Potash 糞尿加鉀肥		Night soil 糞尿
	Manuring per mow	
5,000 cat.	Night soil	5,000 cat.
25 ,,	Chloride of Potash	——
3,564 cat.	*Yield* per mow	2,686.5 cat.
	Increase per mow due to Potash	877.5 ,,
	Percentage increased	33 %
	每畝施肥量	
5,000 斤	糞尿	5,000 斤
25 斤	氯化鉀	——
3,564 斤	每畝生產量	2,686.5 斤
	加施鉀肥每畝增收量	877.5 斤
	增收率	33 %

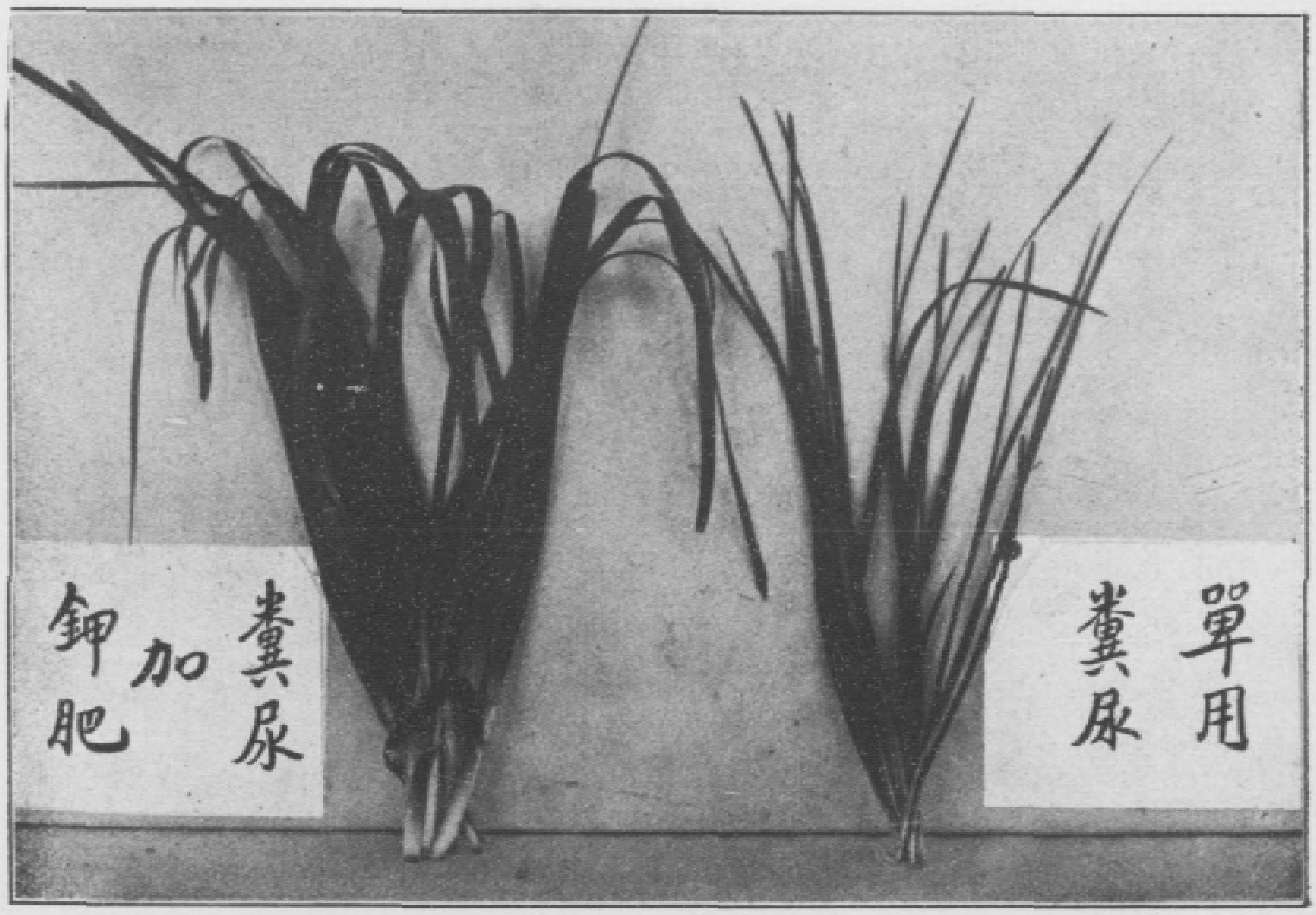
韮

山東青島唐家口子

CHINESE LEEK EXPERIMENT

AT TANGCHIAKOUZE, TSINGTAO, SHANTUNG

圖 二六 Fig. 26



Night soil plus Potash		Night soil
	Manuring per mow	
5,000 cat.	Night soil	5,000 cat.
25 ,,	Chloride of Potash	——
3,564 cat.	*Yield* per mow	2,686.5 cat.
	Increase per mow due to Potash	877.5 ,,
	Percentage increased	33 %
	每畝施肥量	
5,000 斤	糞尿	5,000 斤
25 斤	氯化鉀	——
3,564 斤	每畝生產量	2,686.5 斤
	加施鉀肥每畝增收量	877.5 斤
	增收率	33 %

第十三表　落花生——山東

號數	試驗地點	施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
	一九三二年在山東省試驗				
一	即墨黃家山	土糞一〇〇〇斤加氯化鉀	二〇斤	五四・〇斤	一〇・〇%
二	即墨塔子大川	土糞一〇〇〇斤加氯化鉀	二七斤	一八九・〇斤	四二・〇%
三	高密古鎮	土糞八〇〇斤及荳餅加氯化鉀	二〇斤	一四一・八斤	一四・〇%
四	高密夏莊	土糞八〇〇斤加氯化鉀	二〇斤	四〇・五斤	七・五%
		加施鉀肥後之平均增收量及增收率		一〇六・三斤	一八・四%

第十四表　各種作物

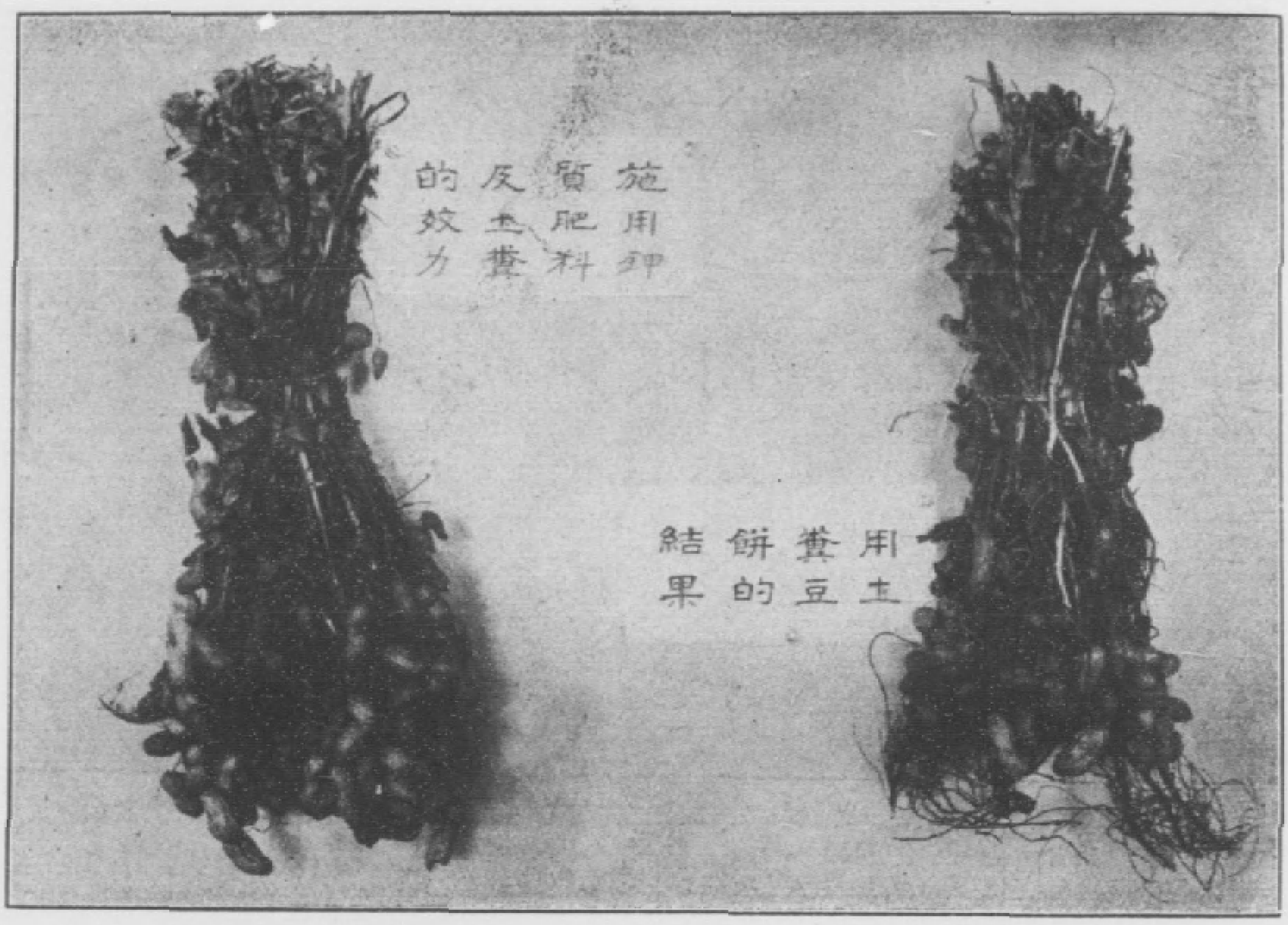
號數	試驗地點		施用肥料（每畝）		加施鉀肥增收量（每畝）	增收率
一	**元參**	一九三三年在浙江省試驗				
	杭縣笕橋胡家石橋		土肥加氯化鉀	六〇斤	六〇〇・〇斤	二五%
二	**蓆草**	一九三四年在浙江省試驗				
	溫州山河埠		硫酸錏，燐酸40% 加氯化鉀	三〇斤	三六〇・〇斤	三七%
三	**除蟲菊**	一九三五年在江蘇省試驗				
	上海北新涇		硫酸錏，過燐酸鈣 加硫酸鉀	二〇斤	二一二・七斤	四九%
四	**菸葉**	一九三五年在河南省試驗				
	許昌		硫酸錏，過燐酸鈣 加硫酸鉀	一五斤	五九・三斤	三三%

落花生

山東高密古鎮

PEANUTS EXPERIMENT

圖 二七 AT GUA CHIEN, KAOMI, SHANTUNG Fig. 27



Usual manure plus Potash 土肥加鉀肥		Usual manure 土肥
	Manuring per mow	
800 cat.	Compost	800 cat.
50 cat.	Beancake	50 cat.
20 cat.	Chloride of Potash	——
1,181.3 cat.	*Yield* per mow	1,039.5 cat.
	Increase per mow due to Potash	141.8 cat.
	Percentage increased	14 %
	每畝施肥量	
800 斤	土糞	800 斤
50 斤	荳餅	50 斤
20 斤	氯化鉀	——
1,181.3 斤	每畝生產量	1,039.5 斤
	加施鉀肥每畝增收量	141.8 斤
	增收率	14 %

甘蔗

浙江義烏

SUGAR CANE EXPERIMENT

圖 二八　　AT IWU, CHEKIANG　　Fig. 28

General view of the experimental field showing the differently treated plots.

甘蔗試驗地之全景，指示各種不同處理之生長狀況

NP 氮燐		NPK 氮燐鉀
	Manuring per mow	
40 cat.	Sulphate of Ammonia	40 cat.
45 ,,	Superphosphate	45 ,,
— ,,	Chloride of Potash	24 ,,
309.7 cat.	*Yield* per mow (sugar)	380.6 cat.
	Increase per mow due to Potash	70.9 cat.
	Percentage increased	23 %

	每畝施肥量	
40 斤	硫酸錏	40 斤
45 斤	過燐酸鈣	45 斤
——	氯化鉀	24 斤
309.7 斤	每畝生產量 (糖)	380.6 斤
	加施鉀肥每畝增收量	70.9 斤
	增收率	23 %

如何施用化學肥料

關於採取施用三要素之方法，吾人認爲中國農民至今尙無對於各種不同作物，自己混合施用三要素之充分知識，因此吾人應依照各種作物所需三要素之適當分量，混合完成之後，供給農民，使其便於施用。一般作物施用某種必要元素，較其實際所需者，或多或少，稍有百分之一二之差，實屬無關重要，蓋多則遺留土壤之中，仍可供下季作物吸收，較之毫不施用，終覺高出一籌也。歐美各國，其農業生產，早已步入科學基礎，運用三要素混合肥料，已極普遍；中國初雖討不及此，近年來則已有實際採用三要素混合肥料之趨向矣。

吾人茲復將在中國試驗施用混合肥料與土法施肥之比較成績，舉出少數於下：

鉀質肥料公司完全混合肥料試驗成績表

第一表　水稻——浙江

一九三四年——與單用硫酸錏比較

號數	試驗地點	施用肥料（每畝）		施用氮燐鉀完全肥料增收量（每畝）	增收率
一	溫州張安	完全混合肥料 氮一〇% 燐五% 鉀一〇%	二〇斤	一三八・〇斤	四二%
二	溫州郭石橋	完全混合肥料 氮一〇% 燐五% 鉀一〇%	二〇斤	一二〇・〇斤	三五%
三	溫州鷗江	完全混合肥料 氮一〇% 燐五% 鉀一〇%	二〇斤	一四〇・〇斤	四四%
四	溫州張克家	完全混合肥料 氮一〇% 燐五% 鉀一〇%	二〇斤	一六五・〇斤	四六%
五	溫州張家堵	完全混合肥料 氮一〇% 燐五% 鉀一〇%	二〇斤	一七四・〇斤	六七%

六	溫州東鄉	完全混合肥料	氮 一〇% 燐 一五% 鉀 一〇%	二〇斤	一三五・〇斤	四五%
七	楚門西山	完全混合肥料	氮 一〇% 燐 一五% 鉀 一〇%	二〇斤	七五・〇斤	一六%
	一九三七年——與旱用硫酸錏比較					
八	義烏石橋頭	完全混合肥料	氮 八% 燐 七% 鉀 八%	六〇斤	一三五・五斤	三八%
	施用氮燐鉀完全肥料後之平均增收量及增收率				一三五・三斤	四二%

第二表　棉花——河北

號數	試驗地點	施用肥料（每畝）		加施氮燐鉀完全肥料增收量（每畝）	增收率
	一九三六年在河北省試驗				
一	安國縣小南流	土糞八〇〇斤加完全混合肥料（氮七% 燐六% 鉀一六%）	二七斤	八二·九斤	八二·〇%
		完全混合肥料（氮九% 燐五% 鉀一四%）	二七斤		
二	安國縣海市村	土糞八〇〇斤加完全混合肥料（氮九% 燐五% 鉀一四%）	五四斤	五五·三斤	六〇·〇%
三	安國縣東梲里	土糞八〇〇斤加完全混合肥料（氮九% 燐五% 鉀一四%）	六〇斤	八三·一斤	八七·五%

棉　花

河北小南流

COTTON EXPERIMENT

圖 二九　　AT HSIAU NAN LIU, HOPEH　　Fig. 29

NPK 氮燐鉀		Usual manure 土肥
	Manuring per mow	
800 cat.	Compost	800 cat.
54 „	Complete NPK (9-5-14) mixture	——
184.3 cat.	*Yield* per mow	101.4 cat.
	Increase per mow due to complete NPK mixture	82.9 cat.
	Percentage increased	82 %

	每畝施肥量	
800 斤	土糞	800 斤
54 斤	氮燐鉀(9-5-14)完全肥料	——
184.3 斤	每畝生產量	101.4 斤
	加施氮磷鉀完全肥料每畝增收量	82.9 斤
	增收率	82 %

棉　花

河北南溝埠

COTTON EXPERIMENT AT NAN GO PU, HOPEH

圖 三〇 Fig. 30

Usual manure 土肥　　　　NPK 氮燐鉀

Usual manure 土肥		NPK 氮燐鉀
	Manuring per mow	
800 cat.	Compost	800 cat.
——	Complete NPK (9-5-14) mixture	60 cat.
92.2 cat.	*Yield* per mow	135.2 cat.
	Increase per mow due to Complete NPK mixture	43 cat.
	Percentage increased	47 %
	每畝施肥量	
800 斤	土糞	800 斤
——	氮燐鉀(9-5-14)完全肥料	60 斤
92.2 斤	每畝生產量	135.2 斤
	加施氮燐鉀完全肥料每畝增收量	43 斤
	增收率	47 %

四	安國縣南溝埠	土糞八〇〇斤加		四三・〇斤	四七・〇%
		完全混合肥料 {氮 七% 磷 六% 鉀 一六%}	三三斤		
		完全混合肥料 {氮 九% 磷 五% 鉀 一四%}	二七斤		
五	安國縣閻村	土糞八〇〇斤加		四三・〇斤	四七・〇%
		完全混合肥料 {氮 七% 磷 六% 鉀 一六%}	二七斤		
		完全混合肥料 {氮 九% 磷 五% 鉀 一四%}	二七斤		
	加施氮磷鉀完全肥料後之平均增收量及增收率			六一・五斤	六四・七%

第三表　棉花——浙江

一九三七年在浙江省試驗——與單用荳餅比較

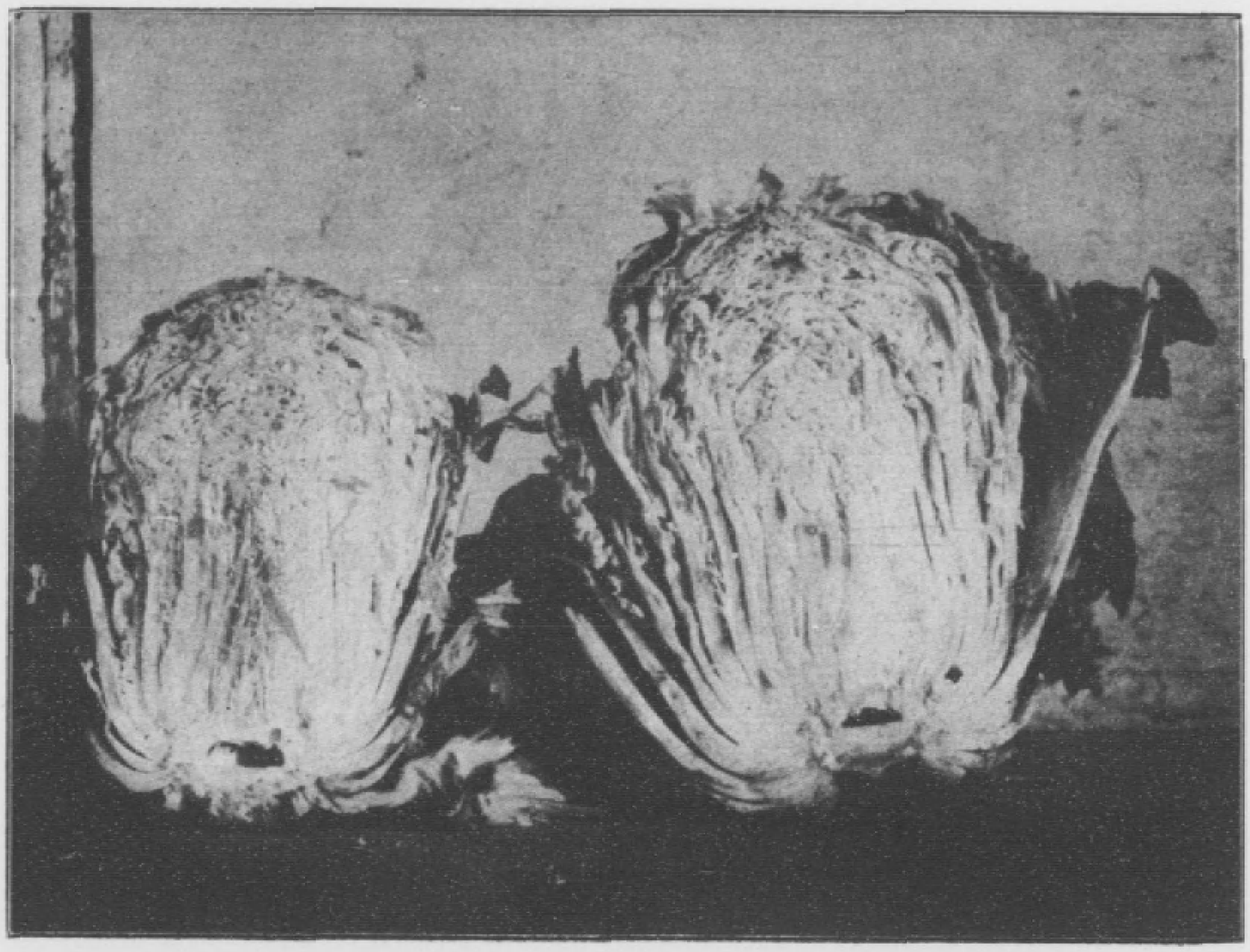
號數	試驗地點	施用肥料（每畝）	施用氮燐鉀完全肥料增收量（每畝）	增收率
一	餘姚龍泉	完全混合肥料（氮六%、燐九%、鉀八%）一〇〇斤	四九·〇〇斤	一七·〇%
二	餘姚龍泉	完全混合肥料（氮六%、燐九%、鉀八%）一〇〇斤	五九·〇〇斤	二二·〇%
三	餘姚石堰	完全混合肥料（氮六%、燐九%、鉀八%）八〇斤	三六·〇〇斤	一七·〇%
四	餘姚大奧	完全混合肥料（氮六%、燐九%、鉀八%）一〇〇斤	二九·〇〇斤	一四·〇%
施用氮燐鉀完全肥料後之平均增收量及增收率			四三·二五斤	一七·五%

白　菜

江蘇崇明

WHITE CABBAGE EXPERIMENT

圖 三一　　AT TSUNG MING ISLAND, KIANGSU　　Fig. 31



Usual manure 土肥　　　　N P K 氮燐鉀

Manuring per mow

Beancake	200 cat.	Sulphate of Ammonia	33 cat.
Night soil	1,000 ,,	Superphosphate	33 ,,
		Sulphate of Potash	33 ,,
9 cat.	*Weight* per piece		12 cat.
	Increase of weight per piece due to complete NPK mixture		3 cat.
	Percentage increased		33 %

每畝施肥量

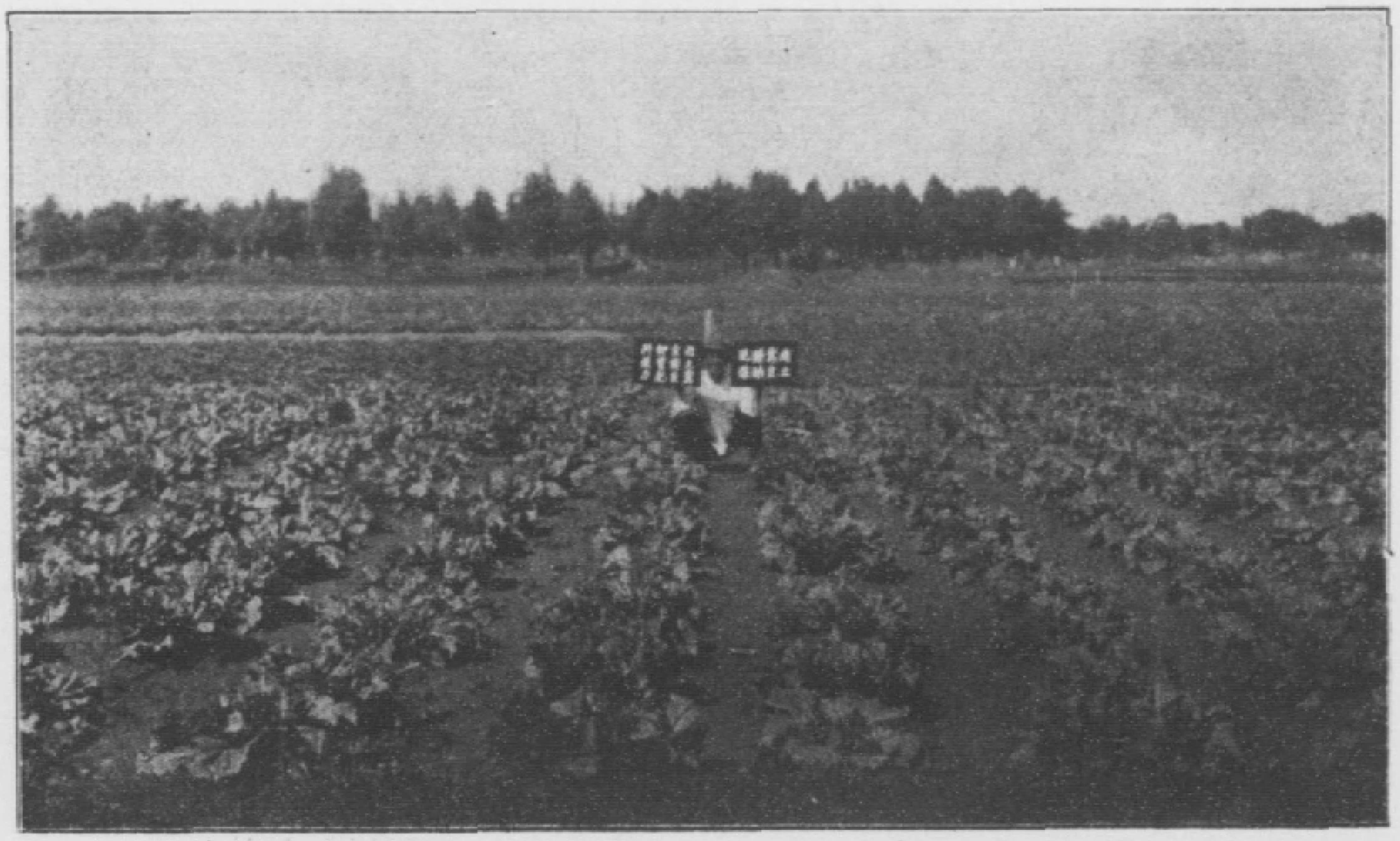
豆餅	200 斤	硫酸錏	33 斤
糞尿	1,000 斤	過燐酸鈣	33 斤
		硫酸鉀	33 斤
9 斤	每棵重量		12 斤
	施用氮燐鉀完全肥料每棵增收量		3 斤
	增收率		33 %

白　菜

山東城陽

CABBAGE EXPERIMENT

圖 三二　　AT CHENGYANG, SHANTUNG　　Fig. 32



Usual manure plus Potash 土肥加鉀肥　　　Usual manure 土肥

Manuring per mow

2,000 cat.	Compost	2,000 cat.
500 ,,	Beancake	500 ,,
40 ,,	Sulphate of Potash	——

每畝施肥量

2,000 斤	土糞	2,000 斤
500 斤	荳餅	500 斤
40 斤	硫酸鉀	——

第四表　白菜——河北

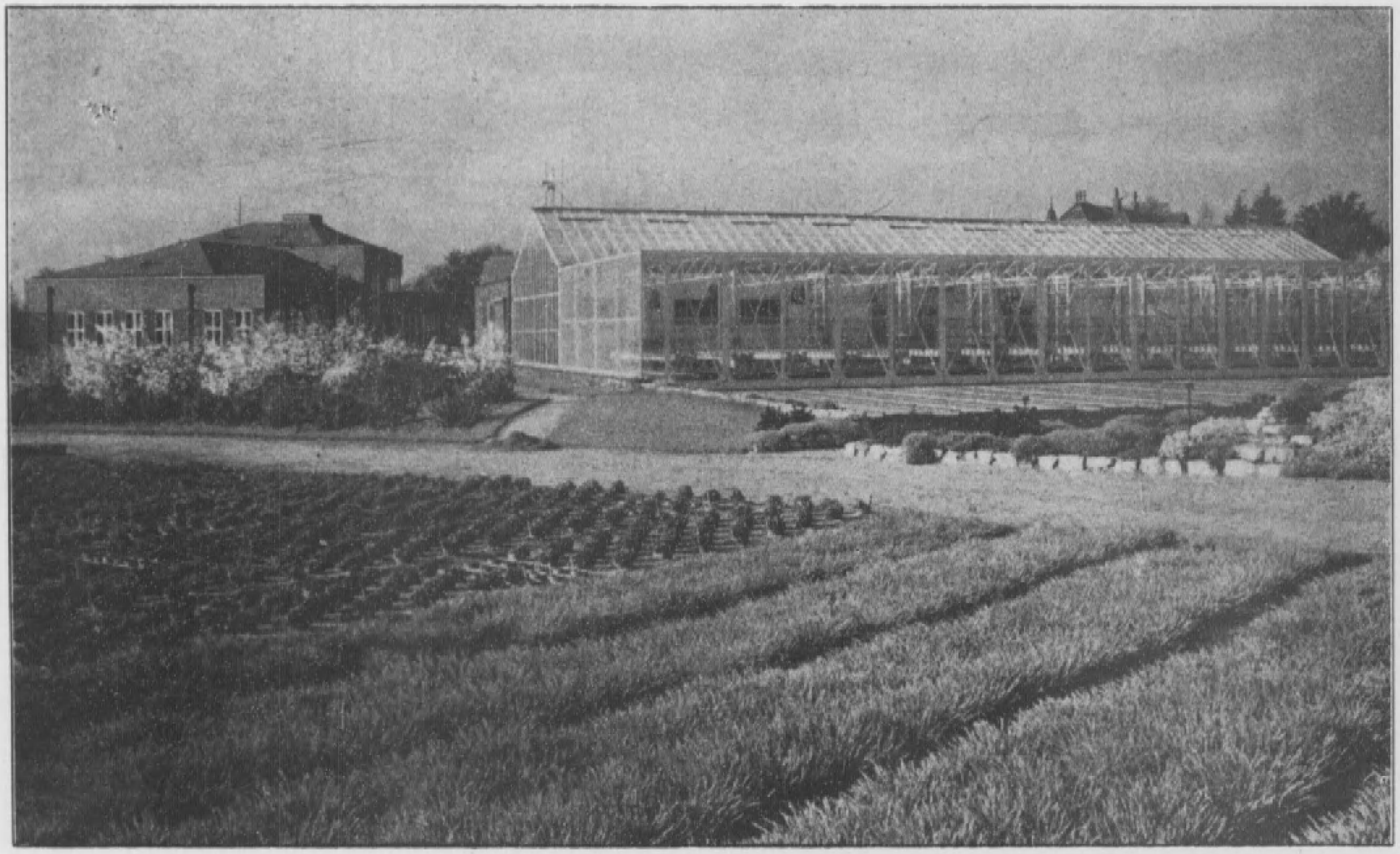
一九三四年在河北省試驗

號數	試驗地點	施用肥料（每畝）	加施氮燐鉀完全肥料增收量（每畝）	增收率
一	天津郭莊子	土糞二，〇〇〇斤加		
		完全混合肥料（氮六%　燐六%　鉀一六%）一六四斤	三，二〇九·五〇斤	三六·〇%
		完全混合肥料（氮六%　燐六%　鉀一六%）二四六斤	四，四六〇·五〇斤	五六·〇%
二	天津楊柳青	土糞二，〇〇〇斤加		
		完全混合肥料（氮六%　燐六%　鉀一六%）六六斤	五三〇·〇〇斤	九·〇%
		完全混合肥料（氮六%　燐六%　鉀一六%）九九斤	一，八六五·〇〇斤	三一·〇%
		完全混合肥料（氮六%　燐六%　鉀一六%）一三二斤	二，八二七·〇〇斤	四四·五%
		完全混合肥料（氮六%　燐六%　鉀一六%）一九八斤	四，五〇五·〇〇斤	六八·〇%

三	天津八里台	土糞二，〇〇〇斤加 完全混合肥料	氮六% 燐六% 鉀一六%	一二七斤	二，五五〇・〇〇斤	五〇・〇%
		完全混合肥料	氮六% 燐六% 鉀一六%	一九一斤	三，三二五・〇〇斤	六五・〇%
四	天津河興莊	土糞二，〇〇〇斤加 完全混合肥料	氮六% 燐六% 鉀一六%	二九五斤	四，七一七・〇〇斤	六〇・〇%
		完全混合肥料	氮六% 燐六% 鉀一六%	三九三斤	六，二九〇・〇〇斤	八〇・〇%
五	天津河興莊	土糞二，〇〇〇斤加 完全混合肥料	氮六% 燐六% 鉀一六%	一九六斤	四，五四七・六七斤	五三・〇%
六	天津河興莊	土糞二，〇〇〇斤加 完全混合肥料	氮六% 燐六% 鉀一六%	一四七斤	二，七一八・六八斤	三二・五%
七	天津河興莊	土糞二，〇〇〇斤加 完全混合肥料	氮六% 燐六% 鉀一六%	九八斤	二，二八六・五二斤	二七・〇%
加施氮燐鉀完全肥料後之平均增收量及增收率					三，三七一・六八斤	四七・一%

柏林立西脫斐爾特農業試驗場

圖 三三　　試驗地及實驗室一覽　　Fig. 33



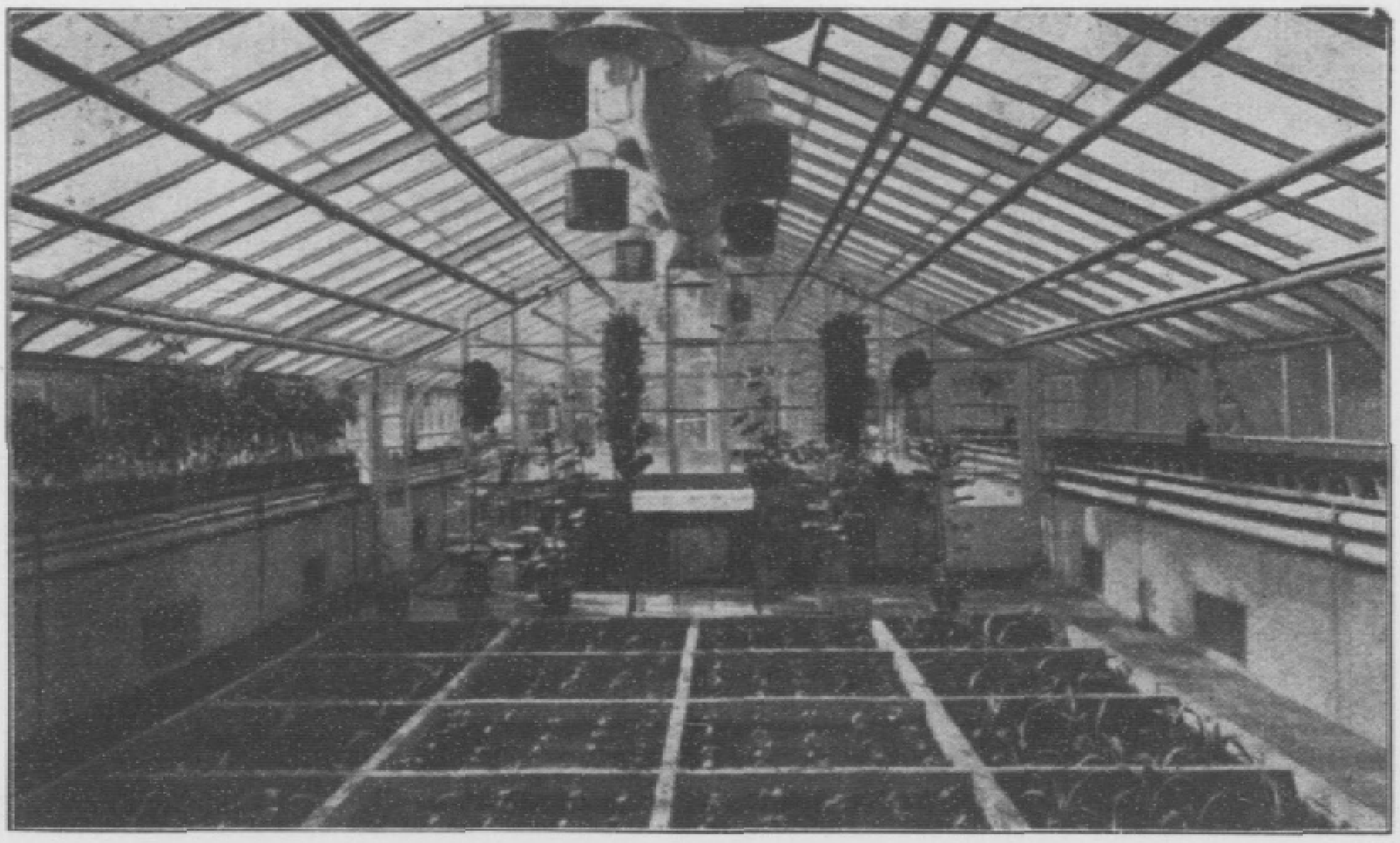
Agricultural Experiment Station
Berlin—Lichterfelde

A view of the experiment field with the laboratory buildings in the back ground.

温　室

熱帶植物肥料試驗

圖 三四　　Fig. 34



In the greenhouse

Fertilizer experiments on tropical plants.

駐華鉀質肥料聯合公司之立場及其營業方針

中國正在努力復興農業，鉀質工業家深覺有準備合作，促其實現之必要，故特委託駐華鉀質肥料聯合公司來華，指導中國農民，使其認識如何施用化學肥料，——尤其是鉀質肥料之方法，藉使中國政府在努力改進中國農業之過程中，獲得多少協助。

德國之鉀礦，係由多數公司共同經營。在鉀鹽沉積層蘊藏豐富之地帶，開掘有礦穴二百餘處。此項鉀礦穴均位置於德國中部，大抵自北方哈諾伐爾 (Hannover) 起，直蜿蜒至南方妥林奇昂森林 (Thuringian Forest) 爲止。第一個礦穴係在一八五六年斯旦斯福 (Stassfurt) 附近地方首先開採，因此斯旦斯福地名，卽成爲鉀質工業之通常代用語，相沿至今。代表德國鉀質生產者，爲一大規模之推銷組織，名曰：德國鉀質辛狄凱 (Deutsches Kalisyndikat G. m. b. H.)。設總公司於柏林，內設農業部，辦理科學指導及宣傳工作。此外另有農業試驗場，設於立西脫斐爾特 (Lichterfelde)，有極大之實驗室及最現代化之機械設備。關於一般植物營養料——尤其是鉀質肥料方面諸種問題，均爲

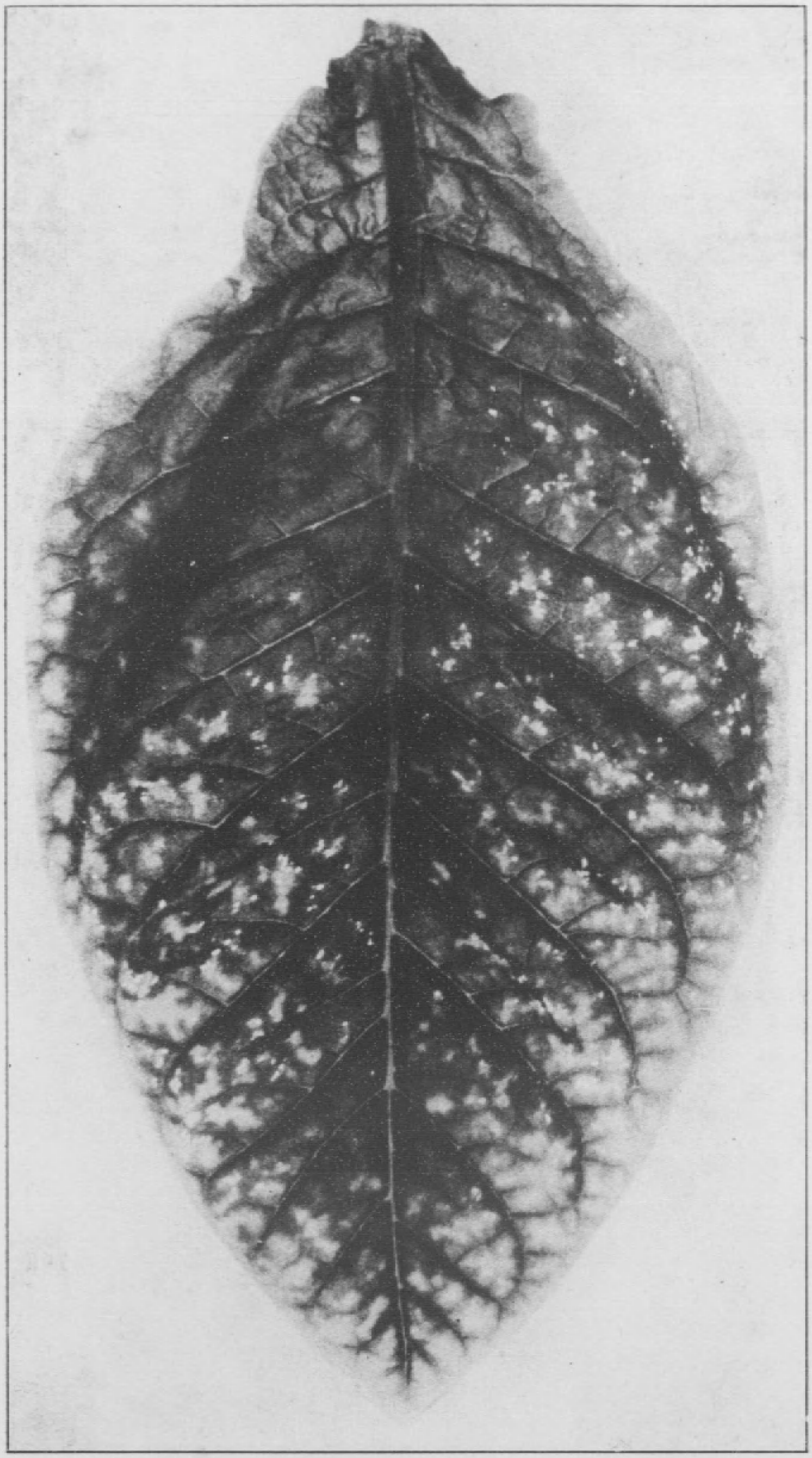
其悉心研究之對象。該場對於農業化學界有極有價值之貢獻，故在農業出版界及各種國際會議上，常得到稱揚與贊許。半月刊植物之養料（Die Ernährung der Pflanze），即係該辛狄凱農業部所出版，每期印行二萬份，就中七千份係送往國外定戶者。內容係專門研究鉀質肥料及其他植物營養料對於各種植物之功效。該刊出版以來，已有三十四年之久，其所立論，無不抱定科學立場，且又富有極精美之土壤圖表，故備受全球土壤科學家之推重。

法國鉀礦，其中大多數為法國政府所經營。在阿爾薩斯鉀質肥料貿易公司(Société Commerciale des Potasses d'Alsnce) 名稱下，將所有各礦，聯成一種聯合組織。總公司設在巴黎。關於鉀質肥料各種問題之研究工作，則由科學農業處 (Direction du Service Scientifique et Agricole) 辦理。內有土壤化學分析試驗室之設備，統由法國著名農學專家多人主持其事。出版月刊鉀質肥料 (La Potasse)，按月發表最新消息。

一九三一年駐華鉀質肥料聯合公司開設之初，即分設公司於上海，香港，青島，天津等處，均各聘有極富經驗之農業專家。並在中國沿海如廣東，廣西，福建，浙江，江蘇，山東，及河北等省，開始進行工作。

菸葉

圖 三五　　菸葉呈現斑點一卽缺乏鉀質之徵象　　Fig. 35



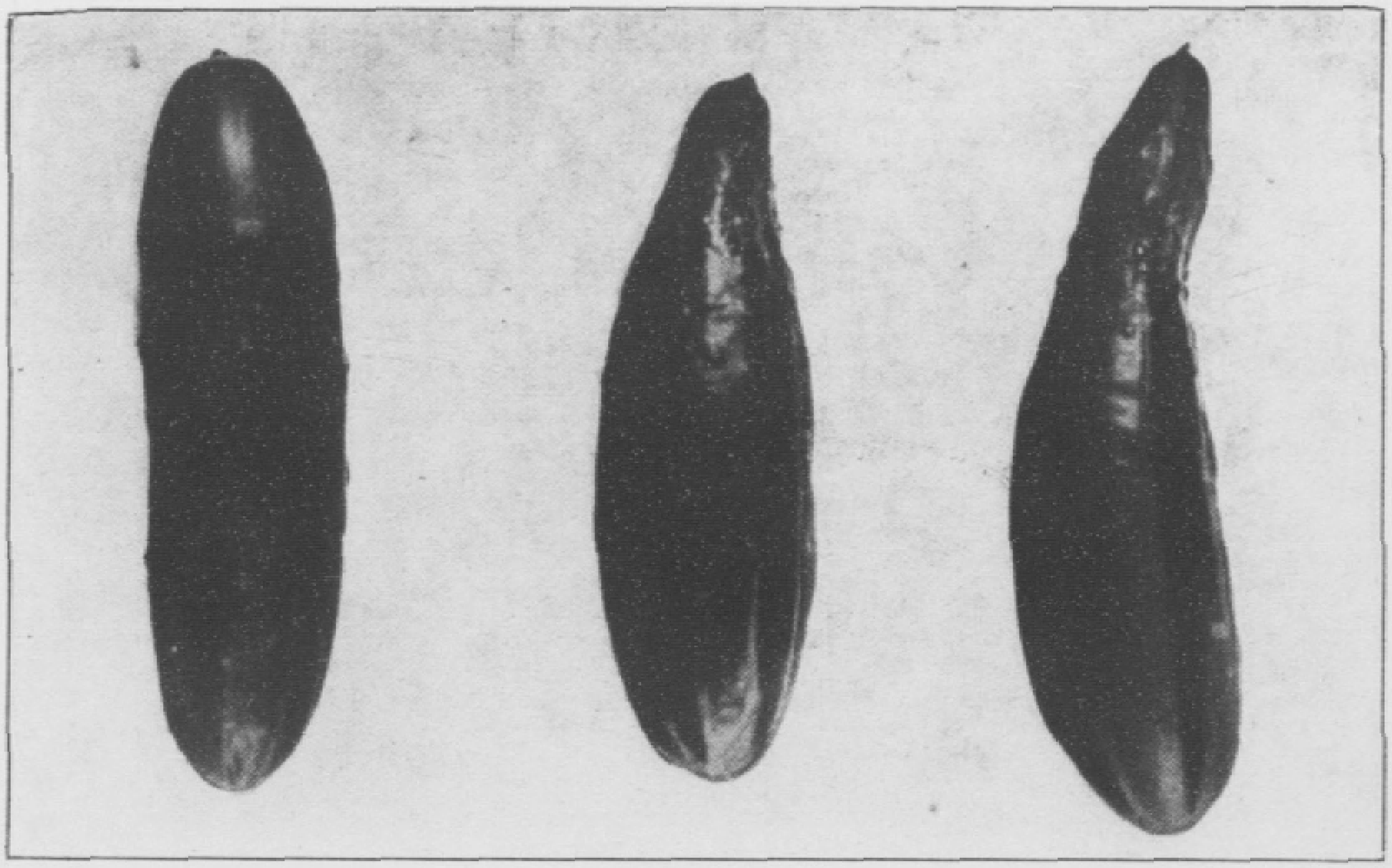
Tobacco leaf

Tobacco leaf showing spots due to Potash deficiency.

胡瓜

左：　　吸收適量鉀質

圖 三六　　右：(二果) 缺乏鉀質　　Fig. 36



Cucumber

on left: Sufficient Potash.
on right: (2 fruits) Potash deficiency.

爲欲考核各地農業實況，及洞悉正確情況，則非實地調查，不足以竟其功。駐華鉀質肥料聯合公司有鑒及此，特派農業專家到處旅行，訪問鄉農，調查農田，並精密研究各縣各地不同作物及其耕種方法。

土壤分析工作，亦復同時進行。凡由各處採來各種土壤標樣，均分別標記，裝聽，寄往柏林及巴黎化驗。至於所作各種試驗，已如上述，所得效果，莫不明白證明：鉀質肥料適當施用，旣使作物產量增加，復使作物品質改良。

駐華鉀質肥料聯合公司深幸獲得中國農業家完全了解，相與密切合作。此種合作之主要目的，卽在促進採用良好之生產方法，——尤其注重施用含有相當數量之鉀質之混合肥料，藉使作物得以充分發展。

各農業試驗場，例如南京中央農業實驗所，對於鉀質肥料問題，表示極感興趣；而各大學農學院，尤其是廣州國立中山大學農學院，且特設一系，研究肥料與土壤，並作各種試驗。

採用氮，燐，鉀三要素完全肥料之原則，現已在中國各級政府之農業機關中極度發展。

中國政府農村建設程序中，已將肥料問題包括在內。且認爲施用化學肥料固屬必要，而肥料比率與分量之適當配合，尤應注意。因此，若干省政府已命令主管機關開始研究土壤及植物所需之必要養料，並已依照土壤之內涵及植物各別之需要，擬定各種不同之化學肥料混合方式，俾與各地之天然肥料配合施用。

浙江省實施農村建設計劃，頗著聲譽，並首先在建設廳下設立化學肥料管理處，其所擬訂之氮，燐，鉀三要素必須共同施用之條例，早已公布實施。該廳復在上海開辦化學肥料混合工場，以便供給農民氮，燐，鉀三要素混合肥料。

江蘇省亦採取相似政策，推動該省農民施用三要素混合肥料，並授權江蘇省農民銀行農產運銷處辦理並施行之。

廣東省於廣州近效西村，設立肥田料廠，製造及混合各種肥料。混合之方式，係由農林局各專家所審定。

此外各合作社及經營農產物之大商行，亦咸認爲欲獲得質量均佳之作物，必須使農民在彼等統制之下，銷用三要素混合肥料。

吾人今再指出中國每年農產品之輸入，仍有數萬萬元之巨，如下表：

花椰菜

葉脈間呈淡黃色

圖 三七　　葉之邊緣組織枯死　　Fig. 37

Cauliflower

Yellowish coloration between the veins of the leaves.
Death of marginal tissue of the leaves.

農產品每年輸入中國之數量及價值

（根據海關報告自一九二七至一九三六年十年間之平均數）

品名	數量	價值
米	一，〇四七，九二〇公噸	一〇七，七四六，六六五元
小麥	五七七，〇〇〇公噸	四二，一〇二，九〇五元
麵粉	二九三，八三〇公噸	三四，四一五，一七五元
糖（未煉及已煉合計）	四九二，二四三公噸	八一，四二四，五〇〇元
菸葉	二三四，七〇四公噸	三四，七九九，五六九元
棉花	一六一，四六八公噸	一二一，四三八，六九八元
合計	二，八〇七，一六五公噸	四二一，九二七，五一二元

但若仿行新式耕種方法，及採用均勻完美之化學肥料，必能挽回幾百萬元現金之外溢。歐戰後，許多國家之所成就，卽可作爲前例。就中若干國家，前者因未採用新式方法，故生產不敷全國民之需要；戰後實施新式方法以來，卽能完全自給，現則實際上已能生產一切必要之食糧而無匱乏，更不必再以數萬萬元巨款流出國外矣。顧此種極大之成功，惟有於採用新式方法，——尤其在妥善施用大量人造肥料之條件下，

方克有成耳。

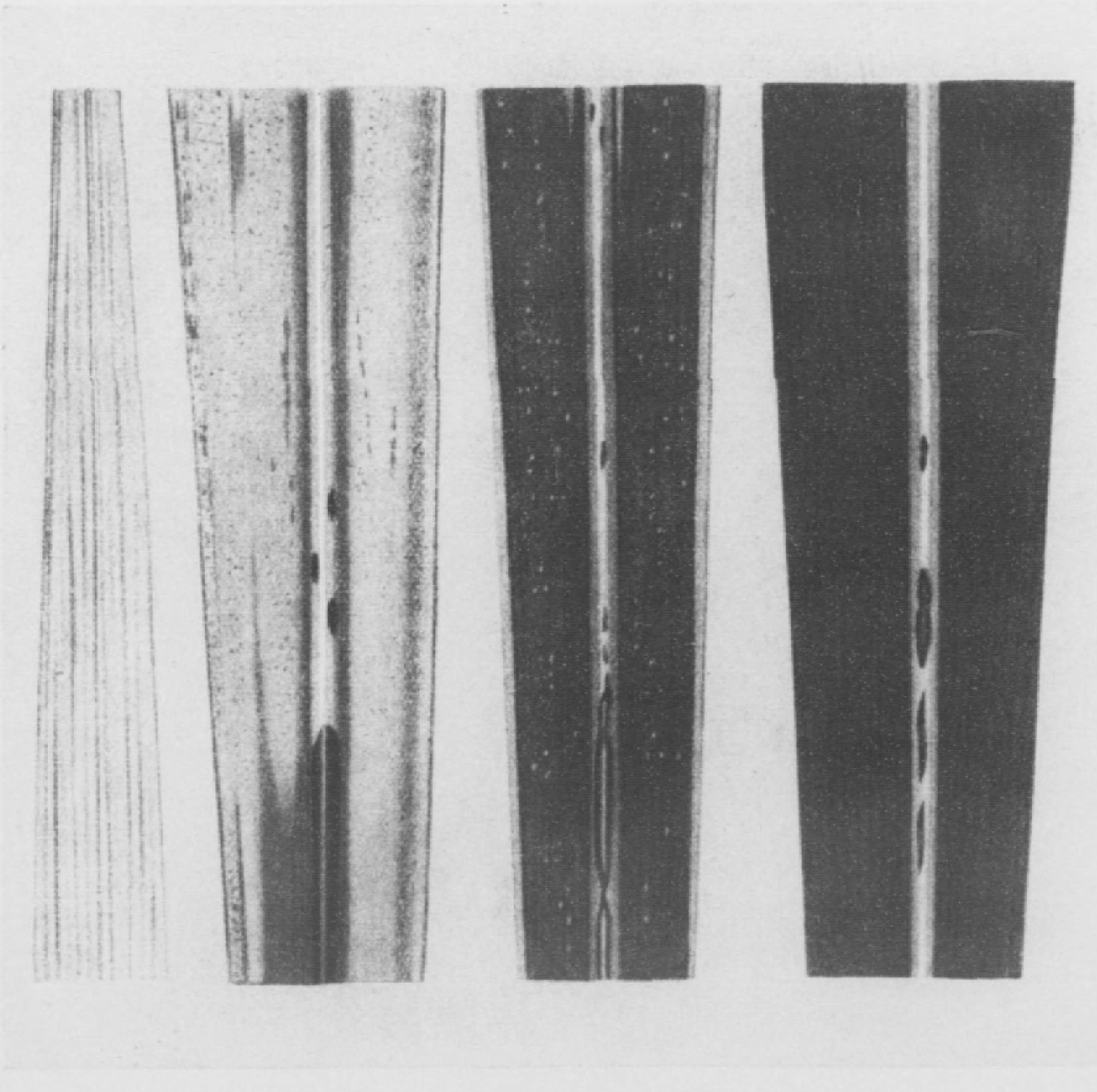
綜上以觀：氮，燐，鉀三種肥料，在農業上誠屬必需，世界任何國家，莫不大量採用，業已完全證明。關於鉀質肥料，舉例言之：美國本國雖亦有鉀質肥料生產，但每年仍須輸入約八十萬公噸之譜。至於日本，與中國相似，原以其本國肥料爲施肥之主要部分，現亦已採取改進方法，雖其本國亦有氮肥及某種限度之燐肥生產，每年却仍須輸入相當數量之氮肥，燐肥，以及約廿七萬五千公噸之鉀肥。

爲使中國農業趨向於現代化，以增進生產起見，駐華鉀質肥料聯合公司極盼與所有對於中國農業發生興趣之人士，共同合作，助其發展。無論在農業生產方面，或農業教育方面，吾人固無不願虛心領教，與在可能範圍之內，盡力予以協助也。

甘 蔗

葉上呈棕色條紋及白色斑點

圖 三八　　棕紅色斑點與葉中肋組織之局部枯死　　Fig. 38



Sugar Cane

Brown stripes and whitish spots on the leaves.
Brownish red spots with local necrosis of the tissue of the midrib.

棉花

左：　吸收適量鉀質

右：　缺乏鉀質

葉枯乾過早

圖 三九　　棉莢開裂不齊纖維品質粗劣　　**Fig. 39**

Cotton

on left:　Sufficient Potash.

on right:　Potash deficiency.

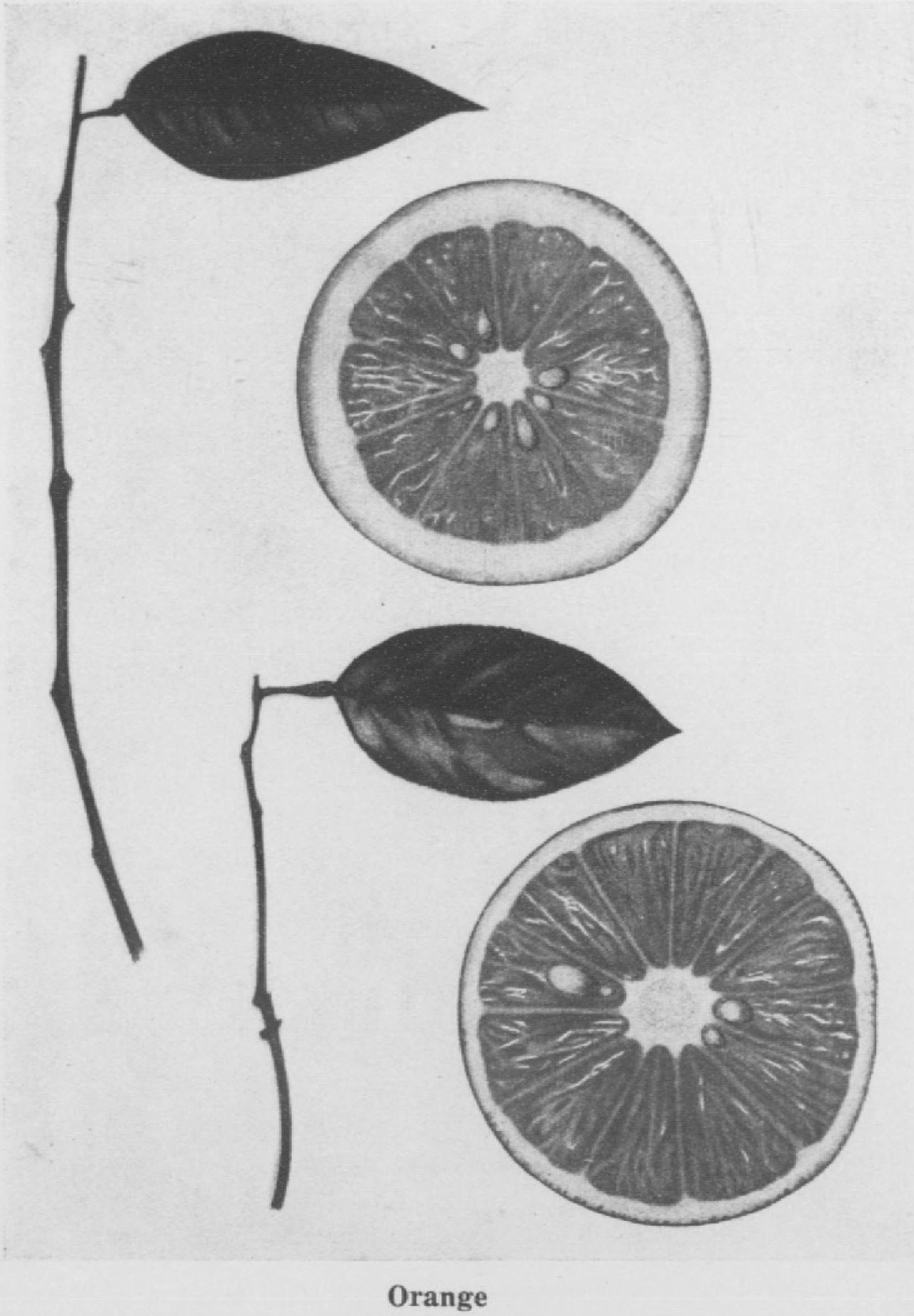
Premature withering of the leaves.

Irregular ripening of the bolls.

Poor quality of fibre.

橘

下面　吸收適量鉀質
上面　缺乏鉀質
　　　葉呈青綠色而尖小
圖 四〇　　果皮粗厚　　Fig. 40



Orange

below:　Sufficient Potash.
above:　Potash deficiency.
Bluish green pointed leaves.
Thick-skinned fruits.

水 稻

葉之顏色在尖端開始發黃而至銹棕色
枯死斑點散布在葉及穗之面上
圖 四一　穀粒構成不良　Fig. 41

Rice

Yellowish to rust brown coloration of the leaves starting at the tips.
Irregular necrotic areas on the surface of the leaves and ears.
Grain formation poor.

Thus it is fully demonstrated that the three kinds of commercial fertilizers: *Nitrogen, Phosphoric acid and Potash* are needed and all countries in the world use them since in great quantities. For instance as regards potash, the U.S.A., though producing potash themselves, are still importing about 800,000 tons potash salts every year. In Japan, where, like in China, domestic fertilizers have formed the basis of manuring, the same development has taken place and though producing nitrogen and to some extent also phosphoric acid, she imports every year a certain quantity of nitrogen, phosphoric acid and also around 275,000 tons of potash salts.

With the change towards modernization and increase of production in progress, we should here like to appeal to all those interested in Chinese Agriculture to join in to support this development and we, the Naveo, will be glad to cooperate in every way possible towards the improvement not only of agricultural production but also of agricultural knowledge throughout China.

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Furthermore, Cooperative Societies and big merchants in agricultural products are beginning to see the necessity for distributing NPK complete fertilizers to the farmers under their control, if they want to obtain crops good in yield and quality.

We would like to point out that although China is still importing every year several hundred millions of dollars worth of agricultural products,

Annual Imports into China of Agricultural Products,

10 years' average from 1927 to 1936*

	Tons	*Dollars*
Rice	1,047,920	107,746,665.—
Wheat	577,000	42,102,905.—
Flour	293,830	34,415,175.—
Sugar, Crude and Refined	492,243	81,424,500.—
Tobacco	234,704	34,799,569.—
Cotton	161,468	121,438,698.—
T o t a l	2,807,165	421,927,512.—

the adoption of modern method of cultivation and especially for the use of well balanced commercial fertilizers could free her from these irredeemable losses through the export of millions worth of specie. An example of this has been afforded by many countries after the last War; several of these countries formerly did not produce enough to feed their own population for lack of modern methods. After the War steps were taken to make these countries self-supporting. Now they are producing practically all their basal food stuffs and have thus been relieved of the burden of paying hundreds of millions of dollars to foreign countries for their food bill. This great achievement could only be secured by applying modern methods, especially with reference to commercial fertilizers in large quantities and in the right proportion.

*Statistics from the Chinese Maritime Customs Reports.

Agricultural Experiment Stations such as the National Agricultural Research Bureau at Nanking, have shown keen interest in the problem of Potash fertilizers and Agricultural Colleges, especially that of the Sun Yat Sen University at Canton, are maintaining a special division for the study of fertilizers and soils and for carrying out experiments.

The principle of the use of complete fertilizers, containing Nitrogen, Phosphoric Acid and Potash is now developing rapidly in China amongst the different official bodies connected with agriculture.

In the programme of Rural Reconstruction, the Chinese Government Authorities have included this problem of fertilization and advocate the necessity of using chemical fertilizers and of using them in proper proportions. Following this development, some of the Provincial Governments have also ordered a study of the soil and plant food requirements. Basing upon the particular requirements of the plants and composition of the soil, different formulae of chemical fertilizers to be used in combination with local, natural manures have been recommended.

Chekiang Province, which is well known for her advanced and enterprising plans regarding rural reconstruction, was the first province to order the creation of a Bureau for the Control of Chemical Fertilizers at Hangchow. The regulations issued by the Bureau, introduced the use of the three elements N P K, i.e. Nitrogen, Phosphoric Acid and Potash. Besides, in order to ensure the distribution of NPK complete fertilizers, the Chekiang Reconstruction Bureau has organized the Chemical Fertilizers' Mixing Factory, located in Shanghai.

Kiangsu Province has also taken measures to promote the use of the combined three elements by the farmers of this province and has entrusted the Kiangsu Farmer's Bank, Department of Transportation and Marketing of Agricultural Products, with the task of putting these plans into effect.

In Kwangtung Province, a chemical fertilizer plant has been erected at Sai Chuen, near Canton, for the manufacturing and mixing of fertilizers, the formulae being recommended by the experts of the Bureau of Agriculture.

other plant nutrients in the plants. "Die Ernährung der Pflanze" has been published for 34 years and is greatly appreciated by soil scientists the world over, for its scientific standing and excellent soil maps.

The French Mines, the majority of which are in the hands of the French Government, have formed a combined organisation under the name of the "Société Commerciale des Potasses d'Alsace", with Head-Office in Paris. The research work for the study of problems of Potash fertilizers are conducted by the "Direction du Service Scientifique et Agricole", headed by noted French Agriculturists, and by a laboratory for chemical analysis of soils. A monthly bulletin "La Potasse" is published for giving up-to-date information.

Since the arrival of Naveo in 1931, offices, to all of which well experienced agricultural experts are attached, were opened in Shanghai, Hongkong, Tsingtao and Tientsin. The Naveo started to work in the Coastal Provinces of China namely: Kwangtung, Kwangsi, Fukien, Chekiang, Kiangsu, Shantung and Hopeh.

For the purpose of collecting accurate information and getting complete knowledge of the local agricultural conditions, the agronomists of the Naveo travelled extensively in the country and visited farmers in their villages and on their fields. They studied carefully the different crops and the methods of cultivations in each district.

Soil analysis have been made. Numerous samples of typical soil formations have been taken at different places and forwarded to Berlin and Paris for analysis. As mentioned above, a large number of experiments have been carried out and the results obtained prove clearly that the proper use of Potash does improve the crops with regard to both, quantity and quality.

The Naveo gladly acknowledges to have met with a full understanding from part of the Chinese Agronomists for close co-operation. The ultimate aim of this co-operation is to promote the use of better methods of plant production, especially through the use of complete fertilizers containing the amounts of Potash indispensible for optimum development of the crops.

THE NAVEO'S STANDING AND POLICY

The potash industry, realising China's efforts towards the revival of her agriculture showed their readiness for co-operation by entrusting the N.V. Overzeesche Kali Export Maatschappij, Amsterdam, (Naveo), with the work of acquainting the Chinese farmers with the use of fertilizers in general and potash in particular, thus assisting the Chinese Government in their effort to improve China's agriculture.

The German Mines are operated by numerous concerns comprising over 200 shafts which have been bored in the various districts rich in Potash deposits. These Potash beds are situated in Central Germany and extend roughly from Hannover in the North to the Thuringian Forest in the South. The first mine was sunk in 1856 near Stassfurt, and Stassfurt has remained a byword of the Potash Industry ever since. The German Potash producers are represented by an extensive sales organization with Head-Office in Berlin under the name of "Deutsches Kalisyndikat G.m.b.H.", which includes an Agricultural Department, also in Berlin, entrusted with scientific and educational work. The German Potash Syndicate also maintains an Agricultural Experiment Station at Lichterfelde, with large laboratories and the most up-to-date equipment imaginable where intensive research work is being conducted on all problems relating to plant nutrition in general and to potash in particular. The valuable contributions of this Institute in the field of agricultural chemistry has often gained recognition in the agricultural press and at International Congresses. "Die Ernährung der Pflanze", a bimonthly publication of 20,000 copies, of which 7,000 are sent to subscribers abroad, is issued by the Agricultural Department of the German Potash Syndicate. It is devoted to the study of the functions of potash and

Table No. 4—Cabbage in Hopeh.

No.	Place	Application per Mow in catties	Increase per Mow through NPK mixture in catties	Percentage increased
	Year 1934.			
1	Ku Chuang Tzu Tientsin	2000 cat. Compost, plus 164 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	3209.5	36
		246 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	4460.5	56
2	Yan Liu Tsing Tientsin	2000 cat. Compost, plus 66 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	530.0	9
		99 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	1865.0	31
		132 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	2827.0	44.5
		198 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	4505.0	68
3	Balitei Tientsin	2000 cat. Compost, plus 127 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	2550.0	50
		191 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	3325.0	65
4	Ho Hsing Chuang Tientsin	2000 cat. Compost, plus 295 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	4717.0	60
		393 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	6290.0	80
5	Ho Hsing Chuang Tientsin	2000 cat. Compost, plus 196 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	4547.67	53
6	Ho Hsing Chuang Tientsin	2000 cat. Compost, plus 147 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	2718.68	32.5
7	Ho Hsing Chuang Tientsin	2000 cat. Compost, plus 98 cat. of a mixture containing: 6% N, 6% P_2O_5, 16% K_2O	2286.52	27
		Average increase per mow through application of NPK mixture	3371.68 cat.	47.1%

N = Nitrogen

P_2O_5 = Phosphoric Acid

K_2O = Potash

Table No. 3—Cotton in Chekiang.

No.	Place	Application per Mow in catties	Increase* per Mow through NPK Mixture in catties	Percentage increased
	Year 1937.			
1	Lung Chuan, Yu Yao	100 cat. of a mixture containing: 6% Nitrogen, 9% Phosphoric Acid, 8% Potash	49.0	17
2	Lung Chuan, Yu Yao	100 cat. of a mixture containing: 6% Nitrogen, 9% Phosphoric Acid, 8% Potash	59.0	22
3	Zaen, Yu Yao	80 cat. of a mixture containing: 6% Nitrogen, 9% Phosphoric Acid, 8% Potash	36.0	17
4	Ta An, Yu Yao	100 cat. of a mixture containing: 6% Nitrogen, 9% Phosphoric Acid, 8% Potash	29.0	14
		Average increase per mow through application of NPK mixture	43.25 cat.	17.5%

*) Compared with Beancake alone.

Table No. 2—Cotton in Hopeh.

No.	Place	Application per Mow in catties	Increase per Mow through NPK Mixture in catties	Percentage increased
	Year 1936.			
1	Hsiau Nan Liu, Ankwo	800 cat. Compost, plus 27 cat. of a mixture containing: 7% Nitrogen, 6% Phosphoric Acid, 16% Potash plus 27 cat. of a mixture containing: 9% Nitrogen, 5% Phosphoric Acid, 14% Potash	82.9	82
2	Hai She Twin, Ankwo	800 cat. Compost, plus 54 cat. of a mixture containing: 9% Nitrogen, 5% Phosphoric Acid, 14% Potash	55.3	60
3	Dung Guan Li, Ankwo	800 cat. Compost, plus 60 cat. of a mixture containing: 9% Nitrogen, 5% Phosphoric Acid, 14% Potash	83.1	87.5
4	Nan Go Pu, Ankwo	800 cat. Compost, plus 33 cat. of a mixture containing: 7% Nitrogen, 6% Phosphoric Acid, 16% Potash plus 27 cat. of a mixture containing: 9% Nitrogen, 5% Phosphoric Acid, 14% Potash	43.0	47
5	Yen Zswin, Ankwo	800 cat. Compost, plus 27 cat. of a mixture containing: 7% Nitrogen, 6% Phosphoric Acid, 16% Potash plus 27 cat. of a mixture containing: 9% Nitrogen. 5% Phosphoric Acid, 14% Potash	43.0	47
		Average increase per mow through application of NPK mixture	61.5 cat.	64.7%

TABLES OF EXPERIMENTS WITH COMPLETE FERTILIZERS CONDUCTED BY NAVEO

Table No. 1—Rice in Chekiang.

No.	Place	Application per Mow in catties	Increase* per Mow through NPK Mixture in catties	Percentage increased
	Year 1934.			
1	Chang An, Wenchow	20 cat. of a mixture containing: 10% Nitrogen, 5% Phosphoric Acid, 10% Potash	138.0	42
2	Jen Sia Chiao, Wenchow	20 cat. of a mixture containing: 10% Nitrogen, 5% Phosphoric Acid, 10% Potash	120.0	35
3	Erka, Wenchow	20 cat. of a mixture containing: 10% Nitrogen, 5% Phosphoric Acid, 10% Potash	140.0	44
4	Chang Kia Ka, Wenchow	20 cat. of a mixture containing: 10% Nitrogen, 5% Phosphoric Acid, 10% Potash	165.0	46
5	Chang Ka Tang, Wenchow	20 cat. of a mixture containing: 10% Nitrogen, 5% Phosphoric Acid, 10% Potash	174.0	67
6	Tong Chiang, Wenchow	20 cat. of a mixture containing: 10% Nitrogen, 5% Phosphoric Acid, 10% Potash	135.0	45
7	Si Shan, Tsu Mong	20 cat. of a mixture containing: 10% Nitrogen, 5% Phosphoric Acid, 10% Potash	75.0	16
	Year 1937.			
8	Sa Chiao Tu, I Wu	60 cat. of a mixture containing: 8% Nitrogen, 7% Phosphoric Acid, 8% Potash	135.5	38
		Average increase per mow through application of NPK mixture	135.3 cat.	42%

*Compared with Sulphate of Ammonia alone.

How to use Artificial Fertilizers

Regarding the way in which the three elements should be offered for consumption in Chinese Agriculture, we have come to the conclusion that the Chinese farmers have up to now not yet learned to make up their own mixtures for the different crops. We are of the opinion, therefore, that they should be supplied with mixtures containing the three elements in the proportions most suitable to the various crops.

It is generally accepted that it is less important whether the crops receive one or two per cent of one of the necessary elements over or below their actual requirements,—the surplus being often retained in the soil for the benefit of the next season—than that the plants should not receive them at all. Complete mixtures proved to be extremely popular in Europe and U.S.A. where agricultural production has been on a scientific basis for some time. In China too, a definite turn towards the use of complete mixtures could be observed during recent years.

We are also giving on pages No. 28 to 31 a limited number of experiments in China, in which complete fertilizers have been used as compared with local methods of manuring.

Table No. 14—Various.

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1933 in Chekiang.			
		SCROFULARIA		
1	Wu Ka Za Chiao, Chien Chiao Hanghsien	Local Manure plus 60 cat. Chloride of Potash 80%	600.0	25%
	Year 1934 in Chekiang.			
		MATTING GRASS		
2	Shan Ho Shien, Wenchow	Sulphate of Ammonia, Phosphate 40% plus 30 cat. Chloride of Potash 80%	360.0	37%
	Year 1935 in Kiangsu.			
		PYRETHRUM		
3	Peh Sin Kin Shanghai	Sulphate of Ammonia, Superphosphate plus 20 cat. Sulphate of Potash 90%	212.7	49%
	Year 1935 in Honan.			
		TOBACCO		
4	Hsuchow	Sulphate of Ammonia, Superphosphate plus 15 cat. Sulphate of Potash 90%	59.3	33%

Table No. 13—Peanuts in Shantung.

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1932.			
1	Huang Gia San Tsimo	1000 cat. Compost plus 20 cat. Chloride of Potash 80%	54.0	10
2	Ta Ze Guang Tsimo	1000 cat. Compost plus 27 cat. Chloride of Potash 80%	189.0	42
3	Gua Chien Kaomi	800 cat. Compost, Beancake plus 20 cat. Chloride of Potash 80%	141.8	14
4	Chia Zuang Kaomi	800 cat. Compost plus 20 cat. Chloride of Potash 80%	40.5	7.5
		Average increase per mow through application of Potash	106.3 cat.	18.4%

Table No. 12—Vegetables in Shantung.

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1932.			
		CUCUMBER		
1	Tangchiakouze, Tsingtao	5000 cat. Compost, 50 cat. Beancake plus 28 cat. Sulphate of Potash 90%	3564.0	404%
		CHINESE LEEK		
2	Tangchiakouze, Tsingtao	5000 cat. Compost plus 25 cat. Sulphate of Potash 90%	877.5	33%
		MAIZE		
3	Tangchiakouze, Tsingtao	1000 cat. Compost, 50 cat Beancake plus 40 cat. Chloride of Potash 80%	401.7	92.5%

Table No. 11—Vegetables in Kwangtung.

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1933.	GARLIC		
1	Dor King, Chaoyang	Sulphate of Ammonia plus 30 cat. Potash Manure 48% KCl	585.5	19.7%
		GINGER		
2	Chaoyang	Sulphate of Ammonia plus 30 cat. Potash Manure 48% KCl	277.0	17%
	Year 1934.	YAMS		
3	To Yuen, Kongmoon Sunwui	Sulphate of Ammonia plus 20 cat. Chloride of Potash 80%	545	31.2%
	Year 1935.	TURNIP		
4	Huon Tsing, Kityang	Sulphate of Ammonia plus 35 cat. Potash Manure 48% KCl	1,529.5	28.6%

Table No. 10—Kaoliang in Shantung.

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1932.			
1	Tsimo	1000 cat. Compost, 50 cat. Beancake plus 20 cat. Sulphate of Potash 90%	249.7	127.5
	Year 1933.			
2	Huang Sen Guan Lungkow	1500 cat. Compost plus 37 cat. Chloride of Potash 80%	202.5	49
3	Ying Gia Zuang Hwanghsien	1500 cat. Compost plus 33 cat. Chloride of Potash 80%	101.2	24
4	Bo Ma Hwanghsien	1500 cat. Compost plus 27 cat. Chloride of Potash 80%	189.0	30
5	Chiang Ling Kaomi	800 cat. Compost plus 30 cat. Chloride of Potash 80%	81.0	21.5
6	Chiang Ling Kaomi	800 cat. Compost plus 33 cat. Chloride of Potash 80%	45.0	18
		Average increase per mow through application of Potash	144.7 cat.	45%

Table No. 9—Millet and Glutinous Millet in Shantung.

No.	Place	Application per Mow in catties		Increase per Mow through Potash in catties	Percentage increased
	Year 1933.				
1	Tsimo	1000 cat. Compost plus 20 cat. Chloride of Potash	80%	69.5	35.5
2	Fangtze	1200 cat. Compost, 50 cat. Beancake plus 20 cat. Chloride of Potash	80%	81.0	50.0
3	Fangtze	1200 cat. Compost plus 20 cat. Chloride of Potash	80%	114.8	39.5
4	Tsimo	1000 cat. Compost, 50 cat. Beancake plus 20 cat. Sulphate of Potash	90%	98.8	47.0
5	Chengyang, Tsimo	1000 cat. Compost plus 20 cat. Sulphate of Potash	90%	40.5	12.5
6	Chia Zuang, Kaomi	800 cat. Compost plus 27 cat. Sulphate of Potash	90%	121.5	37.5
7	Chia Zuang, Kaomi	800 cat. Compost plus 20 cat. Chloride of Potash	80%	94.5	35.0
8	Chang Ling Kaomi	800 cat. Compost plus 27 cat. Sulphate of Potash	90%	115.2	52.0
9	Chang Ling Kaomi	800 cat. Compost plus 20 cat. Chloride of Potash	80%	212.5	73.5
10	Chuchiao	1300 cat. Compost plus 35 cat. Sulphate of Potash	90%	67.0	25.0
11	Shaho	1300 cat. Compost plus 27 cat. Chloride of Potash	80%	52.3	13.0
12	Chiang Ling Kaomi	800 cat. Compost plus 33 cat. Chloride of Potash	80%	64.1	25.0
13	Wu Gia Zuang Kaomi	800 cat. Compost plus 27 cat. Chloride of Potash	80%	51.5	40.5
14	Mau Ze Tuen Kaomi	800 cat. Compost plus 27 cat. Chloride of Potash	80%	40.5	12.0
		Average increase per mow through application of Potash		87.4 cat.	35.6%

Table No. 8—Potatoes in Shantung

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1932.			
1	Litsun Tsingtao	2000 cat. Compost plus 15.6 cat. Sulphate of Potash 90%	96	12.5
		plus 31.2 cat. Sulphate of Potash 90%	328	42.0
		plus 46.8 cat. Sulphate of Potash 90%	428	55.0
		plus 62.4 cat. Sulphate of Potash 90%	626	80.5
		plus 78.0 cat. Sulphate of Potash 90%	1,470	188.5
2	Tangchiakouze Tsingtao	2000 cat. Compost, Beancake plus 29.4 cat. Sulphate of Potash 90%	1,073.1	36.0
		Average increase per mow through application of Potash	670.2 cat.	69.1%

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1933.			
12	Tangchiakouze Tsingtao	1000 cat. Compost plus 40 cat. Chloride of Potash 80%	505	44.0
13	Fu Shen Suo Tsingtao	1000 cat. Compost plus 40 cat. Sulphate of Potash 90%	533.3	44.5
14	Yen Li Chuang Kiaochow	1000 cat. Compost plus 33 cat. Chloride of Potash 80%	351	30.5
15	Ying Tsun Kiaochow	1000 cat. Compost plus 33 cat. Chloride of Potash 80%	420	38.5
16	Pang Gia Chuang Kiaochow	1000 cat. Compost plus 33 cat. Chloride of Potash 80%	742.5	67.0
		Average increase per mow through application of Potash	453.4 cat.	39.5%

Table No. 7—Sweet-Potatoes in Shantung

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1932.			
1	Tangchiakouze Tsingtao	1500 cat. Compost plus 40 cat. Sulphate of Potash 90%	331	45.5
2	Lingiaying Tsimo	1500 cat. Compost plus 40 cat. Sulphate of Potash 90%	328.3	21.5
3	Chin Gia Pingtu	1500 cat. Compost plus 40 cat. Chloride of Potash 80%	262	31.5
4	Tangchiakouze Tsingtao	1500 cat. Compost plus 30 cat. Sulphate of Potash 90%	289	23.0
5	Chiaogiakou Tsimo	1500 cat. Compost plus 35 cat. Sulphate of Potash 90%	277	21.0
6	Hsiehchiaying Tsimo	1500 cat. Compost plus 35 cat. Sulphate of Potash 90%	681.7	42.0
7	Shinkouchuang Tsimo	1500 cat. Compost plus 40 cat. Sulphate of Potash 90%	602.5	52.0
8	Shinkouchuang Tsimo	1500 cat. Compost plus 45 cat. Sulphate of Potash 90%	329.5	37.5
9	Dungyao Tsingtao	1500 cat. Compost plus 40 cat. Sulphate of Potash 90%	756	30.5
10	Wangerhchuang Erhshilipu	1500 cat. Compost plus 47 cat. Sulphate of Potash 90%	463	33.0
11	Tungchiachuang Erhshilipu	2000 cat. Compost plus 47 cat. Sulphate of Potash 90%	381.8	70.0

Table No. 6—Sweet-Potatoes in Kwangtung

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1932.			
1	Kek Koi, Kityang	Local Manure, Sulphate of Ammonia plus 30 cat. Chloride of Potash 80%	530	30.6
2	Siang Mong Le, Chaoyang	Local Manure plus 30 cat. Chloride of Potash 80%	238	6.8
	Year 1933.			
3	Liao Tson, Chaoyang	Local Manure plus 30 cat. Chloride of Potash 80%	410	16.0
4	Kim Po, Chaoyang	Local Manure plus 30 cat. Chloride of Potash 80%	622.5	31.3
5	Mang Hang, Chaoyang	Sulphate of Ammonia plus 30 cat. Chloride of Potash 80%	378.5	31.0
6	Ao Koi, Chaoyang	Sulphate of Ammonia plus 30 cat. Chloride of Potash 80%	306	43.9
7	Swan Men, Chaoyang	Sulphate of Ammonia plus 30 cat. Potash Manure 48% KCl	443	9.2
8	Swan Men, Chaoyang	Sulphate of Ammonia plus 30 cat. Potash Manure 48% KCl	434	8.8
9	Swan Men, Chaoyang	Sulphate of Ammonia plus 30 cat. Potash Manure 48% KCl	357.5	7.9
10	Ngao Tao, *Chao An*	Sulphate of Ammonia plus 30 cat. Potash Manure 48% KCl	405.5	12.3
	Average increase per mow through application of Potash		412 cat.	19.8%

Table No. 5—Wheat in Shantung

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1932-1933 in Shantung.			
1	Zei Kuo Pingtu	2000 cat. Compost plus 20 cat. Chloride of Potash 80%	26.2	21
2	Hsia Zuang Kaomi	2000 cat. Compost plus 33 cat. Chloride of Potash 80%	30.4	20
3	Kaomi	2000 cat. Compost plus 33 cat. Chloride of Potash 80%	70.8	81
4	Kaomi	2000 cat. Compost plus 20 cat. Chloride of Potash 80%	27.0	35
5	Hwang Chi Pu	2000 cat. Compost plus 25 cat. Sulphate of Potash 90%	93.7	68
6	Yueng Gia Tsimo	1700 cat. Compost plus 33 cat. Sulphate of Potash 90%	67.5	59
7	Liu Gia Ying Tsimo	1700 cat. Compost plus 33 cat. Sulphate of Potash 90%	101.3	29
8	Liu Ting Tsimo	1700 cat. Compost, 50 cat. Beancake plus 27 cat. Chloride of Potash 80%	60.0	30
9	Dung Gia Erhshilipu	1500 cat. Compost plus 27 cat. Chloride of Potash 80%	94.5	34
10	Liu Gia Erhshilipu	1500 cat. Compost plus 27 cat. Chloride of Potash 80%	101.3	42.5
11	Wang Gia Fangtse	1500 cat. Compost plus 27 cat. Sulphate of Potash 90%	85.5	65.5
12	Chengyang Tsimo	1700 cat. Compost plus 27 cat. Chloride of Potash 80%	108	59
13	Chengyang Tsimo	1700 cat. Compost plus 20 cat. Chloride of Potash 80%	54	31
		Average increase per mow through application of Potash	70.8 cat.	44.2%

Table No. 4—Wheat in Chekiang and Kiangsu

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
		Year 1934 in Chekiang.		
1	Yeh Zah	Sulphate of Ammonia, Superphosphate plus 20 cat. Chloride of Potash 80%	27.5	23.0
2	Yeh Zah	Sulphate of Ammonia, Superphosphate plus 20 cat. Chloride of Potash 80%	33.75	28.0
		Year 1935 in Kiangsu.		
3	Chuan Chiao Shanghai	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	50.0	15.0
		b/20 cat. Chloride of Potash 80%	75.0	22.5
		Year 1935 in Chekiang.		
4	Dong Sha Wuchow	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	31.7	16.0
		b/20 cat. Chloride of Potash 80%	38.0	19.0
5	King Fong Chiao Hanghsien	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	34.0	13.5
		b/20 cat. Chloride of Potash 80%	52.0	21.0
		Year 1937 in Kiangsu.		
6	Loh Hong, Pootung Shanghai	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	66.0	16.0
		b/20 cat. Chloride of Potash 80%	70.0	17.0
		Year 1937 in Chekiang.		
7	King Hua	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	70.0	35.0
		b/20 cat. Chloride of Potash 80%	84.4	42.0
8	Ma Tsin I Wu	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	33.8	21.0
		b/20 cat. Chloride of Potash 80%	37.6	24.0
		Average increase per mow through application of Potash	50.27 cat.	22.4%

Table No. 3—Water Rice in Kiangsu and Chekiang.

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
		Year 1931 in Kiangsu.		
1	Sin Za Changchow	Beancake plus 15 catt. Sulphate of Potash 90%	100	20
2	Chu Tsoh Yuen Changchow	Beancake plus		
		a/20 cat. Sulphate of Potash 90%	136	28
		b/40 cat. Sulphate of Potash 90%	235	49
		Year 1933 in Kiangsu.		
3	Si Mong Sungkiang	Clover as green Manure plus 20 cat. Chloride of Potash 80%	90	18
		Year 1935 in Chekiang.		
4	Mo Tse Yu Yao	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	85	18
		b/20 cat. Chloride of Potash 80%	110	24
5	Loh Ka Chiao Shiao Shan	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	67	13
		b/20 cat. Chloride of Potash 80%	74	14
		Year 1937 in Chekiang.		
6	Huangyen	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	71	12
		b/20 cat. Chloride of Potash 80%	92	16
7	Wang Yan Mi I Wu	Sulphate of Ammonia, Superphosphate plus 15 cat. Chloride of Potash 80%	65	13
		Year 1937 in Kiangsu.		
8	Tsin Pu	Sulphate of Ammonia, Superphosphate plus		
		a/10 cat. Chloride of Potash 80%	60	10
		b/20 cat. Chloride of Potash 80%	72	12
		Average increase per mow through application of Potash	96.7 cat.	19%

Table No. 2—Water Rice in Kwangtung and Fukien

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties	Percentage increased
	Year 1933 in Kwangtung.			
1	Lung Shan Jao Ping	Sulphate of Ammonia plus 20 cat. Potash Manure 48% KCl	59.0	10
2	Lin Mai-Hieng, Chao An	Sulphate of Ammonia plus 20 cat. Potash Manure 48% KCl	114.37	27
3	Lin Mai-Hieng, Chao An	Sulphate of Ammonia plus 20 cat. Potash Manure 48% KCl	41.25	7
	Year 1934 in Kwangtung.			
4	Sha Ping, Hokshan	Sulphate of Ammonia plus 15 cat. Chloride of Potash 80%	95.0	28
5	Mok Ho, Hokshan	Sulphate of Ammonia plus 15 cat. Chloride of Potash 80%	70.0	17
6	Sun Chuen-Lung, Mok Ho, Hokshan	Sulphate of Ammonia plus 15 cat. Chloride of Potash 80%	80.0	27
	Year 1936 in Fukien.			
7	Cheung Chow Lunghai	Sulphate of Ammonia plus 16 cat. Potash Manure 48% KCl	60.0	17
8	Kang Mui Hai Ching	Sulphate of Ammonia plus 20 cat. Potash Manure 48% KCl	74.0	20
9	Kang Mui Hai Ching	Sulphate of Ammonia plus 20 cat. Potash Manure 48% KCl	55.0	17
10	Kang Mui Hai Ching	Sulphate of Ammonia plus 20 cat. Potash Manure 48% KCl	47.0	15
	Average increase per mow through application of Potash		69.5 cat.	18.5%

These results were obtained *without Phosphates* and further increase should be obtainable by including Superphosphate which can be easily supplied by the Fertilizer Factory at Saichuen, Canton.

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties Sugar	Cane	Percentage increased Sugar	Cane
		Year 1937 in Fukien.				
8	Tien Mui, Tonan	Sulphate of Ammonia and Beancake plus 50 cat. Potash Manure 48% KCl	158.3		34.3	
9	Lo Kow, Chang Chow	Sulphate of Ammonia plus 40 cat. Potash Manure 48% KCl		528		14.2
10	Sen Tsu Heing, Chang Chow	Sulphate of Ammonia plus 50 cat. Potash Manure 48% KCl		560		9.2
11	Sen Tsu Heing, Chang Chow	Sulphate of Ammonia plus 50 cat. Potash Manure 48% KCl		1,750		29.2
		Year 1937 in Kwangtung.				
12	1st Cane Plantation of Tungkoon Sugar Mill	Peanutcake and 12-8-4, NPK Mixture plus:				
		a) 11.88 c. Chloride of Potash 80%	85.6		12.5	
		b) 23.76 „ „ „ „	87.7		12.8	
		c) 35.64 „ „ „ „	49.6		7.3	
		Average increase per mow through application of Potash:				
		Sugar	97.1 cat.		19.0%	
		Cane		1,735 cat.		24.7%

TABLES
OF EXPERIMENTS CONDUCTED BY NAVEO

Table No. 1—Sugar Cane

No.	Place	Application per Mow in catties	Increase per Mow through Potash in catties Sugar Cane	Percentage increased Sugar Cane
	Year 1934 in Kwangtung.			
1	Chiao Shu Po, Chaoan	Sulphate of Ammonia plus 50 cat. Potash Manure 48% KCl	4,358	51.2
2	Chiao Shu Po, Chaoan	Sulphate of Ammonia plus 40 cat. Chloride of Potash 80%	1,480	19.7
	Year 1935 in Kwangtung.			
3	Ungkung, Jaoping	Sulphate of Ammonia plus 60 cat. Potash Manure 48% KCl	62.5	12.5
4	Kek Koi, Kityang	Sulphate of Ammonia plus		
		a) 20 cat. Chloride of Potash 80%	35.5	7.4
		b) 30 „ „ „ „	120.5	21.4
		c) 40 „ „ „ „	87.5	18.2
5	Kui Soo, Puning	Sulphate of Ammonia plus 50 cat. Potash Manure 48% KCl	121.0	36.8
6	Hunkgao, Tenhai	Sulphate of Ammonia and Superphosphate plus 50 cat. Potash Manure 48% KCl	180.5	34.7
	Year 1936 in Kwangtung.			
7	Kek Koi, Kityang	12-8-4 NPK Mixture plus		
		a) 8.2 c. Chloride of Potash 80%	110.0	17.1
		b) 16.4 „ „ „ „	66.0	12.6

grown. In supplementing the work done by agricultural institutions and experiment stations, the Naveo has carried out numerous experiments and demonstrations.

It would, of course, lead too far to give here a detailed report on the work done by our Company in China in this direction, but we are giving on the following pages a compilation of our experiments' results. These tables give the increases in yield through an additional application of Potash and are ample proof that agricultural production in China can be considerably increased and improved upon by including Potash in the present methods of fertilization.

of the soil and forthwith the food question is to be solved. Such a combination of natural manure and commercial fertilizers has been found to be extremely valuable, as the former gives humus and bacterial life to the soil while the fertilizer offers the necessary plant food, supplying at the same time the plant nutrients in an easily available form, which is, of course, a very important factor.

It has to be mentioned in this connection that most soils have a high absorbing power for the nutritive elements and especially for Potash. This leads often to errors in cases where only a small quantity of Potash has been given. Insufficient amounts will be absorbed by the soil in such a way that visible results of Potash fertilization can only be noticed after full saturation of the soils' capacity for absorbing Potash; only from that moment on will it be available for the roots.

Fertilizing Improved Seeds

Another fact which will necessitate the scientific utilization of chemical fertilizers consists in the raising of improved seeds. Big progress has been realized in the cultivation of varieties more productive and of better quality. Such improved plants, of course, will give their fullest yield and show all the capacities for which they have been selected, only if they are grown under proper conditions with the necessary nourishing elements that they demand. With the perfecting of plants which become more responsive to higher fertility, the use of chemical fertilizers plays a more important role than in the case of cultivation of the native strains. The neglect in the proper application of chemical fertilizers will lead to failure, and all the long and expensive efforts spent on plant breeding will be wasted. Therefore, the successful introduction of improved seeds must go hand in hand with the adoption of chemical fertilizers.

Field Experiments

In order to decide the proportions in which the three elements are to be used, intensive research work has been carried out in Western countries and has been used to good advantage in China. Further investigations were necessary to ascertain the special requirement of Chinese soils and crops under average conditions, indicating at the same time in which way the crops have to be fertilized, if satisfactory result shall be expected. But it must be mentioned and this is, of course, highly important that such quantities of plant food must be in the soil in an easily soluble form in order to enable the plants to make use of them during the entire growing period. This is a very important factor which indicates that, besides natural manures, commercial fertilizers must be used in modern agriculture as they provide readily available plant food.

Necessity of Using Artificial Fertilizers

China is an ideal farming country. Nowhere in the world can farmers be found, who are so diligent, so hardworking and so naturally predisposed for agriculture. Soil and climatic conditions in most of the provinces are nearly unrivalled. On such valuable basis, Chinese agriculture has been developed already centuries ago to a very high standard. But the Chinese farmers have found out that their soils are becoming exhausted after continuous cropping. In order to prevent this and, on the other hand, in order to feed the steadily increasing population, methods have been worked out to compensate the soil as much as possible for that part of its nutrient capital removed by the crops.

Without knowing the scientific principles, the farmers found that by fertilizing with night-soil, compost, beancake and ashes the fields could, to a certain extent, be brought back to their normal producing capacity. But according to modern experience this could only be of temporary help specially as more and more food-stuff is needed for the population, which is continually on the increase. The old methods could not keep up the fertility of the soil and new methods had to be found or had to be adopted from other countries where the same development took place earlier than in China on account of the industrialization which started in Western countries in the second half of the last century.

Comprehensive research work has been done already by the Chinese Government and by foreign interested Companies, which led to the conclusion, that besides the Chinese natural manures, commercial fertilizers have to be used if the fertility for a long time (as practically all soils in China have!) and with the lighter types of soils containing naturally small amounts of minerals. As Potash deficiency causes very marked physiological disturbances in the plant, typical signs of Potash starvation can be observed on plants cultivated on such soils. Such external symptoms are: leaves of plants which are lacking in Potash are covered with brown spots and the margins are becoming brown and crinkled, the formation of chlorophyll, the most important factor in the assimilation of carbon dioxyde by the leaves, does not take place in a proper way, the development of the root system is absolutely insufficient, the germinating power of the seeds is decreasing, the appearance of the plants is greatly changed, specially in later periods of growth, the anatomical structure is weakened and, in consequence of these symtoms, the yield will be more or less affected, according to the seriousness of the deficiency. The symptoms described here will appear only in extreme cases and after all resources of Potash contained in the soil have been exhausted by the preceeding crops. It is, therefore, necessary to remember that even early stages of potash deficiency will cause depressions in the yield and that sometimes a considerable quantity of potash will be necessary to restore the fertility of the soil, once potash deficiency symptoms have become apparent.

Amounts of Plant Food Removed

As mentioned already, all plants are in need of the three principal elements, but the requirements of each of them are varying in accordance with their special needs. Thus, plants producing large amounts of vegetable matter would require comparatively high amounts of Nitrogen, while others, producing mainly sugar and starch, would be more in need of Potash. Such crops as sugar cane, root crops and fruit trees have to be dressed specially with Potash but without omitting either Nitrogen or Phosphorus as no element can be replaced by either or even by both of the others. Also this theory has been formulated by Justus von Liebig and has been substantiated by research carried out throughout the world.

The coloured chart (fig. no. 10) gives an idea of the amounts of plant food removed by the plants from the soil age of starch and sugar are responding greatly to Potash. As has been proved by extensive experiments, potash has a specific effect on the root development of the plants, which are thus in a decidedly better position to overcome periods of drought. Potash improves the structure of the plants generally, resulting in two advantages as compared with crops not fertilized with Potash: the plants and fruit trees become more resistant against lodging and breaking respectively; besides, a stronger structure brings about better keeping quality, better resistance to diseases and attacks by insects and parasites.

Therefore, besides increasing the yield, Potash must be regarded as that element which gives quality to agricultural products, which is of such big importance to-day.

Some other elements, as for instance, Calcium, Magnesium, Iron and Sulphur are also taking part in the building up of plants, but they are of less significance as far as their replacement through the farmer is concerned as they are usually available in the soil in sufficient quantities.

As shown above, all the elements have their own effect on plant vegetation and, therefore, it will be easily understood, that all of them must be available together, if a regular growth shall be secured. Deficiency of one of them will lead to unsatisfactory results.

Plant Food Deficiency Symptoms

More or less marked symptoms are indicating the lack of the different elements.

Nitrogen starvation, for instance, is indicated by the yellow colour of the leaves and poor growth of the plants in general.

If *Phosphoric acid* is lacking, the flowering and the formation of seeds and fruit is affected. Deficiency in *Phosphoric acid* causes delay in the maturing of the crop and impedes a normal development of the root system.

But most of the plants are removing from the soil larger amounts of *Potash* than of the other nutrients. The danger of an impoverishment of the soil in potash is, therefore, especially great on those soils which have been under intensive cultivation

THE IMPORTANCE OF POTASH IN AGRICULTURE

There is no human being, no animal, no plant in this world which, when chemically analysed, does not contain Potash in bigger or smaller quantities, besides other elements. What does this mean to us? It indicates that Potash must be a very essential building stone of natural life. Without Potash, no life. This leads further to the conclusion that Potash has to be always available, if growth of living matter shall be ensured.

Function of Elements

There are two other main elements, Nitrogen and Phosphoric Acid, which are absolutely essential besides Potash, and it is of interest to study from the scientific side the functions of each of these elements which play such a fundamental part in the nutrition of plants.

Nitrogen

is building up the vegetable matter and produces proteins and amids. No plant will be able to bear fruit if there is not enough Nitrogen available in order to allow a satisfactory growth of the plant itself. In other words, Nitrogen makes the plants grow and gives them a luxuriant foliage with dark green colour.

Phosphoric Acid

has its functions specially in the formation of seeds and fruit. But also the proteins are containing Phosphorus, which leads to the conclusion that it is also essential in the building-up of these in the plants.

Potash

is indispensable in forming the carbohydrates, which can be easily proved by the fact that all plants with a high percenttransportation charges per unit of K_2O being too high, thus rendering its use uneconomical.

Distribution of Potash

From the table given below it can be seen to what extent Potash is being used in the principal agricultural countries:

Potash consumption of the main agricultural countries in K_2O tons, year 1936.

Germany (1935/36)	949,000	tons
U.S.A.	333,000	„
France	220,000	„
Japan	100,000	„
Holland	92,000	„
Great Britain and Ireland	70,000	„
Belgium	56,000	„
Denmark	32,000	„

In order to meet the demand which is mostly seasonal, large storage bins have been built at the main distributing centers, i.e. the Potash factories and at the main points of export: Hamburg, Bremen and Antwerp. They are fitted with the most modern equipment such as can be seen from the photograph (Illustration fig. 1). On removal from the store houses the salts are either loaded into the railway waggons or they are bagged and weighed and sown up by special machines for shipment overseas.

Large quantities of Potash salts are being shipped to all parts of the world. The Potash wharves mentioned above have a storing capacity of over 300,000 tons of salts and are capable of handling 12,000 tons per day.

Description of Potash Salts

Sulphate of Potash 90%

contains 48% pure Potash (K_2O) and is mostly being manufactured from Chloride of Potash and Kieserit (Sulphate of Magnesia); as it is practically free from chlorines, it is admirably suited to the manuring of crops producing sugar and starch as well as of tobacco, vegetables and fruit.

Chloride of Potash 95%

is highly concentrated and contains 61% K_2O. Because of its high concentration it is being used for high grade mixtures and industrial purposes but comes under Government Regulations if imported singly into China.

Chloride of Potash 80%

with 50% K_2O, is the salt most commonly used because of its comparatively high concentration and its economical use. Its colour varies from white to grey and red, with the texture varying from fine powder to large crystals. As fertilizer dealers and farmers in China came first into contact with Sulphate of Ammonia, they are inclined to judge other fertilizers from the appearance of Sulphate of Ammonia, this being the only fertilizer with which they are thoroughly familiar. Since farmers are extremely conservative, it will take some time before they will understand that commercial fertilizers are sold on basis of their chemical analysis and that this is the only point that matters, whereas colour and size of crystals are irrevelant.

Potash Manure 48% KCl.

with 30% K_2O, is being used extensively in U.S.A. for cotton and has proved very popular in Fukien, in spite of its low percentage. Also in this case the colour varies from white to red, the white grade being preferred.

Kainit

is a crude salt, i.e. it has not undergone any manufacturing process, and contains 14-17% K_2O. Because of this low percentage it is unsuited for use in far-away countries, the

After a period of tropical climate which has evidently favoured the evaporation of huge quantities of water, there must have been a period of strong continental winds which have deposited a layer of fine clay dust thus protecting the highly soluble salts from being washed away. Owing to later geological formations and upheavals, the Potash deposits were buried at a depth of 1,000-10,000 feet from the surface of which only the ones within 1-2,000 feet are being mined. Some of the deposits were tilted and form "saddles" as is shown in the illustration accompanying this issue.

Potash Mining

As Potash, unlike rock-salt is deposited in comparatively thin layers, sometimes less than 6 feet thick, the mining requires an elaborate net-work of galleries, making operations costly and complicated. The tunnels are driven by blasting, by means of electric drills and explosives which are also fired electrically. The salt loosened by the charges are loaded into conveyors and thence into small railway-trucks, which are taken to the shafts, and from there to the factories by hoisting machines. In order to ensure the safety of the workers, the old workings are refilled to prevent caving in; for this, rock-salts or residues from the factories are being used.

Potash Manufacturing

The factories are needed for converting into concentrated salts, the crude salts which usually contain from 9-17% K_2O and which are, therefore, uneconomical for shipment to far-away countries. For the manufacturing of Chloride of Potash ingredients not suitable for fertilizers have to be eliminated by long and costly processes of dissolution and separation. The dissolving process is taking place in large vats and from here, the hot Potash solution is dispatched, via settling tanks, into the cooling system with vacuum cooler, spraying tower or crystallization vat. From here, the Potash salts are transported to the rotary driers and thence to the store houses. Other salts require different processes of manufacturing which cannot be discribed here due to lack of space.

Introduction

In the middle of last century, Justus von Liebig, one of Germany's foremost agricultural chemists, had stressed the importance of the combined use of the three main plant nutrients, namely Nitrogen (N), Phosphoric Acid (P_2O_5) and Potash (K_2O) for the maintenance of soil-fertility; besides, Calcium (Ca O) is often needed.

It was fortunate that soon afterwards mines which had been sunk near Stassfurt in Germany originally for the mining of rock salt were found to contain rich deposits of Potash salts, a discovery which was responsible for the development of one of the most important industries in Germany; moreover, the increasing application of Potash fertilizers brought about a considerable increase in agricultural production, not only in Germany but in the whole world. The ensuing demand for Potash salts led to the discovery of further Potash deposits in other parts of Central Germany and in Alsace.

Origin of Potash Deposits

As to the origin of these deposits, the theory is generally accepted that the present formations are the result of the evaporation of sea-water which must have flooded Central Europe at regular intervals, at a prehistoric stage, forming large lakes. These lakes evaporated due to the intense heat and the various salts crystallized out, according to their solubility, in the following order:

Calcium Sulphate,
Rock Salt,
Sulphate of Potash and
Chloride of Potash, also called Muriate of Potash.

POTASH

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