(4) その他

トマト苗床におけるシルバープラスチックフィルム，シルバーストライプ入りブラックフィルム，シルバーテープの設置によるアブラムシ類，アザミウマ類防除試験

トマトの重要害虫は，ウイルス病を媒介するアザミウマ類（TSWVの媒介）や アブラムシ類（他のウイルス）である。ところで，アブラムシ伝搬性の野菜類ウイルス病の発生を抑制する技術として，シルバーフィルム等の銀白色被覆資材の利用が日本などでは試みられている。そこで，これら資材を使用し，苗床におけるウイルス病発生抑制効果を検討した。アブラムシは白色又は銀白色に対して忌避行動を示すが，アザミウマ類は誘引性を示す傾向があるといわれている。ウルグァイのトマトの主要病害はTSWVによる黄化えそ病と考えられることから，その媒介虫であるアザミウマ類に対する排斥効果についてシルバーストライプ入りブラックフィルムについて検討した。

〔材料及び方法〕

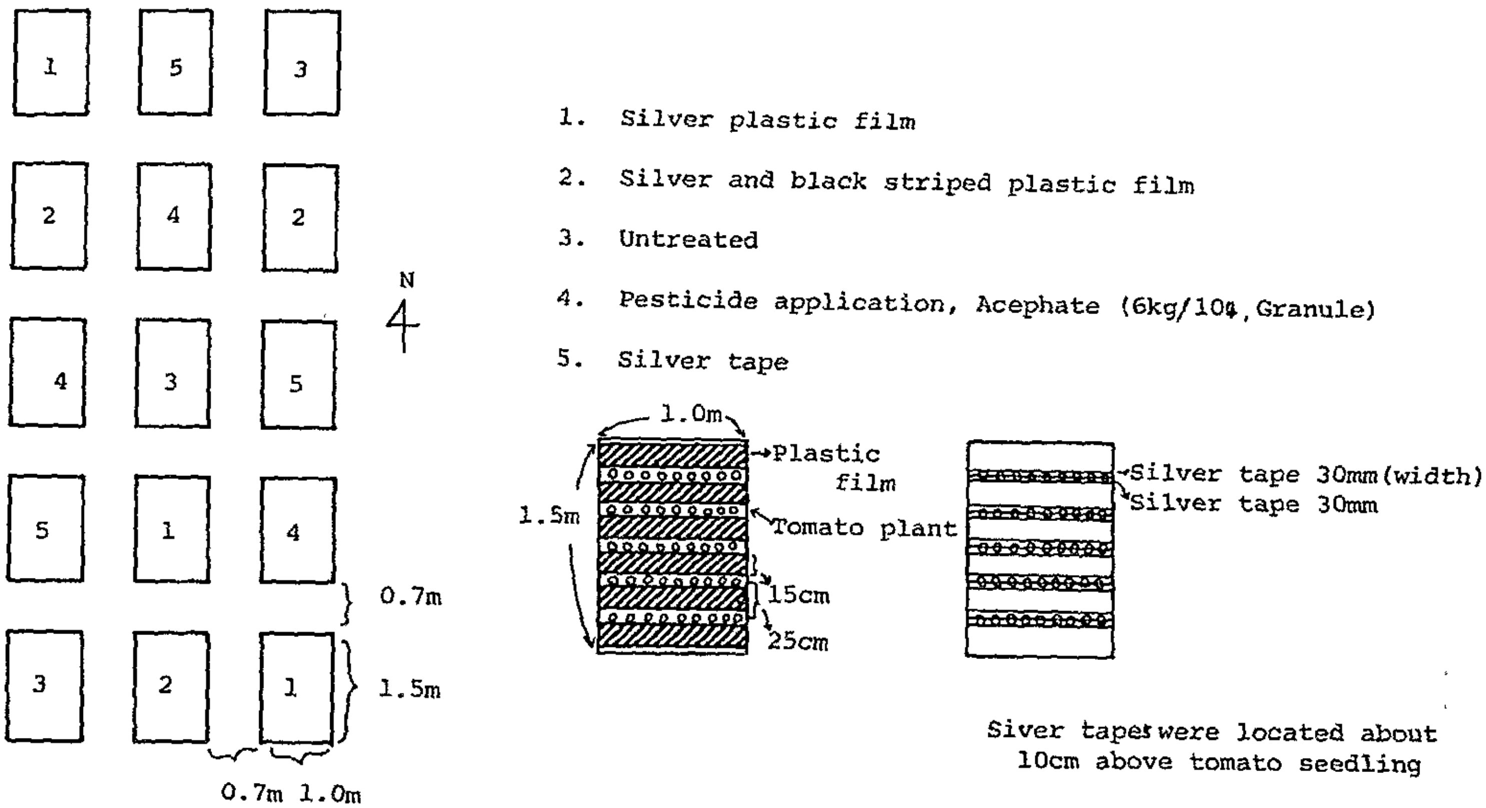
マルチング資材：シルバープラスチックフィルム（マルチミラー®），シルバーストライプ入りブラックフィルム（ニチノームシコン®），シルバープラスチックテープ（ミラーテープ® 30m/m）。

トマトの育苗は普通圃場で行なわれるが，生育を促進させる目的で，トマト稚苗期をガラス室内で育苗し，約15cmに生育した2月11日に圃場に設定した苗床に移植した。各試験区は第5図のとおりである。

調査は各試験区に粘着トラップを設置して行なった。アザミウマ類は，白色粘着トラップ（5cm×5cmの白色ビニールテープにタングルフットを塗布）への誘引数を，アブラムシ類は，黄色粘着トラップ（白色と同じ大きさ，黄色テープを使用）により誘殺数を調べた。

〔結果及び考察〕

日本から発送した資材の到着が遅れたため，試験開始が2月中旬になった。このため調査はすべてカウンターパートの Ing. Nũñez にまかせた。私の帰国時には調査中。



第5図 Field map of thrips and aphids control test

5. アザミウマ類及びモモアカアブラムシ (Myzus Persicae) の発生変動

アザミウマ類，アブラムシ類の今年の発生は極めて少ないようで，夏季にトマト，ピーマンのウイルス病の発生が極めて少なかったことからも，ウイルス媒介昆虫の発生が少なかったことがうかがわたる。そこで，Ing.Briozzo，カウンターパートの Ing. Nūn͂ez 等により調査されたアザミウマ類成虫の白色粘着トラップへの飛来数のデータ(ラス・ブルハス農場)及び Ing.Nūn͂ez により数年間調査されたモモアカアブラムシ (M. Persicae) 成虫の黄色水盤への飛来数のデータ (エスタンスエラ農試) を，また，それぞれの試験場 (一部他場所のものを含む) の気象データを引用させてもらい，発生変動について解析を試みた。

(1) アザミウマ類の発生消長

供試したデータは，1975年より1981年まで6年間にわたり，ラス・ブルハス試験場内のタマネギ圃場に設置された粘着トラップにより，誘引された個体数調査及びタマネギ葉上に寄生しているアザミウマ類の個体数の直接見取りによって調査したもの及び雨量・温度のデータである (虫害研究室による調査，データは未発表)。

第6図はアザミウマ類の誘引個体の月別年間発生変動を図示したものである。縦軸に1か月当たり誘引数の対数値を取り，月ごとに示した。降雨量 (1か月合計値) を棒グラフで，月平均気温を点線で示した。

季節的発生消長は，8～9月頃から飛来がみられ，10月，11月と個体数が増加し，12月頃にピークに達し，2月頃まで高密度で経過し，以降減少していくのが一般的である。1975～76年の1～2月には一度個体数が減少し，3月に再び増加がみられるが，これは1月に115㎜の多雨，2月に25㎜の少雨によるものと推定される。同様の傾向が，1976～77年の10月の多雨と11月の個体数減少，1979～80年の9月から1月にかけての少雨，乾燥と個体数増加に明確に現われている。

年次的な発生変動をみると，年により比較的早くから，多くの個体数の発生がみられる年 (1979～80)や逆に発生が遅く，しかも個体数の少ない年 (1975～76) など大きな差異がみられる。1979～80年は早くからの発生がみられ，11月にはすでに1か月当たり約1,000頭 (1トラップ当たり) の誘引個体がみられている (11月以降は欠測値となっているが，アザミウマ類の発生は激しかったとのことである)。この年のTSWVによるトマト黄化えそ病の発生は激しく，100%のり病株率がみられた圃場もあったという。一方，1975～76年及び1980～81年の両年は，比較的アザミウマの発生も少なく，またTSWV病の発生も少なかったという (TSWVの発生については，病理研究室の Ing. Carlos Lasa及び野菜研究室長の Ing. César R. Maeso の証言及び調査データから)。年間発生変動の主要因は，

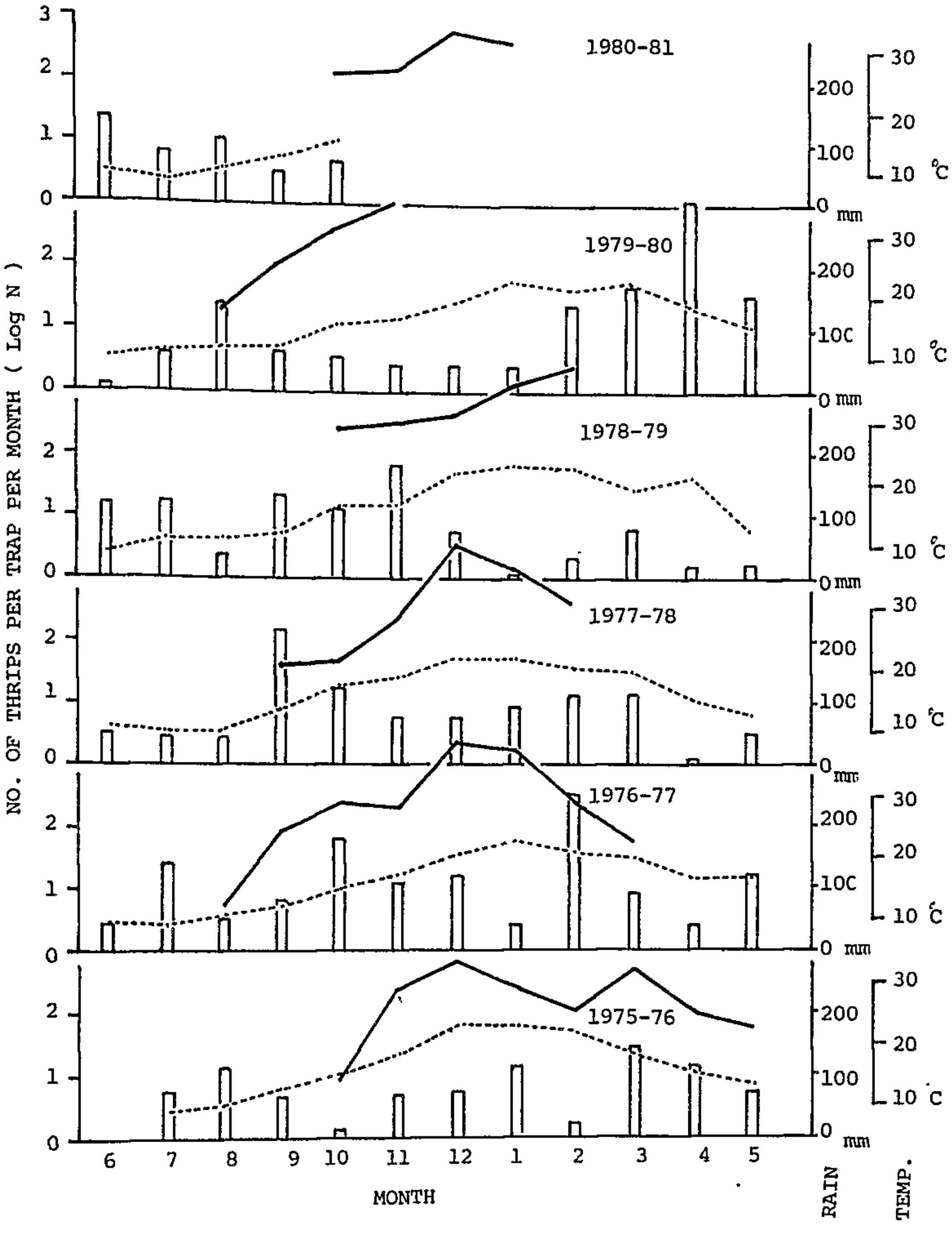
気象条件特に雨量，降雨日数に関係あると推定される。春先の発生は冬季の雨量など，夏季の多発生は春〜夏季の雨量などに強く影響を受けているものと推定される。詳細な解析は，調査資料が不足し，また時間的余裕もなく，今回はできなかったが，的確なアザミウマ類の発生予察法の確立のため，この点は今後の重要研究課題と考えられる。

第７・８図は縦軸にトラップ当たり（１週間ごとの）のアザミウマ類の個体数（対数値）を，横軸にタマネギ１株当たりの寄生数（トラップによる誘引日の１週間後の個体数，対数値）を取りプロットしたものである。第６図は１９７６年９月〜７７年１月，第７図は１９８０年１１月〜１２月のデータである。タマネギの苗及び収穫間近かの株では著しく寄生数が少ないので，これらの計算から除外した結果，両年共極めて高い相関関係（第６図では r＝0.９７６**，第７図では r＝0.９６０**）を示した。これらのことから，タマネギ圃場に設置された粘着式トラップでの誘引個体数消長から，タマネギ寄生消長の推定が可能であることがわかった。

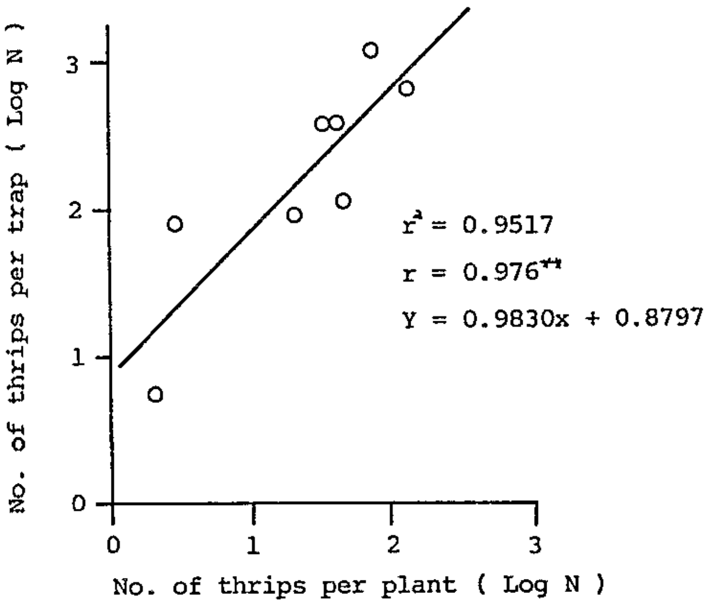
(2) モモアカアブラムシ Myzus parsicae の発生消長

供試したデータは，１９７６年より１９７９年までの４年間にわたり，エスタンスエラ試験場で Ing. Nũñẽz により調べられたもので，同試験場内に設置された黄色水盤に飛来した M. persicae 有翅成虫を月ごとに集計したものである。

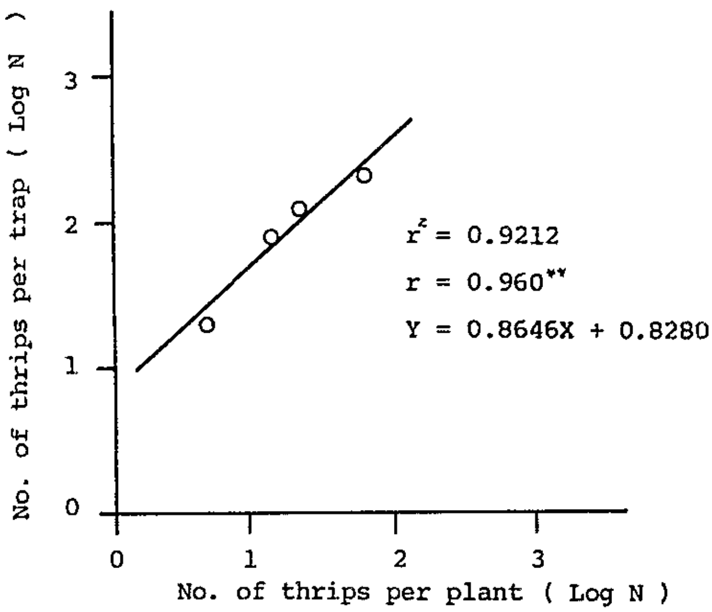
第８図に M. persicae 有翅成虫の年次的，季節的発生変動を，第９図に月平均気温と降水量を示した。M. persicae の季節的発生消長は，２〜３月頃より発生がみられ，４〜５月頃にピークに達し，その後急激に減少し，７〜８月にはみられらくなる。９月頃より再び発生がみられ，１０月，１１月頃がピークとなり，１２月にはみられなくなる。野菜畑での M. persicae の作物上の生息数を調べてみても，１２月から２月までの夏季にはほとんどみあたらない。秋，春の２山型を示す発生である。年次変動はかなり大きく，４年間の最小・最大発生年の間には約８倍の差がみられる。これらの年次変動は，気象特に気温と降雨によるものと思われたが，調査資料がまだ十分でなく，今回は残念ながら詳細な解析はできなかった。



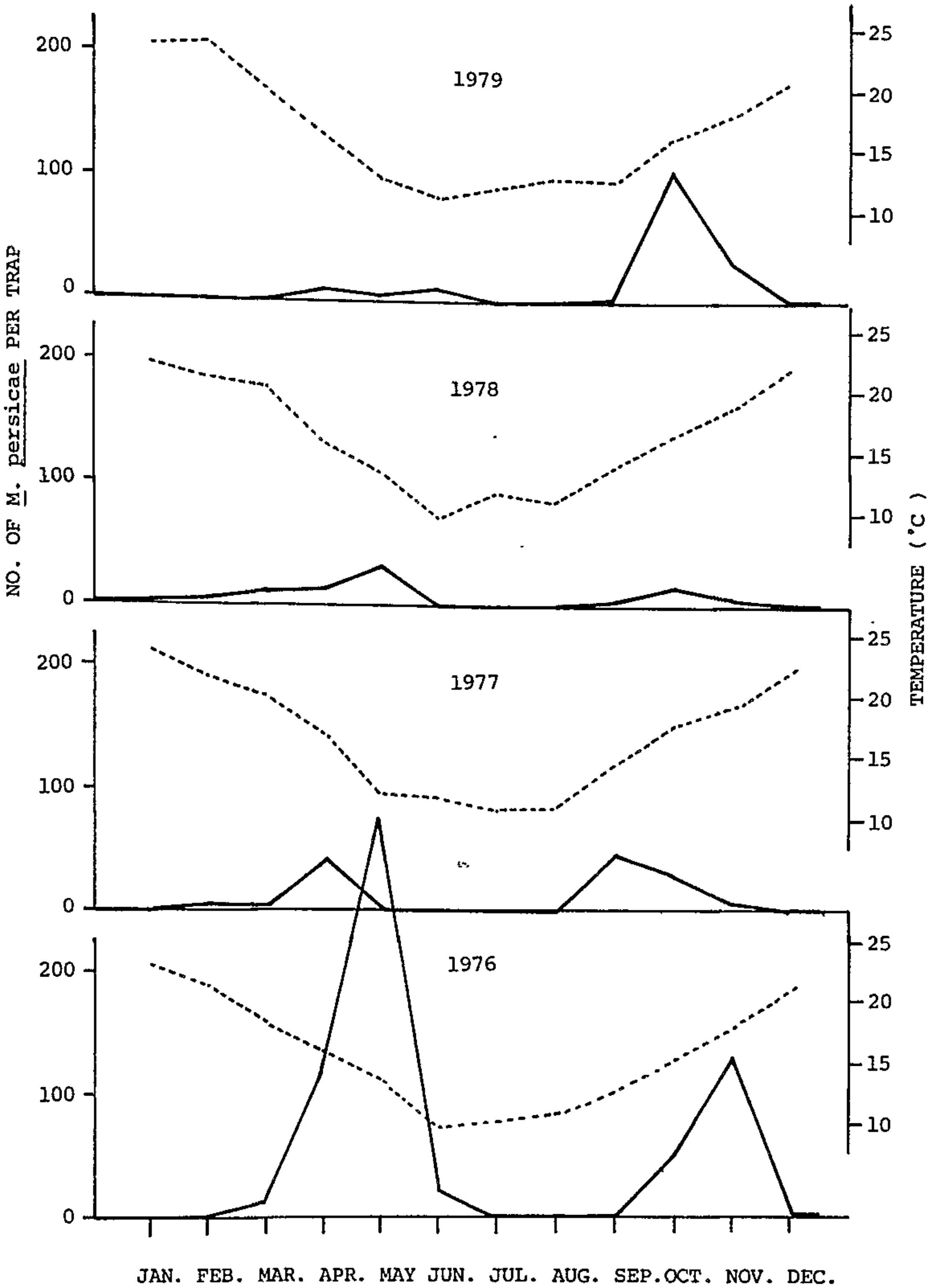
第6図 Seasonal and yearly changes of occurrence in thrips.
Solid line: number of thrips, dotted line: mean temperature, bar : rain.
Occurrence of virus disease on tomato: 1975-76 (few, 13%), 1976-77 (much, 20%), 1977-78 (much), 1978-79 (few), 1979-80 (heavy), 1980-81 (few).



第7図　Relationship between number of adult thrips attracted by sticky trap and number of nymph, adult on onion (on one week after observation of sticky trap). Sep. 1976 - 1977.



第8図 Relationship between number of adult thrips attracted by sticky trap and number of nymph and adult on onion (on one week after observation of sticky trap). Nov.- Dec. 1980.



第9図　Seasonal and yearly changes of occurrence in M. persicae. Solid line: number of M. persicae, dotted line: mean temperature (°C).

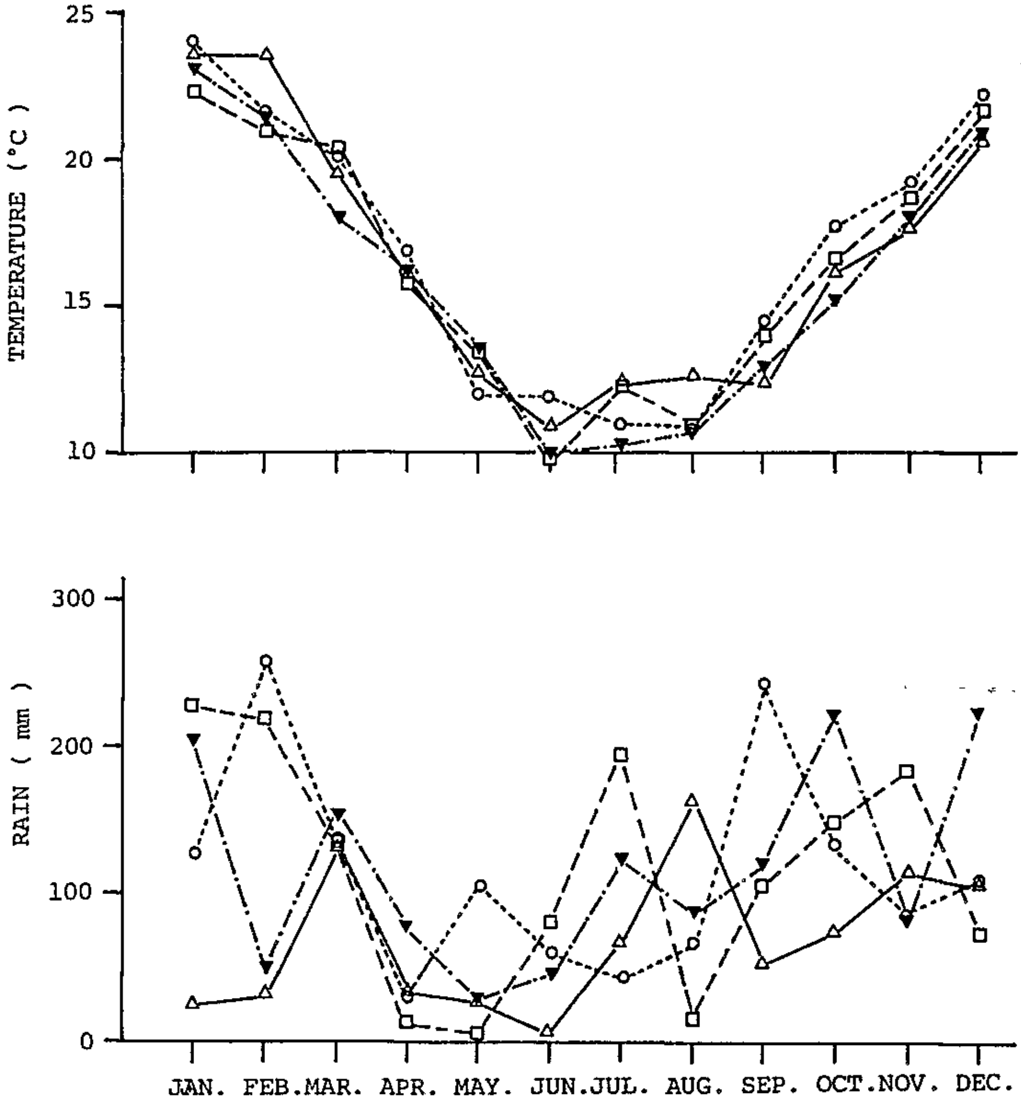


Fig.10 Seasonal and yearly fluctuations of monthly mean temperature (upper) and rain (lower). ▼ : 1976, ○ : 1977, □ : 1978, Δ : 1979.

6. 研究の現状と今後の問題点

ウルグアイ国における主要な野菜の害虫のリストアップはおおむね終ったと考える。しかし，このプロジェクトに参加した害虫担当専門家は鈴木氏と私の2名で，両名共に同じ夏季の3か月のみである。夏季の実質2か月間の短い間の調査であるから，春，秋，冬に発生する害虫で（例えば1980年の春に判明したニンニクのAceria tulipal のような），重要種の欠落もあるものと思うので，この点の補足調査は今後に期待したい。なお，今回の出張で各作物からアザミウマ類の標本を採集した。アザミウマ類の分類は難しいので，採集した標本は，分類の専門家に送付して同定を依頼する予定である。

トマト，ピーマンなどナス科作物で最も重要と考えられる害虫は，重要病害となっている黄化えそ病ウイルス（TSWV）を媒介するアザミウマ類とその他のウイルス病を媒介するアブラムシ類であろう。これらウイルス病の防除は，アザミウマ類とアブラムシ類の対策にかかっている。

巡回調査をしたトマト圃場などの畦内にはアザミウマ類の寄主であるヒルガオ科の1種Convolvulus arvensis やスベリヒユPortulacea oleracea の雑草が多くあり，それらの花に多数のアザミウマ類が寄生していた。これら雑草もTSWVの宿主と推定されることから，本ウイルス病の防除対策上にこれらの雑草への留意と対策も不可欠と考える。

バレイショを含めた各種ナス科作物における，今年の各種ウイルス病の発生は，昨年に比較して極めて少なかった。夏季の適当な雨量と，病虫害による被害の少なかったことから，トマトなどでは豊作貧乏となった位である。これらウイルス病の発生が今年少なかったのは，アザミウマ類，アブラムシ類の発生が少なかったことに起因している。アザミウマ類，アブラムシ類の少発生は，冬季，春季の雨量，気温などに影響されたものと推定されるが，世代を重ねるのが早いことから夏季の気象条件によっても大きく左右される。これら害虫発生の年次変動は大きい。今後これら害虫の発生消長の解析的研究は各種ウイルス病の防除対策上に是非とも必要である。数年間集められたデータについて，今回この点の解析を一部試みたが，十分な解析ができなかった。更に年次を重ね，十分なデータを整えた上で，電算機による数理統計的な解析研究が望まれる。

アブラムシ類，アザミウマ類及びウイルス病の防除法として，農薬による方法（浸透性殺虫剤，マシン油散布など），耕種的な方法（今回実験を試みた雑草駆除など）及び生態的方法（シルバーマルチなどによる飛来防止）などがある。現在これらについて研究が進行中であり，その成果が期待されると共に，より深い研究が望まれる。

現在，農菜栽培農家への巡回調査・指導が行なわれており，防除指導も行なわれているが，今後，農薬使用の現状を十分に把握し，一層の適切な防除指導を望みたい。これには，今回，ラス・ブルハス農試で行なったような各種防除試験，被害許容水準の解析，重要害虫の生態などの研究が不可欠である。しかし，現在ラス・ブルハス試験場で野菜害虫を専門に研究しているのは1

人である（もっとも，ウルグアイ国全体で昆虫学者は１７名，この中で多少なりとも野菜害虫に関係しているのはラス・ブルハス試験場の３名と，ウルグアイ大学の４名のみ）。カウンターパートのIng.Ñuñezは研究テーマを多く持ち，実に意欲的に研究しているが，研究は防除のための応急的，断片的な試験が中心になりがちである。このような現状から，研究対象を重要害虫にしぼった基礎的な生態研究が望まれ，差当たっては，最重要と見られるアザミウマ類の生態解明のための研究に着手していく必要があると思う（現在の研究は，生態的な面が全く欠けている）。アザミウマ類の生態的な研究を進めるには種の同定が必要である。まず始めに，トマト，ピーマン，雑草などのアザミウマ類の種類構成を明らかにすることである。また，アザミウマ類によるウイルスの伝搬機構や本病流行に関する疫学的な研究も重要であろう。

その他の害虫で次いで問題となるものとしては，各種野菜に加害するDiabrotica やEpitrixなどの甲虫，トマト，バレイショ，ナス等を加害するScrobipalpula absolutaやサビダニの１種Auculops lycopersici を挙げることができる。特に，Diabrotica やEpitrix は,成虫の葉への食害以上に幼虫による根への食害が大きいと思わたるが，ウルグァイでの研究は何もない。今後の調査研究が要望される。

農薬は，現在，日本ではすでに毒性，残留問題などで使用禁止となっているものも多く使用されており，その散布頻度も多いようである（カウンターパートに，日本の主要野菜の防除体系の１例を紹介しておいた）。ウイルス病対策には，予め設定した防除計画に従った農薬の反復散布も必要であるが，天敵保護，薬剤抵抗性害虫の出現防止や農薬の安全使用等の立場から，害虫の生態を踏まえ，発生に見合った，必要最少限度の薬剤施用を心がけ，出来る限り散布回数を少なくするようにしたいものである。

バレイショ寄生のモモアカアブラムシM persical は,従来使用してきた殺虫剤では効力が減退し，防除効果があまり挙がらなくなっているという話を聞いている。これらアブラムシの殺虫剤抵抗性については，今回，検定試験を行なう予定であったが果たせなかった。これは，今後の重要な研究課題となろう（カウンターパートとの話し合いにより，近い将来彼が調査することになっている）。

以上，昭和５４年に提示されたウルグアイ野菜研究計画，基本計画は一応研究が進んでおり，今後に残された問題点も多いが，研究の方向性は示されたものと思う。

Research on Pests of Vegetable Crops in Uruguay and Its Control

Hideo YAMADA

Research on pests of vegetable crops in Uruguay and its control of Japan-Uruguay Vegetable Research Cooperation Project was carried on from December 1980 to March 1981 at Las Brujas Agricultural Experimental Station in Las Piedras Canelones, Uruguay.

This research was carried out with Ing. Agr. Saturnino Nunez, my counterpart. The present report deals with the results obtained in the research.

1. Pests of major vegetables and its importance in Uruguay.

Research studies on pests of major vegetables and its importance in Uruguay in this Project were done for the first time by Mr. Tadao SUZUKI in 1979. We further carried on research from December 1980 to March 1981. Pests of major vegetables and its importance in Uruguay known in these researches are summarized in Table 1.

One of the most important pest on tomato is thrips (Thrips tabaci and Frankliniella schultzei) known as a vector of tomato spotted wilt virus disease. The thrips infest on various kind of crops and weeds. In this summer, many number of thrips were observed remarkably on flowers of weeds such as Convolvulus arvensis at tomato field. For controlling tomato spotted wilt virus disease, it seemed important to manage these thrips in and around the tomato fields. On tomato, the thrips mostly infest on flowers. On the other hand, they are scarcely recognized on the leaves. In this summer, occurrences of thrips was less than last summer. Thereafter, we could scarcely find out the tomato plants infected with tomato spotted wilt virus. It is necessary to do analytical studies on yearly changes of thrips occurrence and its reasons. Aphids are seemed important as vectors of virus diseases of tomato. Another important pests of tomato are Agrotis ipsilon, Peridroma margaritosa, Scrobipalpula absoluta, Epitrix fasciata, Diabrotica speciosa, Epicauta adspersa, Myzus persicae, Macrosiphum euphorbiae, Tetranychus bimaculatus and Auculops lycopersici.

Important pests of potato are Agrotis ipsilon, Peridroma margaritosa, Gnorimoschema operculella, Epitrix fasciata, Diabrotica speciosa, Epicauta adspersa, Myzus persicae, Macrosiphum euphorbiae, Empoasca spp. It is suggested that the damage of tuber by larvae of Epitrix and Diabrotica may be sometimes severe. On eggplant, Agrotis ipsilon, Peridroma margaritosa, Epitrix fasciata and Diabrotica speciosa are important. On pepper, Agrotis ipsilon, Peridroma margaritosa, Epitrix fasciata, Diabrotica speciosa, Thrips tabaci and Myzus persicae. Although appearance of virus diseased plant was low level in this summer, thrips and aphids seemed important as same as on tomato plant. On onion, Thrips tabaci is a most important pest. It was found that the onion thrips considerably cause yield losses of onion. Aceria tulipae on garlic and Epilachna paenulata on pumpkin are also important pests.

2. Effectiveness of some pesticides against onion thrips, Thrips tabaci on onion field.

Thrips tabaci is the most important pest of onion in Uruguay. Therefore, evaluation test on effectiveness of 9 pesticides to T. tabaci were conducted at onion field from December 1980 to January 1981. The test was conducted to find pesticides with less toxicity to mammals and less persistence that will control the thrips.

The results obtained are summarized in Table 5. Decametrin, Acephate and Fenitrothion were screened as the most effective pesticides against T. tabaci on onion (see Table 5). Thrips disappeared for 13 days after application of these three pesticides. Malathion, Endosulfan and Cipermetrin were shown to be effective for only 4 days after application. On the other hand, Dimethoato, Diazinon and Vamidothion were not effective.

Then, for controlling T. tabaci on onion, the following application method was found to be very promising: applying the residual pesticides as Decametrin, Acephate or Fenitrothion every 2 weeks on younger plants or seedling and applying the pesticides as Malathion, Endosulfan or Cipermetrin right before the harvesting. But, the economical application times of pesticides are further needed to examined. Besides, much attention must be paid on adverse effects against the natural enemy caused by insecticidal application.

3. Evaluation of onion yield losses caused by Thrips tabaci.

Thrips tabaci is well known as onion thrips also in Uruguay and the most important pest attacking only leaf on onion. But, relationship between the leaf damage by this thrips and the yield losses has not been known in detail. It is very important to know the economic threshold density of *T. tabaci* in its control.

Therefore, yield losses caused by the different populations of onion thrips infesting were examined at the onion field from October 1980 to February 1981. Thrips of approximately 0, 10, 25, 50 and 100 nymphs per onion plant were experimentally kept and onion yield losses in weight were investigated, respectively. When densities on onion plant became higher than the above mentioned densities, pesticides were applied to control the thrips densities on onion. The results are shown in Tables 8, 9 and Figs. 2, 3 and 4.

In this summer, thrips occurrence was in low level. Then, times of pesticide applications at plots in which thrips populations were approximately 0, 10, 25, 50 and 100 nymphs levels per plant were 7, 2, 1, 1 and 0, respectively.

As shown in Figs. 2 and 3, damages caused by thrips attacking were very remarkable. The more application times of pesticides became, the less leaf damage became. The yield of onion is shown in Table 9. It was found that relationship between the yeidl fo onion and mean density of thrips infesting per onion plant highly correlated (r = 0.94, Fig. 4).

It is very difficult to evaluate the economic threshold density of a pest because much attention must be paid. On the assumption that the economic injury level of onion thrips is 15% yield losses, control threshold density may be supposed to be about 25 nymphs per onion plant.

4. Control of thrips at tomato field and appearance of tomato spotted wilt virus disease.

Thrips are one of the most important pests on tomato in Uruguay, and are known as vectors of tomato spotted wilt virus. Control of tomato spotted wilt virus mostly depends upon the control of thrips. Tomato spotted wilt virus in thrips is persistent type virus and adult thrips which got tomato spotted wilt virus at nymphal stage on the diseased plants can only transmit the pathogen virus to other plants. So insecticidal application and another management of thrips for controlling tomato spotted wilt virus diseases were examined at tomato field from December 1980 to March 1981.

These results are shown in Tables 11, 12, 13 and 14. The tested pesticides were Metasistox, Vamidothion, Carbofuran and Cipermetrin. Among these chemicals, most effective pesticides were Cipermetrin (applications every

15 days) and carbofuran (application to soil as a flowable, Tables 14 and 15). Number of plant infected with tomato spotted wilt virus on plots with these 2 applications were 2 and 5 plants of 96 plants, respectively, while 13 to 25 plants were infected in other plots. Population densities of thrips infesting on tomato flowers well coincided with tomato spotted wilt virus disease appearance mentioned above (Table 11).

Effectiveness of weed control at tomato field against the thrips populations and the tomato spotted wilt virus diseases appearances were next tested, since weed of the tomato field were seemed to have an important role for the development of thrips populations and the virus disease prevalences. But, no thrips population on tomato flowers and tomato spotted wilt virus were decreased.

5. Seasonal and yearly changes of occurrence in thrips and *Myzus persicae*.

In this summer, occurrences of thrips and aphids were less than last summer, and consequently virus diseases of tomato were not much prevalent. There are some data about catches of thrips by sticky trap at Las Brujas Experimental Station which investigated by Ing. Briozzo and Ing. Nũnẽz and aphids by yellow pan water trap on Estanzuela Experimental Station investigated by Ing. Nũnẽz. Therefore, relationships between seasonal and yearly changes of thrips and aphid population and the weather, especially rain and mean temperature, were analyzed to gain informations on occurrences of thrips and aphids and virus diseases transmitted by them.

Seasonal and yearly changes of thrips population

Numbers of thrips collected by sticky trap were investigated for six years from 1975 to 1981 and numbers of thrips on leaves of onion were observed for two years.

Seasonal changes in number of thrips captured were shown in Fig. 6. In generally, the flying to sticky trap began on August to September. The flying became to peak on December and was kept on high level till February, and subsequently decreased low level (Fig. 6). When fine weather sometimes continued for long time in summer season, it was shown that the thrips population increased rapidly. Relationship between number of thrips captured per trap every one week and number of thrips on onion (on one week after observation of sticky trap) were shown to be well correlated

(Fig. 7, r = 0.976**, Fig. 8, r = 0.960**). From these facts, it seemed that the population density of thrips on onion may be estimated from number of thrips captured by sticky trap at onion field.

Yearly changes in number of thrips captured were shown in Fig. 6. Occurrence of thrips was seemed more than that in other years in 1979-80 and considerably in 1976-77 and 1977-78, too. In these years, occurrence of tomato plant infected with tomato spotted wilt virus was also more.

Seasonal and yearly changes of *Myzus persicae* population

Number of *Myzus persicae* captured by yellow pan water trap were investigated for four years from 1976 to 1979.

Ⅳ　野菜栽培専門家報告書

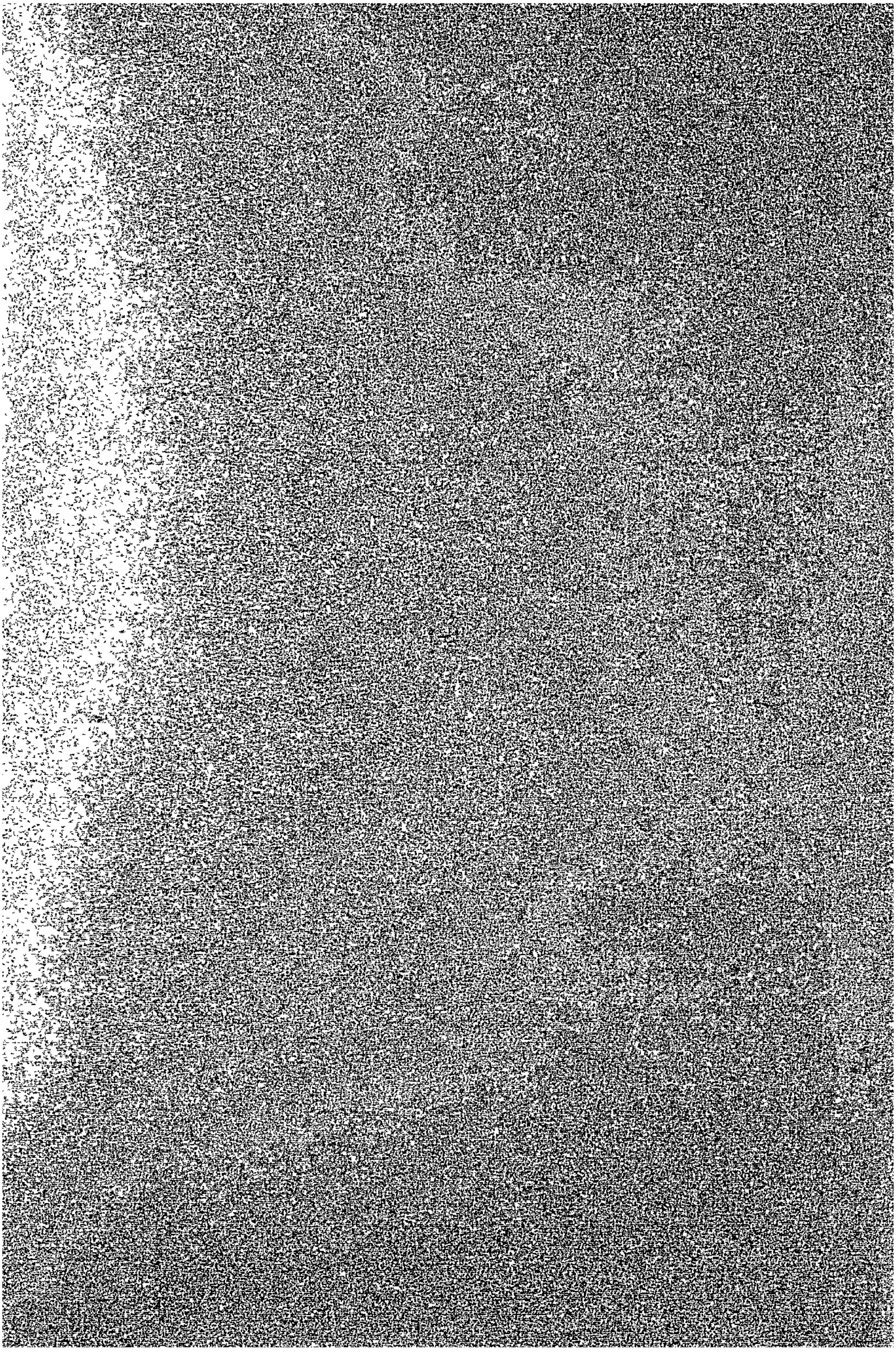
VEGETABLE CULTURE

施　山　紀　男

派遣期間

昭和55年12月11日～

昭和56年3月10日



要　　約

1) 現在ウルグアイにおいて除草剤は１００％輸入されており，海外のデータに基づいて使用基準が定められている。また使用基準は我国と比べると必ずしも明確ではない。将来は各野菜について，土性，作型，気象条件に応じて使用基準を明確にすることが必要と考えられる。

2）そのためには簡単な試験基準に基づいて除草剤試験を実施し，使用基準を明確にすることが必要と思われる。そこで日本の除草剤試験実施基準と野菜の登録除草剤使用基準を英訳して今後の参考に供した。

3）雑草防除特に除草剤の使用方法に関して情報が農家に十分浸透していないように思われ，普及体制に問題があるように思われる。

4）我国の除草剤試験方法を示すためと，乾燥条件における加工用トマトの生産安定を計るため直はん栽培トマトにおいて除草剤試験を実施した。ジフェナミドが優れた除草効果を示したので，現在ウルグアイには輸入されていないが，将来は有効な除草剤と思われる。

5）加工用トマトに関しては，加工工場の機械設備が古いため，生産コストが高く，品質は必ずしも優れていない。栽培上は収量と品質の面から，品種比較，施肥法，病虫害防除．尻腐れ病対策，灌漑，付種期，直はん栽培，省力化などの栽培上の基礎的な問題について試験を実施する必要がある。

6）現在ウルグアイでは野菜の生育の化学調節は必ずしも必要な技術ではないが，将来栽培技術が向上し，作型等の分化が進むにつれて，試験研究を実施する必要が出てくるものと思われる。そこで日本での，野菜の生育の化学調節の現状について，イチゴのジベレリン処理と作型の関係，及びトマト，ナスの着果安定剤を中心に紹介し，ウルグアイでの将来の方向について論議した。

REPORT ON VEGETABLE CULTURE IN URUGUAY

with special reference to weed control, tomatoes for processing,
and chemical growth regulation

May 6, 1981

Norio SEYAMA

Summary

1. It will be necessary in the future to establish the application method of herbicides according to vegetable crops, cropping type, soil properties, and climatic condition.

2. I thought that simple standard test method on herbicides will be required in the future. I translated the standard test method of herbicides used in Japan into English and also translated the application method of herbicides registered for vegetable crops in Japan.

3. Enough information on chemical weed control are not available to farmers and much intensive extension service will be required in Uruguay.

4. In direct-seeded tomatoes, diphenamid seemed to very promising though it is not available now in Uruguay, and I demonstrated the herbicide test method adopted in Japan.

5. Some experiments would be necessary on variety, fertilization, irrigation, planting time, blossom end rot, diseases, direct-seeding, labor saving at harvesting, etc., in order to produce raw fruits superior in quality with high productivity.

6. I introduced the present status of chemical regulation of crop growth and development in vegetable production in Japan. Chemical growth regulation will become popular in Uruguay in the future accompanied with the development of technology.

Acknowledgment

Help has been given by Ing. Maeso, Ing. Villamil and Ing. Arboleya, Estacion Experimental Granjera "Las Brujas" in visiting some government offices of Uruguay, agricultural cooperations, canners and farmers. Help has also been given by Ing. Villamil in arranging the manuscript of this report. I am deeply grateful to all of them.

1. Weed and weed control in vegetable production in Uruguay

1) Introduction

According to the progress of agricultural technology, high productivity can be attained without heavy input of labor. In Uruguay, her own technology will have to developed, because socio-economical situation is quite different from Japan or the United States, and it will result in a higher productivity.

Weed control is one of the most important problems for higher productivity. Weeding takes much labor without mechanization or the application of chemicals. It is commonly observed in any country that farmers grow vegetable crops in a rather small area with the heavy input of labor and materials. Modern sophisticated methods of weed control have been accepted recently as compared with main crops like cereals. Now, modern technology is required for weed control also in this country.

During my stay in Uruguay, we have visited some government offices, agricultural cooperations, distributors of agricultural chemicals, and farmers. I have tried to grasp the present situation of weed control in this country. I would be happy if I could help the progress of weed control technology in vegetable production of Uruguay.

2) Weeds in Uruguay

Table 1 shows the common weeds in Uruguay which are dominant in upland field in comparison with Japan. I am not a taxonomist and am afraid whether some part of this weed list of Uruguay and Japan might be incorrect. However, it is possible to presume the some difference in weeds between Uruguay and Japan. There are some weeds which do not emerge in Uruguay or Japan in Table 1, but it does not mean that they never emerge, but means that they are not common in the upland fields. Some of them might emerge.

Generally speaking, most of dominant weeds are different in species between Uruguay and Japan, though they are common in the genus. Only a few of them belong to the same species; for instance, common lambsquarters (Chenopodium album), purple nutsedge (Cyperus rotundus), barnyard grass (Echinochloa crus-galli), purslane (Portulaca oleraceae), and small chickweed (Stellaria media). Some common weeks like Digitaria, Poa, Rumex, Setaria are different in species.

Table 1 Popular weeds of upland field in Uruguay and Japan

Scientific name	Family name		Common name			Popularity	
			Uruguay	Japan	US	Uruguay	Japan
Amaranthus lividus	Amarantaceae	(A)	-	Inubiyu	livid amaranth		+
nuricantus		(A)	yerba meona	-	-	++	
quitenis		(A)	yuyo colorado	-	-	++	
vividis		(A)	-	Honaga-inubiyu	slender amaranth		+
Anthemis arvenis	Compositae	(A)	manzanilla	-	corn chamomile	++	
cotula		(A)	manganilla	-	may weed	++	
mixta		(A)	manzanilla hedionda	-	-	++	
Brassica alba	Cruciferae	(A)	mostaza blanca	-	-	++	
campestris		(A)	nabo silvestre; colza	-	wild turnip	++	
Calystegia hedercea	Convolvulaceae	(P)	-	Kohirugao	hastate bindweed		++
Chenopodium album	Chenopodiaceae	(A)	cenizo	Shiroza	common lambsquarter	++	++
ambrosioides		(A)	yerba de Sta Maria; paico macho	Kearitaso	mexicantes	++	+
ficifolium		(A)	-	Koakaza	-		+
hircinum		(A)	quinoa	-	-	++	
multifidum		(A)	paico hembra	-	-	++	
murale		(A)	yuyo negro; quinoa blanca	-	nettleleaf goosefoot	++	
Convolvulus arvessis	Convolvulaceae	(A)	corrihuela; campanilla blanca	-	field bindweed	++	
Coronopus didymus (Senebiera)	Cruciferae	(A)	mastuerzo hembra	-	swinecress	++	
Cynodon dactylon	Gramineae	(A)	gamilla brava; pata de perdiz; paso de perdiz; paso bermuda; gramilla blanca	-	Bermudagrass	++	
Cyperus iria	Cyperaceae	(A)	-	Kogomegayatsuri	rice flatsedge	+	++
rotundus		(P)	paso bolita	Hamasuge	purple nutsedge	++	++

++ dominant, + commonly emerge in vegetable field, A, annual weed, P, perennial weed

Table 1 (continued)

Scientific name	Family name		Common name			Popularity	
			Uruguay	Japan	US	Uruguay	Japan
Digitaria adscendens	Gramineae	(A)	?	Mehishiba	large crabgrass		++
sanguinalis		(A)	pasto milan; pasto blanco; pasto de cuaresma	-	large crabgrass	++	
timorrensis		(A)	-	Komehishiba	-		+
violasens		(A)	-	Aki-mehishiba	violet crabgrass		++
Echinochloa crus-galli	Gramineae	(A)	gramilla de rastrozo; pata de gallo; borraja cimarrona capin	Inubie	barnyardgrass	++	++
Eleusine indica	Gramineae	(A)	-	Oishiba	goosegrass		++
Elscholzin ciliata		(A)	-	Naginatakoju	drepanium perilla		++
Equisetum arvense	Equisetaceae	(P)	?	Sugina	field horsetail	+	++
Impoea acuminata	Convolvulaceae	(P)	campanilla azul	-	-	++	
cairica		(P)	campanilla azul	-	Cairo morningglory	++	
grandiflora		(P)	batatilla	-	-	++	
indivisa		(P)	batatilla	-	-	++	
Lolium multiflorum	Gramineae	(P)	raigrass; cervolillo	-	Italian ryegrass	++	
Marticaria chamamilla	Compositae	(A)	manzanilla	-	-	++	
Nothoscordum inodorum	Liliaceae	(P)	ajo macho	-	-	++	
Paspalum dilatatum	Gramineae	(P)	pasto miel	Shimasuzumeno-hie	daillisgrass	++	+
distichum		(P)	gramilla brava	Koshimasuzumeno-hie	jointgrass	++	+
notatum		(P)	gramilla blanca	-	-	++	
thunbergii		(P)	-	Suzumeno-hie	Japanese paspalum		+

Table 1 Continued

Scientific name	Family name		Common name: Uruguay	Common name: Japan	Common name: US	Popularity: Uruguay	Popularity: Japan
Poa annua	Gramineae	(A)	pastito de invierno; pelo de rata	Suzumenokatabira	annual bluegrass	++	+
Polygonum acre	Polygonaceae	(?)	yarba de bicho	-	bitter smartweed	+	
aviculare		(A)	sanguinaria	-	prostrate knotweed	+	
blumei		(A)	-	Inutade	-		++
nodosum		(A)	-	Ohinutade	-		++
Portulaca oleracea	Polygonaceae	(A)	verdolaga	Suberihiyu	purslane	++	++
Raphanus raphanistrum	Cruciferae	(A)	rabano silvestre	-	wild radish	++	
Rapistrum rugosum	Cruciferae	(A)	mostacilla	-	-	++	
Rorippa atrovirens	Cruciferae	(A)	-	Inugarashi	-		+
palustris		(A)	-	Sukashitagobo	-		++
Rumex acetosa	Polygonaceae	(P)	-	Suiba	common sorrel		+
acetocella		(P)	-	Himesuiba	red sorrel		+
criopus		(P)	lengua de vaca	?	curly dock	++	
japonicus		(P)	-	Gishigishi	Japanese dock		++
obtusifolius		(P)	-	Ezogishigishi	broadleaf dock		++
pulcher		(P)	lengua de vaca	-	-	++	
Senecio brasiliensis	Compositae	(A)	ogurca negra	-	-	+	
vulgaris		(A)	-	Noborogiku	common groundsel	++	++
Setaria faberi	Gramineae	(A)	-	Akinoenokorogusa	giant foxtail		+
geniculate		(A)	cola de zorro	-	knotroot foxtail	+	
glauca		(A)	-	Kinenokoro	yellow foxtail		+
viridis		(A)	-	Enokorogusa	green foxtail		++

Table 1 Continued

Scientific name	Family name		Common name			Popularity	
			Uruguay	Japan	US	Uruguay	Japan
Sorghum helepenes	Gramineae	(P)	sorgo de alepo	-	johnsongrass	++	
Stellaria alsine	Caryophylleae	(A)	-	Nominofusuma	bog stitchwort		+
media		(A)	capiqui	Hakobe	small chickweed	++	++
Taraxacum officinale	Compositae	(P)	diente de leon	Seiyotanpopo	dandelion	++	+
Urtica urens	Urticacene	(P)	ortiga	-	-	++	

There are some weeds which are not common in Japan: Impoea, Raphanus, Sorghum, and Urtica. However, it does not seem that the difference in the kind of annual weeds would affect much on the chemical weed control. Some weeds which belong to Solanaceae (Solanum), Liliaceae (Nothoscrdum), Unberiferae (Anmi, Erynogium, Foenoculum) and Cruciferae (Brassica, Raphanus) are commonly observed in the vegetable fields of Uruguay and they might become popular in Solanaceae, Allium, or Umberiferae crops respectively accompanied with the progress of chemical weed control.

We can observe the another difference between Uruguay and Japan; perennial weeds like Cynodon, Cyperus, Rumex and Sorghum are popular in vegetable fields of Uruguay.

In winter crops, winter annual weed like Anthemis, Silene, Raphanus, wild oat and rye grass, are dominant but in summer crops in which most vegetable crops are included, summer annual weeds and some perennial weeds mentioned above affect much the crop growth and yield.

3) Weed control in Uruguay

In Uruguay, we often observe that many weeds have flowers or bear seeds in vegetable fields. Weeds might not affect the crop yield in the maturity stage, but weeds have to be controlled as early a stage as possible, in order to decrease the population in the succeeding crop or the following years. And it is also necessary to control perennial weeds. It is very difficult to control them mechanically, but now some excellent herbicides are available for perennial weeds.

Generally we observe that much more weeds grow in vegetable fields in Uruguay than in Japan, though the amount of weeds in vegetable field is differnt among farmers. Some farmers control weeds almost completely with herbicides, machines or simple hand tools. In Japan we have one proverb on weed control; "Good farmer removes weeds in the so early stage as weeds do not emerge yet". Japan is located in the monsoon area and we have much rainfall with moderate temperature in spring to summer. Summer annual weeds grow vigorously. Once agriculture meant weed control. However, it is supposed that weed control should be carried out intensively in order to decrease the weed population steadily.

4) Present situation of herbicide application in Uruguay

All the kinds of herbicide are imported from European countries or the

United States. Some herbicides come from Japan. Now, sodium alloxidin (Kusagard) is highly evaluated as a useful herbicide for perennial grasses. Table 2 and 3 show the amount of herbicides imported in 1979. A great deal of herbicides is imported following to fungicides. The amount of herbicides imported is variable among the years, but there is no definite increase or decrease during some recent years. However, a few herbicides like trifluralin is increasing in the amount of import.

a. Registration system of herbicides in Uruguay

In Uruguay, 100% of agricultural chemicals is imported and the registration system is different from Japan.

Chemical companies or their agencies apply for the permittance of import or sale to Direccion General de Servicio Agronomicos, Ministro de Agricultura y Pesca. They have to present the informations which are available from foreign countries where their chemicals are developed and sold.

The information required as follows;

> the country in which the chemical was developed, the commercial name which it is sold, the chemical company which developed it chemical name, common name, percentage of product, molecular structure, formula, toxicity for human being, animals, bees and fish, residual toxicity, period of biological effect, phytotoxicity, physical and chemical properties of chemical and product, crops which can be applied, the time and type of application, concentration and dosage, etc.

All agricultural chemicals are permitted for four years for import or sale, and registration must be renewed every four years. If enough informations are not available on the chemical, it is permitted to import for one year for testing.

In Japan, agricultural chemicals must be applied for the registration whether they are newly developed or imported, and they must be tested on herbicidal effect, chemical injury on crop, biological toxicity, etc. However, any test have not been carried out in Uruguay and the government offices only check the informations presented by the chemical company, the concentration of active ingredient, the view of products, the label of commodity, etc. They think that their own tests are not necessary, because all agricultural chemicals are imported and the informations required are available from foreign countries. In fact, it is supposed that it would cost much if this country would do her own tests, and that there might not be enough staffs to do many kinds of tests.

Table 2 Agricultural chemicals imported in 1979

	Kg net wt.	US $
Fugicides	1,363,014	3,238,585
Herbicides	621,348	2,520,804
Insecticides	356,817	1,686,900
Acaricides	12,684	58,583
others	41,385	131,051

Table 3 Herbicides imported in 1979

	Kg net wt.		Kg net wt.
Atrazine	27,760	Lenacil	7,300
Atrazine + Ametrin	11,665	Linuron	1,000
Ametrin	4,180	MCPA	5,000
Asulum, Na-salt	15,980	MSMA	14,398
Bentazon, Na-salt	6,120	Metribuzin	10,500
Bromacil	9,927	Molinate	38,201
Carbofluorfen	250	Metanitron	100
Cycloexil	967	Paraquat	10,930
Chlorthal	1,200	Pebulate	3,000
Dalapon	5,670	Piclorum, K-salt + MCPA, K-salt	5,775
Diuron	3,533	Piclorum, isopropyl amino-salt + 2,4-D, isopropyl amino-salt	3,368
Diphenamid	10,000	Prometryn	2,800
2,4-D & its derivatives	58,139	Propanil	58,907
Diuron + Aminotriazol + MCPA	300	Simazine	1,600
		Terbacil	2,327
EPTC	967	Trifluralin	109,765
Fenac, Na-salt	39,648	Trialate	19,660
Fluometuron	9,440	Vernolate	480
Fenmedifam	1,250		
Glyphosate, isopropyl amino-salt	6,792		
Hidracide meleica, diethanol amino-salt	14,424		

b. Chemical weed control in vegetable production in Uruguay

In cereals, about 50-60% of farmers apply herbicides for weed control; mainly hormonal type of herbicides like 2,4-D. Now, monocotyledonous weeds which can not be controlled by 2,4-D are increasing and the control of grass weeds is becoming one of the serious problems in weed control.

Table 4 shows the herbicides commonly used in vegetable crops in Uruguay. Chemical weed control started in this country about 15 years ago, and it had become popular about 5 years ago. However, generally speaking, growers are not so enthusiastic about chemical weed control in vegetable crops as compared with cereals or fruit trees. In cereals or fruit trees, farmers are in a high or medium economical level and easily accept a new technology, but in vegetable crops farmers are in rather low economical level and are not always enthusiastic for new technology. Farmers have used the same herbicide for many years and do not change it to another easily. The consumption of herbicides has not increased in vegetable production since recent few years.

However, there seems to be some difference in chemical weed control among the vegetable production areas of Uruguay. In Rincon del Cerro near Montevideo, 60-70% of vegetable growers use herbicides, while very few farmers apply herbicides in San Jose. There are a few reasons for this; in San Jose, labor is still available and no enough informations on herbicides are not available to farmers though some of them hope to use herbicides.

5) Future of weed control in Uruguay

In Uruguay, about 46% of the population is concentrated in Montevideo and labor force is short in the rural area. It is expected that chemical weed control would become popular in the future. However, there seems to be some problems to be solved.

Firstly, there are differences of soil properties among the vegetable production areas in this country. Moreover, there are many different crops in vegetables which are different in the resistance to chemicals, and there are many different cropping types in vegetable production. The effect of a herbicide is different among the soil properties and climatic conditions either on crops or weeds. The residual activity is also affected by environmental condition. However, the climatic condition is not necessarily consistent with a foreign country from which informations are available.

Table 4 Herbicides in vegetable crops in Uruguay

Herbicide	Crop
MCPA	Asparagus
Lenacil	Spinach, table beet, chard
Trifluralin	Lettuce, cauliflower, cabbage, onion, tomato
Afaron	Onion, carrot, beans, peas, tomato
Prometryn	Carrot, garlic, onion
Atrazine	Sweet corn
Diuron	Onion, garlic, carrot
Metribuzin	Tomato
Paraquat	all vegetables

Therefore, it seems necessary that some tests should be done on a newly imported herbicide and the application method should be established in the future according to crops, the areas, cropping types, soil properties, climatic condition, etc. However, Uruguay is a small country and there are only a few number of researchers on vegetable crops, and it is difficult to introduce the registration system like in Japan. In the future, researchers, chemical companies, agricultural cooperations and farmers would be required to cooperate in order to make progress in weed control.

I thought that a simple test method like in Japan would be useful to study on the effect of herbicide under various environmental conditions. I translated our test method, "the Standard Test Method on Herbicides for Vegetable Crops", into English and also translated the list and application method of herbicides registered for vegetables in Japan.

Secondly, some farmers want to accept a modern technology on weed control, but they have not enough informations on weed control. Some of them do their own tests on herbicides, or some farmers apply a herbicide without following to the instructions and regulations on the label of the herbicide. We visited a farmer who has applied lenacil to spinach and beet 4-5 times a year over many years, and now he can not grow other crops owing to the residual activity of lenacil. Therefore, the extention service is required to be improved on chemical weed control.

Thirdly, perennial weeds like Bermudagrass, johnsongrass, Cyperus, or Rumex are very popular in vegetable fields. Research work is required to control these perennial weeds. Farmers have to remove weeds as early a stage as possible to lower the level of weed population.

Fourthly, all the herbicides are available only in emulsion or wettable powder. However, it is very dry in summer and most farmers have no irrigation system in vegetable fields. It would be necessary to introduce herbicides in granular form in the future, though agricultural chemicals are not imported in granular or powder owing to the high cost.

II. Weed control in direct-seeded tomatoes

Tomatoes are usually transplanted in Uruguay, but plant growth is inhibited by drought at transplanting. Many farmers have no irrigation system. Direct-seeding appears to be very promissing in tomatoes especially for processing. However, weed control is one of the most serious problems in direct-seeded crops. This experiment was carried out to test three herbicides in direct-seeded tomatoes and to demonstrate our herbicide test method of Japan.

Materials and method

The variety used was Loica, and seeded on January 23 and determined on Feb. 20. The plots are shown as follows;

1. No weed control
2. Complete weed control
3. Diphenamid 12 kg/ha (soil, post-sowing)
4. Nitrofen 10 l/ha (soil, post-sowing)
5. Trifluralin 3 l/ha (soil, incoperation, pre-sowing)
6. Trifluralin 3 l/ha (soil, post-sowing)

All herbicides were applied on Jan. 23 and plot size was 1m x 1m. The determination was carried out following to the test method of Japan.

Results and discussion

Tomato germination was slow and began to emerge around the end of Jan. to the beginning of Feb., but there observed no apparent effect of herbicides on germination. However, the growth of tomato seedlings is a little inhibited in the plots in which trifluralin was applied either soil treatment or soil incorporation. Table 1 shows that dominant weed was grasses in the field used. Table 2 shows that weeds were completely controlled by trifluralin whether it was soil incorporated or not. However, it inhibited the growth of tomato seedlings. Plant weight was small in the plots treated with trifluralin. Diphenamid also controlled weeds and only a few weeds emerged. Plant weight was superior. Nitrofen exerted no effect on crop growth, but herbicidal effect was inferior to other herbicides especially on gramineae weeds.

Diphenamid is an excellent herbicide which is selective for Solanaceae crops, but it is not available in Uruguay. It is necessary in the future to introduce diphenamid in order to seed directly in the field especially in tomatoes for processing.

Table 1 Weeds in 'no weed control plot'
(per plot, 1m x 1m)

Weed	No.	Weight
		g
Gramineae	167	452.6
Portulaca	54	258
Amaranthus	6	76
Coronopus	11	12

Table 2 Weeds, chemical injury and the growth of tomato plants

Plot	Ranking: Weeds	Ranking: Chemical injury	Plant wt. of tomato (10 plants/plot)
			g
1	4	0	116
2	0	0	127
3	1	0	161
4	3	0	118
5	0	2	85
6	0	2	58

III. Present status of tomatoes for processing and its future

1) Introduction

Uruguay has a rather mild climate in spring and summer, and could produce good raw tomato fruits for processing in quality. Processing tomatoes can be grown without heavy input of labor. Acreage per farmer is much lower in Uruguay than in Japan. However, the population of Uruguay is only below 3 million and the export of tomato products will be required in the future. Therefore, it is necessary that they produce tomato products which can compete in the international market on quality and price by the improvement of technology in the production of raw tomato fruits.

2) Present status of tomato for processing in Uruguay

a. Climate of Uruguay

Table 1 shows the temperature and rainfall in tomato growing season at Montevideo in comparison with Morioka, Japan. In Uruguay, tomatoes grow under mild climate from spring to summer. Temperature is nearly optimum for coloration in harvest season, while it is a little too high in August and a little too low in September in Morioka. Rainfall in tomato growing and harvesting season is a little lower in Uruguay than in Japan. It is supposed as if the precipitation would be adequate for tomato growth. But soil is very dry at transplanting and in the period of crop growth. The size of tomato vines is smaller than in Japan and the occurrence of blossom end rot is very severe. Irrigation would result in more vigorous growth and higher yield. However, ripened fruits can be left on the vines in the field for a long period under dry conditions, because of few occurrence of fruit cracking. It would result in fewer frequency of picking, better fruit color and lower harvesting cost.

b. Tomato processing industry in Uruguay

We visited LAT (Laboratorio de Analisis y Technologia, Ministrio de Industria), Calforu (agricultural cooperation) and some processors, and asked them the present situation of tomato processing industry in Uruguay. Statistical data on tomatoes for processing were not available in this country. Concentrated products like paste and puree, and whole tomato are mainly produced in this country. Tomato juice which is very popular in Japan or the United States is not produced and is not available at any restaurants or supermarkets in Montevideo. They have no custom to take

Table 1 Temperature and rainfall in tomato growing season at Montevideo and Morioka

Montevideo	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
Min. temp. (°C)	7.1	9.1	13.5	15.7	17.6	15.6	15.4	14.2
Max. temp. (°C)	17.1	19.9	24.2	25.7	28.1	26.2	25.1	21.8
Av. temp. (°C)	11.9	14.7	18.6	20.7	22.8	20.8	20.2	17.7
Rainfall (mm)	84	73	79	77	83	74	104	102
Morioka	March	April	May	June	July	Aug.	Sept.	Oct.
Min. temp. (°C)	-2.9	2.6	7.9	13.1	18.0	19.4	13.9	6.5
Max. temp. (°C)	6.5	14.1	20.2	23.0	26.6	28.5	23.5	17.5
Av. temp. (°C)	1.4	8.0	13.8	17.7	21.8	23.2	18.1	11.5
Rainfall (mm)	82	99	89	120	173	143	179	106

tomato juice in Uruguay.

The government of Uruguay have recently changed the economic policy. Now, every goods can be imported freely with low tax. Therefore, some tomato products are imported from Argentine and Brasil, though some amount is also exported to these countries. The amount of export and import are variable among the years and affected by the amount of production of Uruguay, Argentine and Brasil. In any way, tomato processing industry of Uruguay is now under difficult situation with the new economic policy. The tomato products of Uruguay are a little higher in price than those of Brasil and a little lower than those of Argentine. On the quality, they are inferior to Argentine and at the about same level as Brasil.

The problems in tomato processing industry of Uruguay were as follows;

1) The size of factories is small and machines are aged and out-of-date.

   It is necessary that by the introduction of modern machines the quality should be improved and the production cost should be lowered.

2) Grading of raw tomato fruits is not done strictly. Some farmers do not grade their fruits and processors have to do. It costs much. Sometimes unripened fruits are picked and colored after picking.

3) It is supposed that 60-70% of raw fruits are introduced from fresh market. Some tomatoes go either to fresh market or processing industry depending on price. The production of raw fruits under contract with farmers should be increased in order to get the stable amount of fruits and improve the quality.

4) The price of raw fruits is about N$ 1/kg, but raw fruits which is low in price and high in quality have to be produced in the future by introducing the new agricultural technology in order to compete in the international market.

c. Growers

The average acreage per farmer is about 200 ha in Uruguay, but most farmers who grow tomatoes are concentrated in the range of 5-50 ha/farmer. It proves that farmers small in size grow tomatoes. The average acreage of processing tomatoes appears to be 2-3 ha/farmer. The mechanization of farm work has not developed yet as in the United States, and it appears to be difficult to grow tomatoes in a large area owing to the labor situation.

The production area of tomatoes for processing is concentrated in Montevideo, San Jose and Canelones, because processing factories are also concentrated in and around Montevideo. The average distance from farmer to factory is about 50 km and the maximum distance is not over 80 km. It is supposed that disorders or decay accompanied with transportation would not be serious.

Table 2 shows the yield and fruit quality of some varieties which are grown in Uruguay. The yield is low but soluble solids is very high. Tomatoes for processing is unstaked and the varieties "Rossol", "Roma", "Loica", and "H 1370" are grown. Most of them bear pear-type fruits and suitable for concentrated products. Some pear-type fruits appear in fresh market and they are used for sauce or 'dulce' like marmalade. Loica is an Agentine-bred variety and is regarded as the best variety in Uruguay, because it grows well in dry condition and relatively resistant to tomato spotted wilt virus (TSWV).

In general, tomatoes for processing are planted in September and October, and harvested from the end of February to early April. Average yield is about 20 tons/ha and considerably lower than in Japan. It is partly because the technology in nursing plants is poor as shown by planting aged seedlings or raising plants at a high density in nursery bed, and partly because drought at transplanting and during plant growth inhibits the growth. In San Jose, we observed that tomatoes grew vigorously with irrigation and 50-60 tons/ha yield could be expected in a farm which has an irrigation system. It proves that irrigation would be very useful for tomatoes in this country. Many farmers apply 60 kg N/ha, and 160 kg P_2O_5/ha as base dressing, but many of them do not apply potassium fertilizer.

The frequency of picking is 3-4 times/season on average. Harvesting requires much labor in tomatoes for processing and available labor often determines the acreage which one farmer can grow. A farmer told me that 4 family members and one employee can grow 3-4 ha of tomatoes.

Considering the present situation of tomatoes for processing mentioned above, there appears problems to be solved in the future as follows;

1. Improvement of technology on the nursing tomato plants.
2. The introduction of different type of varieties and research works on varietal difference in yield, fruit quality, disease

resistance, etc.

3. Improvement of fertilization; some farmers do not apply potassium, but it is necessary to make sure whether potassium has really no effect on growth and yield. And it is also necessary to do some experiments on the level of N, P, and other nutritional elements, and fertilization method; sidedressing or the place of fertilizer application.
4. Planting time; farmers require much labor force and too much raw fruits go to factory to process them at the peak of harvesting. By planting over a long period, the harvesting peak can be lowered and also the adequate amount of raw tomatoes are available over whole harvest season.
5. Irrigation
6. Blossom end rot; physiological disorder 'blossom end rot' occurs commonly in this country. Ca fertilization and irrigation are required to control it and it would be necessary to test the introduction of 'round-type' varieties which are rather resistant to blossom end rot. Other disorders like sunburn or fruit cracking are not serious in this country.
7. Disease; TSWV is very common in some years and it is necessary to control thrips as a virus-vector and to introduce a variety resistant to TSWV.
8. Direct-seeding; Most farmers have no irrigation system and plant growth is inhibited with severe drought. Direct seeding would result in a higher and stable yield. However, weed control is one of most serious problems in direct-seeding and some experiments will be required on chemical weed control.
9. Labor; labor will be short in the future and it is necessary to introduce some varieties which bear large fruits and are superior in harvesting efficiency. Further, it will be necessary in the future to study on once-over harvest and mechanical harvesting.

Table 2 Varietal difference of yield and fruit quality in tomatoes for processing

	H1370 (US)	Huilqui (Argentine)	Loica (Argentine)	Napoli (US)	Roma (US)	Ronita (US)
Transplanting to harvesting	80-85 days	90 days	80 days	75 days	75-80 days	75 days
Period of harvesting	end of Feb. to early April	end of Feb. to early April	end of Feb. to early April	early March to early April	mid-Feb. to early April	end of Feb. to early April
Fruit size	110 g	55 g	50 g	50 g	55-70 g	53-68 g
Yield (Kg/ha)	22,500	24,000	30,000	20,500	20,000	21,000
pH	4.3	4.4	4.5	4.4	4.5	4.4
Soluble solids	4.7	5.7	4.9	5.3	5.5	5.0
No. of plants per ha.	19,200	23,500	27,500	33,000	25,600	25,600