PROPOSAL FOR TECHNICAL IMPROVEMENT OF VEGETABLE PRODUCTION AND VEGETABLE SEED PRODUCTION IN DEVELOPING COUNTRIES

BY

THE PARTICIPANTS
OF
COUNTERPART INDIVIDUAL TRAINING
VEGETABLE SECTION

NOVEMBER, 1990

TSUKUBA INTERNATIONAL AGRICULTURAL TRAINING CENTRE
JAPAN INTERNATIONAL COOPERATION AGENCY

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FOREWARD

The counterpart individual training in the fiels of vegetable production and vegetable seed production is implemented successfully according to each curriculum offered by the Tsukuba International Agricultural Training Centre of the Japan International Cooperation Agency.

This training, following the curriculum of Vegetable Crops and Seed Production Courses, was held from June to November, 1990. The programme covered various important subjects related to vegetable production to enable the four participants to improve their knowledge and technical skill.

Based on individual interest and the needs of the participants as well as the organization they belong to, we, the staff of the Vegetable Section, have organized their work in formulating proposals in the curriculum.

This is a collection of technical proposals for the improvement of vegetable production in their respective countries.

Although the four topics of the proposals cannot cover the whole of the field completely, I believe those proposals certainly give impact to the present activities of vegetable production in their countries.

I know that their efforts in formulating the proposals will be rewarded by success in near future.

Lastly, I would like to express my deepest appreciation to all the lecturers and persons from organizations and institutions visited during study tours or observations, who provided participants with interest, guidance and cooperation in preparing these technical proposals.

November, 1991

Tsuyoshi Eida
Managing Director
Tsukuba International Agricultural Training Centre
Japan International Cooperation Agency

LIST OF PARTICIPANTS (COUNTERPART INDIVIDUAL TRAINING)　　VEGETABLE SECTION (1990)

平成２年野菜セクション（カウンターパート個別研修）研修員名簿

1. セルヒオ

2. セサル

3. カタコラ

4. アポリターノ

No.	Name 呼称名	Age 年令	Country 国名	Present Post 現職
Vegetable Crops Production Course (Individual)　野菜生産コース（個別）				
1	Mr. Sergio Alfonso Javier Antigua （セルヒオ）	40	Dominican Republic （ドミニカ共和国）	Assistant Director of National Center and Development Technology, Ministry of Agriculture ドミニカ共和国胡椒開発プロジェクト、農業省カカオセンター副所長
2	Mr. Cesar Antonio Tejada Abreu （セサル）	34	Dominican Republic （ドミニカ共和国）	Researcher, National Center and Development Technology, Ministry of Agriculture ドミニカ共和国胡椒開発プロジェクト、農業省カカオセンター栽培部研究員
3	Mr. Edmund Catacora Pinazo （カタコラ）	41	Peru （ペルー）	Head of Training and Extension, Vegetable Cultivation Technique Center Project ペルー野菜生産技術センタープロジェクト、野菜生産技術センター研修普及部長
Vegetable Seed Production Course (Individual)　野菜採種コース（個別）				
4	Mr. Cesar Apolitano Sanchez （アポリターノ）	45	Peru （ペルー）	Director of Plant Breeding and Seed Production Dept., Vegetable Cultivation Technique Center Project ペルー野菜生産技術センタープロジェクト、野菜生産技術センター研修部長

SCHEDULE FOR
THE PRESENTATION OF PROPOSALS

Vegetable Crops/Seeds Production Course
Tsukuba International Agricultural Training Centre

Date : November 21, 1990 *Place* : Lecture Room 3

TIME	TITLE	REPORTERS
9:30-10:00	Proposal for the introduction of new methods for seedling production in the Dominican Republic	Mr. Cesar A. T. Abreu
10:00-10:30	Proposal of intercrop cultivation between black pepper and vegetable crops in the Dominican Republic	Mr. Sergio A. J. Antigua
10:30-10:40	Break	
10:40-11:10	Proposal for the development of vegetable raising seeding methods in the Research and Training Horticultural Centre of Huaral Peru	Mr. Edmund Catacora Pinazo
11:10-11:40	Proposal for the development of seed production of main vegetables in Peru	Mr. Cesar Apolitano Sanchez
11:40-12:00	General discussion	

Attendance
Tsuyoshi EIDA : Managing Director
Sataro YAZAWA : Deputy Director of Training Division (Coordination)
Yoshihiko NISHIMURA : Deputy Director of Training Division
(Chief Instructor of Vegetable Section)
Kaoru IWASAKI : Instructor
Hidekazu YAMADA : Adviser
Kunio INOUE : Instructor
Hiroshi ONO : Instructor

CONTENTS

Proposal for

THE INTRODUCTION OF NEW METHODS FOR SEEDLING PRODUCTION IN THE DOMINICAN REPUBLIC

by Cesar Ant. Tejada Abreu

CONTENTS

1.INTRODUCTION

The Dominican Republic is a tropical country located between 18° and 20° of north latitude and 68° and 72° of west longitude. The country has a mean temperature of 25°C with a maximum temperature of 34°C and a minimum temperature of 14°C. Rainfall varies from 600 to 2300 mm according to the area. Due to the proximity to the United States and because of the different climates, the land has been divided in to the following areas:

1) Area for production of flowers and vegetables for domestic consumption and export.
2) Area for grain crops and other extensive cultivation for domestic consumption and export.

The production of flowers and vegetables takes place in Constanza and Jarabacoa valleys where some technical improvements have been introduced but they are neither diversified nor widely known.

The use of different methods to produce seedlings is very important for small and medium-size vegetable producers not only in Constanza and Jarabacoa, but also for producers in different parts of the country who would like to grow any king of crops by protecting the seedlings against adverse weather conditions during the first stage of production.

Sheltering planted seeds with wax paper or straw mats to guarantee their early growth is said to have started far back during the Keicho Period (1596-1614) in Miho, Shizuoka Prefecture. That was known as Non-seasonal Cultivation" which is considered to be the origin of present-day protected cultivation and it was mainly used along the coastal areas that have mild weather and plenty of sun. Around 1870, glass hothouses were adapted to Japanese horticulture from western countries and until the 50s vegetable growing was sheltered either by wax paper, straw mats or glass housing all over.

In 1951, farmers were using either Polyvinyl chrolide (PVC) or Polyethylene (PE) plastic housing to protect their cultivation. PVC housing was renewed every year or every two (2) years.

(1) The Importance of Sheltering

The use of plastic cover was quickly developed in agricultural cultivation systems under sheltering. Tunnels were made of bamboo and covered by plastic. Below the plastic houses, cultivation can be developed very early and can be protected easily against winds, rain and other weather conditions.

(2) Different Types of Housing

As a result, horticultural cultivation was done in Japan with different patterns in the initial stage of vinyl housing development when the base was made of a wooden or bamboo frame in multiple units.

After some years iron frames were designed and standardized. One standard pattern was the multi-expanded housing made of iron and bamboo. Another pattern had connected semicircular rounded tubes.

These are representative patterns of plastic houses now. Another standard pattern prevailing now is a single-scale, long-expansion plastic house using H-shape tubes and light iron tubes.

These patterns have been used since 1965. Glass houses with wooden bases have been replaced by vinyl houses or plastic and iron-tube sheltering that have multi-expansion units and a wide front.

(3) Patterns Used

The patterns most widely used in Japan for vegetable seedling production are the following:

1. Single housing
2. Multi-expansion housing

Single
- Flat Arc
- Three quarters
- Type of roof: one-side slanted roof, double-side slanted roof and inverted-V roof

Multiple
- This is built by adding single-arc housing side by side.

The following two types of hot-house are used:
- Glass Hot-house
- Plastic Hot-house

Vinyl Plastic Housing

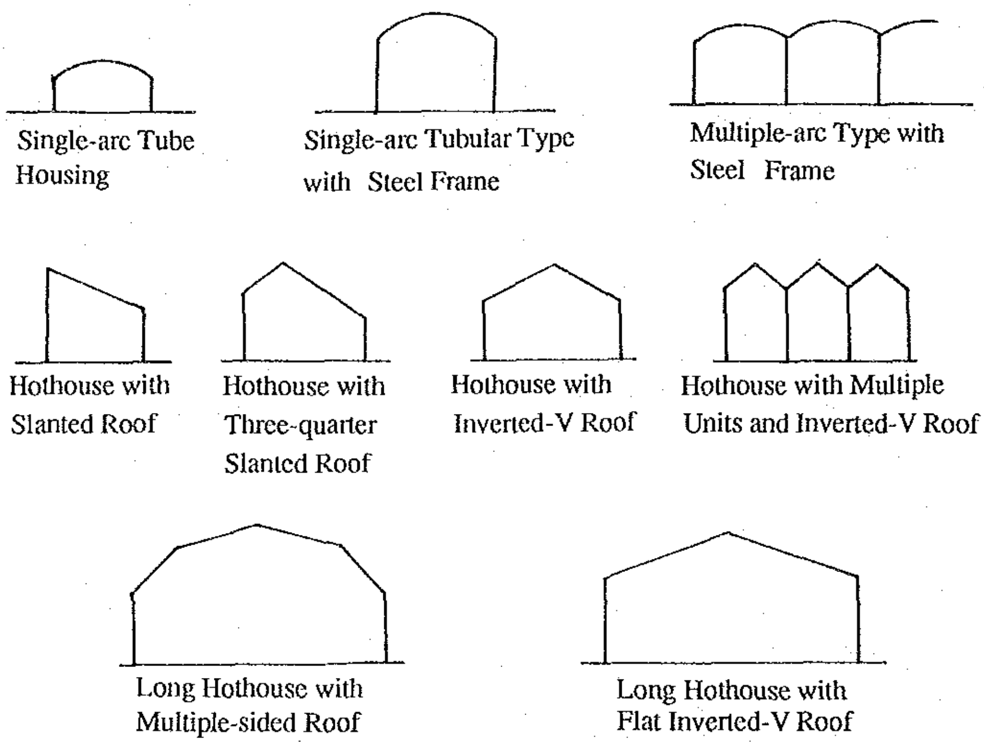


Fig. 1. Different Types of Hothouse in Japan

3. SHELTERING METHODS USED IN JAPAN AND OTHER COUNTRIES TO BE ADAPTED FOR THE DOMINICAN REPUBLIC

The greater amount of vegetables produced in the country is cultivated in the valley of Constanza. This valley has a rainfall of 1026 mm per year and a mean temperature of 18.2°C. Also a large amount of melons, tomatoes for industrial use and other kinds of vegetables are produced in the valley of Azua that has a rainfall of 673 mm and a mean temperature of 27°C. This system to shelter seedlings could be easily adapted in areas of higher rainfall with an average of 1931 mm per year and mean temperature of 25.6°C. The use of tunnels and other sheltering housing could be acceptable not only to protect the growing seeds and seedlings, but it could also be used to grow vegetables. This system would greatly help producers who live in areas where the weather or environmental conditions do not allow growing vegetables.

Applicable Methods to Protect Seedlings

(1) Box Method

The majority of intensively cultivated vegetables are first planted in wooden or plastic boxes. This method is recommended for small amounts of seeds in order to reduce losses in the seeds and it is easy handle. This method can be an easy way to cover or protect planted seeds against heavy rains and expose the young plants (seedlings) to the sunshine when the weather allows it.

(2) Bed Method

In this method, seeds must be first sown in beds before being transplanted to plastic pots or directly to the soil. By sheltering planted seeds with plastic or glass sheets evenly grown seedlings are obtained and the scattering of seeds and seedlings due to heavy rainfall is minimized. In this method it is necessary that the seedbed has a good mixture of soil as this mixture can greatly affect the seed (seedling) growth.

The soil bed must be good to grow strong seedlings that can withstand different adverse conditions such as droughts, high heat,low temperatures and little sunlight.

To make a bed for growing good seedlings it is necessary to have the following:

1) Enough fertilizers.
2) Adequate soil pH for the plants.
3) Non-contaminated seeds free of disease or insects.
4) Good ventilation

(3) Pot Method

In this method the seeds have to be sown firstly in boxes or soiled beds and then they have to be transplanted to plastic pots or other types of pots before being planted in the soil or ground.

By placing the pots in tunnels, dangers caused by heavy rainfall are minimized and also seeds are prevented from catching some diseases.

The following materials typically used in the Dominican Republic can be used to shelter and protect the seedlings.

1) Bamboo mat
2) Palm mat
3) Coconut leaves
4) Banana-tree bracts
5) Palm leaves

(4) Neridoko

This is a method of producing seedlings that has had a certain relevance in Japan, particularly for vegetables that have a weak radicular system during the first stage of seedling formation, especially Chinese cabbage and lettuce.

Adequate materials

1) Wood
2) Soil
3) Compost
4) Fertilizers
5) Fungicide
6) Seeds

Procedure

A wooden frame with a height of 10 cm has to be made with a size suitable for the amount of seedlings that will be needed.

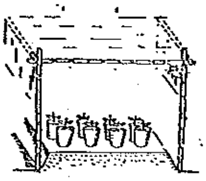
The soil to be used has to be sterilized and disinfected, and then mixed with compost to a proportion of 1:1. It is recommended to add fungicides to disinfect the soil. Water has to be added while the soil is being mixed with the compost as well as the necessary amount of fertilizer. The compound (mixture), after being amassed, has to be put and leveled evenly inside the wooden frame. The compound has to remain a certain period of time in the frame, depending on the weather conditions, before proceeding. After the necessary period of time has passed, blocks of 10 cm x 10 cm are cut. Two boards and a knife are used to facilitate the cutting and then holes are made with the mouth of a bottle in the blocks. The seeds are finally placed and covered with soil dust.

Afterwards, the neridoko is covered with plastic forming a tunnel if the neridoko has not been made inside a hothouse. After the seeds have germinated, unwanted seedlings are removed using scissors and one seedling per block is left for 4 to 5 days afterwards.

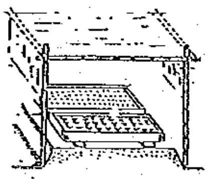
4. RECOMENDATIONS

The use of plastic housing and/or tunnels will be of great importance for the Dominican Republic as vegetables are only cultivated in certain areas the whole year and in other areas during some seasons due to climate conditions. These methods guarantee a greater and continuous production of seedlings for vegetables as well as an increased vegetable production.

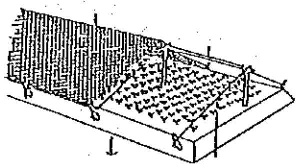
METHODS USED IN THE PHILIPPINES



POT METHOD



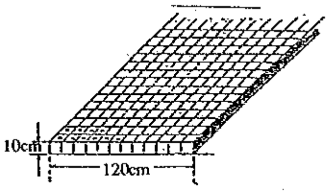
BOX METHOD

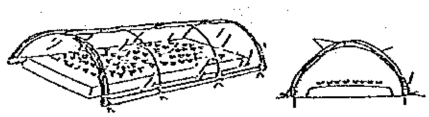


BED METHOD

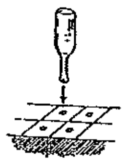
METHODS USED IN JAPAN

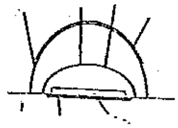
NERIDOKO

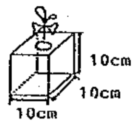




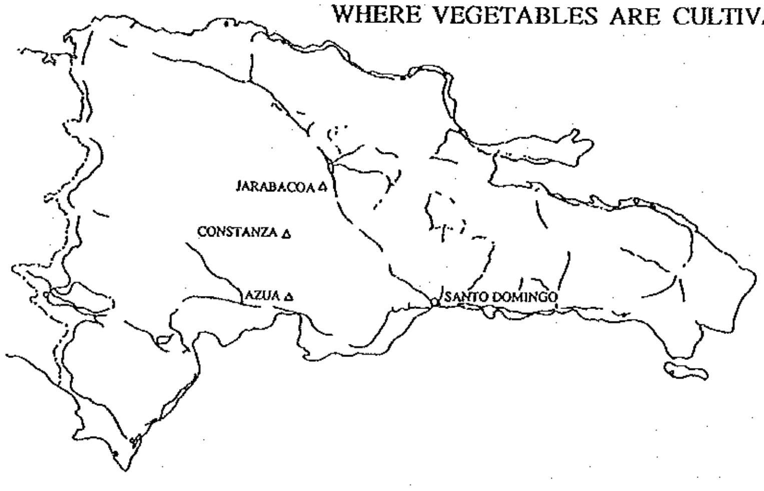
BOX METHOD UNDER PLASTIC TUNNEL







MAP LOCATING THE DIFFERENT AREAS WHERE VEGETABLES ARE CULTIVATED



REFERENCES

1) TIATC, 1988, Proposals for the Technical Improvement of Vegetable Seed Production in the Philippines by the Participants of Vegetable Seed Production Course for the Philippines. Japan International Agency.

2) TIATC, 1989, Proposal for Technical Improvement of Vegetable Seed Production in Developing Countries. The participants of Vegetable Seed Production Course.

3) SEA, 1990, National Agency for Agriculture. Summary of Activities for the Project of Cultivating Pepper in the Dominican Republic.

Proposal for

THE DEVELOPMENT OF INTERCROP CULTIVATION BETWEEN BLACK PEPPER (*Piper nigrum L.*) AND VEGETABLE CROPS IN THE DOMINICAN REPUBLIC

by Sergio A. Javier Antigua.

CONTENTS

1. INTRODUCTION

(1) Outline of the Dominican Republic

The Dominican Republic is a tropical country situated in Central America between 18° and 22° latitude north, and 68° and 72° longitude west, with a mean rainfall of 1,500 mm and mean temperature of 25°C. The soil is classified as alluvial soil.

(2) Outline of Black Pepper Production in the Dominican Republic

In 1982, Mr. Sannosuke Yasumori introduced Black Pepper (*Piper nigrum L*) to the Dominican Republic from Brazil. Mr. Yasumori worked in the Dominican Republic from 1982 to 1986.

The experiments with Black Pepper were started with these introduced plants to observe their adaptation to the soil and climate conditions.

In 1984 some plants were sown in Mata Larga, San Francisco de Macoris and La Majagua, Sanchez city.

(3) Outline of Vegetable Production

The Dominican Republic produces all types of vegetables all year round in the areas which have good climate conditions, such as Constanza Valley and Jarabacoa City. But most farmers cultivate vegetables in the winter season because the temperature condition is better at this time.

2. OBJECTIVE

The objective of the proposal is to discuss the possibility of mixed cropping between Black Pepper and vegetable crops.

3. PRESENT SITUATION OF BLACK PEPPER CULTIVATION IN THE DOMINICAN REPUBLIC

The Dominican Republic has very good soil and climate conditions for the development of black Pepper culture. The soil has a pH of 6.2; the texture is 36% clay, 40% silt and 24% sand. Moreover the nutritional condition is very good. It shows 3% of organic matter, a low level of phosphorus and very high potassium content.

The climate conditions of the experimental areas show a monthly average rainfall of more than 100 mm. Monthly average temperature is 25.6°C for Mata Larga, 25.9°C for Yamasa, 25.3°C for Cevicos and 26.3°C for Sanchez City. These data are shown in Table 1 and 2. This soil and climate condition gives a good perspective for black pepper cultivation.

In the experimental areas, a study of the water balance was made (Fig. 1). In this case Yamasa, Cevicos and Samana are not affected by drought. But in San Francisco Macoris in the months of July, August and September it is affected by water deficiency.

Until now, the black pepper cultivation is limited in these experimental areas and it is showing good development in the soil and climate condition of the Dominican Republic. In this research phase many different trials are being conducted to investigate the following items:

1) sowing density
2) soil nutrition
3) shaded system
4) sowing system
5) rooting system
6) vegetative reproduction, etc.

From 1992, black pepper will be introduced at a farming level according to technology recommended by research trials.

4. PROBLEM IDENTIFIED

In other countries the spacing of black pepper is 2.0 x 2.0 m, 2.0 x 2.5 m or 2.5 x 2.5 m. But in the Dominican Republic it is only 2.5 x 2.5 m.

In black pepper cultivation the farmers must undertake field management with many practices such as: fertilization, weed control, training, etc. All these activities make a very high production cost and the farmers undertake this management during the first three years without receiving any income. They must pay for fertilizers and labor expenses for black pepper cultivation.

Due to this, it is necessary to study the methods which can supply some income to farmers during this time.

5. POSSIBILITY OF MIXED CROPPING

The conditions for the development of black pepper are shown in this paper. They give the possibility for mixed cropping of black pepper and vegetables.

Extra income from black pepper fields for farmers:

With an adequate management of mixed cropping of black pepper and vegetables, farmers can get extra income through this activity. This income can be used for management of black pepper in the first three years culture. In this case, farmers can make a better application of technology in this cultivation.

6. POSSIBLE COMPANION CROPS

Black pepper is a culture that needs light to develop and to be produced. So any crops which create light competition with black pepper are not good for inter crops.

In this case the idea is to research all the vegetable crops (roots and leaves) which do not compete for light with black pepper cultivation.

These vegetables can be:

1) cabbage 2) chinese cabbage 3) lettuce 4) onion
5) turnip 6) carrot 7) radish 8) potato 9) soybean

Table 1. Monthly avarage rainfall at the climatology stations located in the experimental area (mm)

Name of station	Mean yearly	J	F	M	A	M	J	J	A	S	O	N	D
San Fco. Macoria	1428	89	87	65	92	206	120	121	142	115	120	144	127
Yamasa	2067	91	70	75	150	284	234	245	269	216	196	134	103
Cevicos	2090	77	86	95	148	297	254	252	243	187	174	159	118
Samana	2086	146	104	105	135	243	179	207	231	213	227	65	231

Table 2. Monthly avarage temperature at the climatology stations located in the experimental area (c)

Name of station	Mean yearly	J	F	M	A	M	J	J	A	S	O	N	D
San Fco. Macoria	25.6	23.2	23.5	24.5	25.5	26.2	26.9	27.0	27.2	27.1	26.6	25.2	23.9
Yamasa	25.9	24.2	24.6	25.4	26.0	26.6	27.0	27.1	26.9	26.7	26.5	25.5	24.5
Cevicos	25.3	22.9	23.7	24.5	25.5	26.4	26.9	26.7	26.6	26.9	26.3	24.7	23.2
Samana	26.3	24.1	24.4	25.0	25.8	26.9	27.7	28.0	28.0	27.9	27.4	25.9	24.9

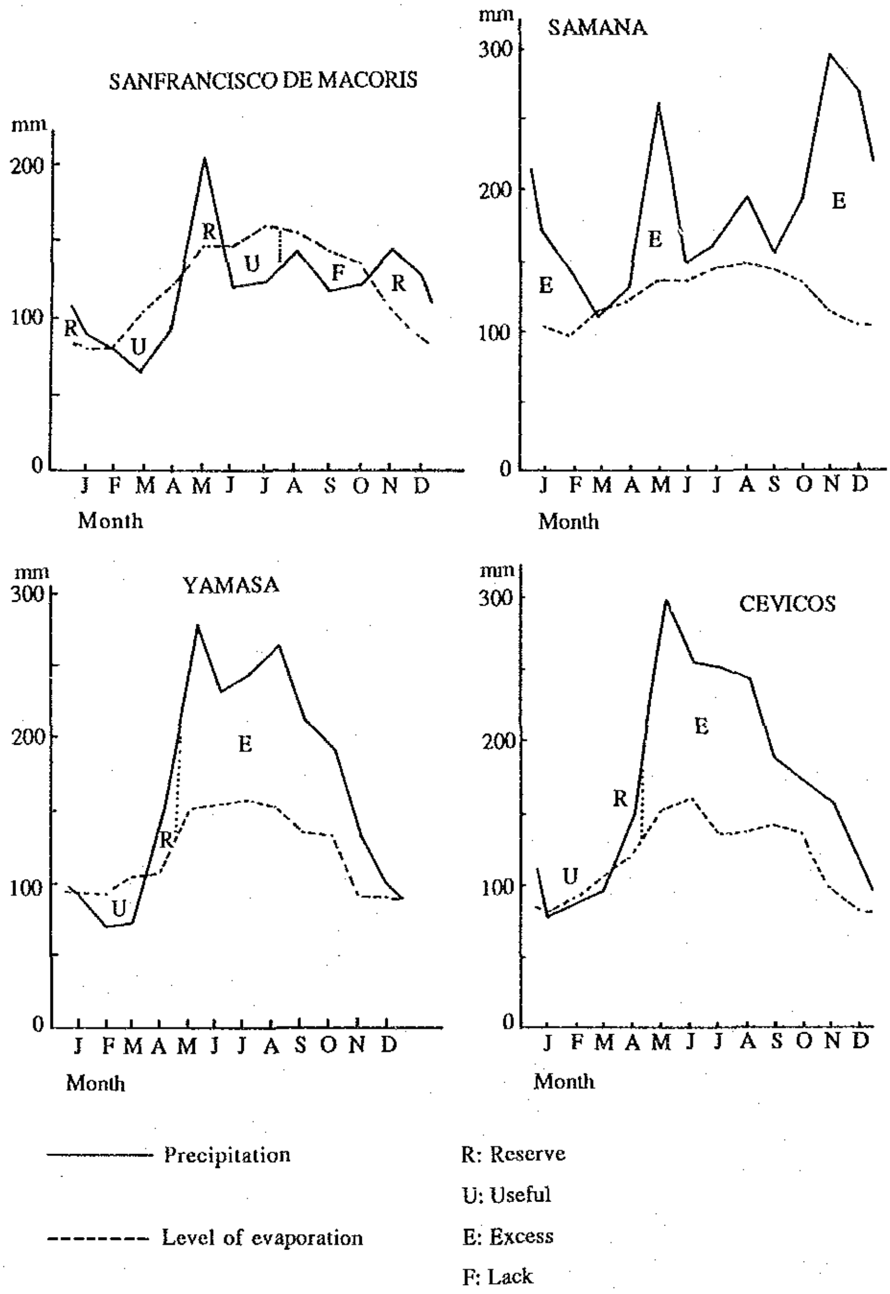
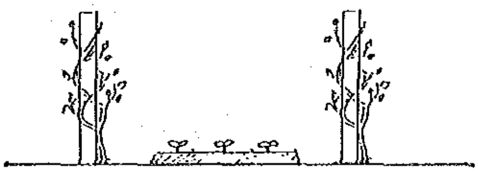


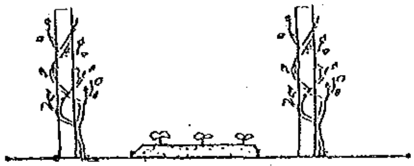
Fig.1 Water balance of the different areas

ANNEX

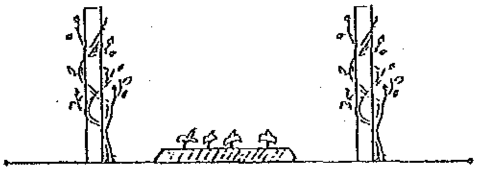
CROPPING PATTERN: INTERCROP CULTIVATION
BETWEEN BLACK PEPPER AND VEGETABLE CROPS.



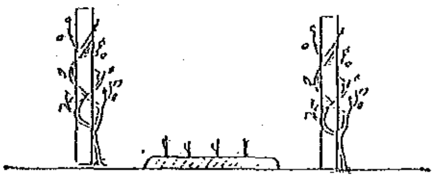
Cabbage



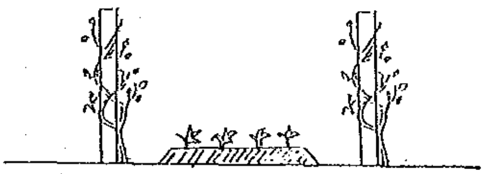
Chinese cabbage



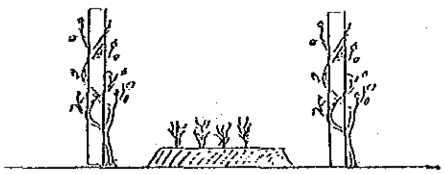
Lettuce



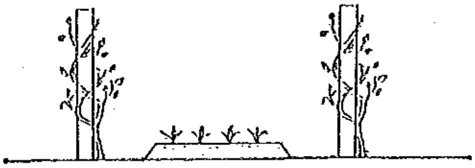
Onion



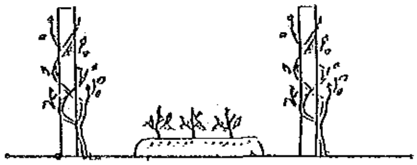
Turnip



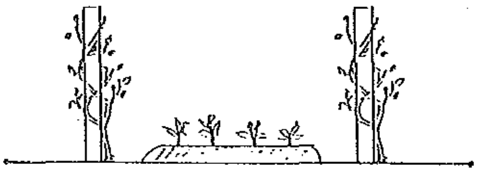
Carrot



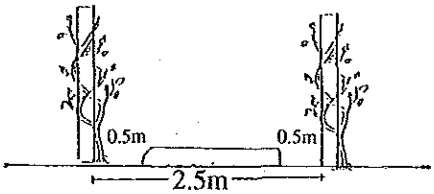
Radish



Potato



Soybean



Proposal for

THE DEVELOPMENT OF VEGETABLE RAISING SEEDLING METHODS IN THE RESEARCH AND TRAINING HORTICULTURAL CENTER OF HUARAL, PERU

By Edmundo Catacora Pinazo

CONTENTS

1. INTRODUCTION

The world population which now already numbers 5,000 million, is expected to reach 7,000 million by the year 2000. To sustain such a large population, an uninterrupted supply of food is essential. Supplying this food is the role of agriculture worldwide.

One of the finalities of modern agriculture is to supply the farmers with the technological options necessary for the rational and efficient utilization of natural resources. Technology must give the opportunity to the farmers to contribute to the improvement of their situation, through making it possible for them to participate in marketing and in the growth of sectors of the economy.

There are several reasons for growing vegetables, but the most important one is for food. Vegetable are essential in the diet, providing figure, trance minerals, vitamins, carbohydrates and protein. Interest in vegetables has increased, especially in developing countries, to supplement the staple vegetable-foods with other vegetables produced locally.

In vegetable cultivation, the ways of raising seedlings play a very important role. It is generally said that the proper way of raising seedlings in the nursery contributes to half of the crop yield, especially for vegetable crop production.

2. OBJECTIVE

The objective of this paper is to produce a technical and practical proposal to the Research and Training Horticultural Center of Huaral-Peru based on the need to improve the technology of raising seedlings employed by Peruvian farmers, through means of evaluation of the raising seedling method of Japanese agriculture (Neridoko), for improvement of vegetable production, thereby increasing the net income of farmers in Peru.

3. BACKGROUND SITUATION

(1) Geographical Location of Peru

Peru is a democratic and independent republic. It is located in the Southern Hemisphere, on the west coast of South America, between 0° and 18° south latitude. Politically, Peru is composed of 24 Departments, 1 Constitutional Province, 180 Provinces and 1,765 Districts (data 1989); all of these places are located from sea level to 4,000 meters above sea level (Fig. 1).

(2) Topography Characteristics

A chain of mountains (The Andes) separate the country into three climatic regions (each has its peculiar flora and fauna).

a) The Coastal Region is mostly arid (desert), and a portion of the desert area is used as the agricultural land (valleys), in which rivers can supply water. It is located between 60 and 800 meters above sea level and represents 10.6% of the national land.

b) The Mountainous Region is a very rough surface. This singular characteristic is due to the Andes Chain. It is located between 800 and 4000 meters above sea level and represents 31.8% of the national land.

c) The Amazon Jungle is located in the lower east side of Peru, between 250 and 1200 meters above sea level, which represents 57.6% of the national land.

(3) Utilization of Land

The total land area of Peruvian territory is around 1,285,216 square kilometers, making country one of the largest in South America after Brazil and Argentina. Peru has cultivated land of approximately 3,691,400 hectares, which represents 3% of the total land area .

(4) Population

The Peruvian population rate is very high, being around 2.6%. The population is approximately 21,278,200 (date 1988) with a population density of around 16.13 persons per square kilometer. 68% of the population live in urban area .

(5) Climate

a) The Coastal Region: the annual mean temperature along the coast is between 19°C and 20.5°C, having a seasonal variation around 8°C; usually foggy from May to November. The annual precipitation average is 60 mm. Table 2 shows the data for average temperature, relative humidity and precipitation from the Research and Training Horticultural Center of Huaral-Peru located in the Coastal Region.

b) The Mountainous Region (highland area): variable climatic conditions. The average annual precipitation is between 600 and 1200 mm, but is usually higher in the summer (December-March); annual average temperature of 14°C to 16°C.

c) The Amazon Jungle area: the North Jungle, where precipitation reaches 3000 mm; the precipitation of the Central Jungle reaches 4,000 mm; and the South Jungle, where precipitation reaches 5,000 mm. The annual average temperature is 25.5°C.

(6) Agriculture in General

a) Administration system in agriculture

Peru is a traditional agricultural country. Its agriculture system is under the rule and surveillance of the Ministry of Agriculture.

b)National Institute of Agricultural and Agroindustrial Research(INIAA)

INIAA is the abbreviation of the Spanish "*Instituto Nacional de Investigacion Agraria y Agroindustrial*, which conducts national planning, directing, execution, supervising and evaluation of agricultural, agroindustrial and fauna research activities. In the same way, it is also in charge of water and soil resources utilization. The INIAA depends directly on the Ministry of Agriculture and has representative offices (Agricultural Research Stations) in homogeneous agroecological zones.

c) Research and Training Horticultural Center of Hural

CICHH is the abbreviation of the "*Centro de Investigatcion y Capacitation Horticola de Huaral*", established by a joint project between the Japan International Cooperation Agency (JICA) and INIAA, which is located in Lima Department, Province of Huaral (Fig. 1). It is 60 meters above sea level, with annual average temperatures of 19.2°C and average precipitation of 2.3 mm (see Table 2). CICHH is in charge of research activities and training relating to vegetables.

(7) Vegetable Crop Production

The production of vegetables is widely distributed throughout Peru, as shown in Table 1.

(8) Major Crop Production in Peru

65% of the total cultivated area is used for foodstuffs, 15% for food crops, 7% for industrial crops (cotton, sugarcane), 7% for animal food grains and 6% for other crops. However, international consumption is not furnished, which is why imports to cover such a deficit represent the main loss in monetary value, principally in red meat, fats and cereals. The main cultivation crops for the natural regions are shown in Table 3.

Table 1 Main Vegetables produced in Peru
(historic series dated between 1980-1985)

Vegetable crop	Production areas (ha)	Annual production (t)	Average yield (t/ha)
Sweetcorn	20,404	126,534	6.19
Green peas	15,876	48,056	3.02
Onion	6,570	124,997	19.02
Tomato	5,722	87,499	15.35
Squash	5,204	74,977	14.34
Carrot	4,036	54,701	13.56
Cabbage	3,353	44,769	12.57
Lettuce	2,750	15,000	5.46
Watermelon	2,678	38,734	14.44
Asparagus	2,233	7,725	3.41
Garlic	2,206	12,293	5.77
Snap beans	1,239	4,922	3.95
Cauliflower	1,153	14,015	12.14
Table beet	1,142	11,442	11.43
Celery	729	9,719	13.29
Melon	545	5,471	10.66
Radish	509	6,902	13.47
Leek	372	4,039	10.93
Strawberry	317	2,865	10.75
Cucumber	186	2,108	11.24
TOTAL	80,360	726,070	

Table 2 Data for average temperature, relative humidity and precipitation in Research and Training Horticultural Center of Huaral

MONTHS	TEMPERATURE (°C)			HUMIDITY (%)			EVAPORAT.	HELIOF.	PRECIPT.
	Max	Mean	Min	Max	Mean	Min	mm.	Sun hrs	mm.
JAN	26.1	22.2	18.3	94.3	82.7	74.3	5.8	5.4	0.9
FEB	27.1	23.5	19.0	90.3	81.3	71.7	5.1	6.4	1.2
MAR	26.0	22.5	19.3	95.3	84.0	73.0	5.8	6.9	0.0
APR	24.5	20.8	16.9	95.7	85.3	74.7	4.7	6.9	0.0
MAY	22.3	18.6	15.1	93.3	85.3	78.7	3.9	5.4	1.0
JUN	19.1	16.2	14.3	95.0	87.7	79.7	2.5	2.1	2.9
JUL	18.7	16.1	13.7	94.7	87.7	79.7	2.3	2.1	2.6
AUG	18.3	16.1	13.9	96.3	89.3	82.7	2.1	1.5	8.2
SEP	19.3	16.6	13.9	96.0	87.0	78.7	2.9	3.2	2.2
OCT	20.3	17.3	14.2	95.0	86.0	77.7	4.2	4.4	0.2
NOV	22.4	18.8	15.2	92.0	84.0	74.0	4.5	4.9	0.9
DEC	25.0	21.1	17.2	93.0	82.5	72.0	5.4	5.5	6.9
ANNUAL	22.4	19.2	15.9	94.2	85.2	76.3	4.1	4.6	2.3

Table 3 Main crops for the natural regions (1988)

COAST		MOUNTAIN		JUNGLE	
Crops	% Land Cultivated	Crops	% Land Cultivated	Crops	% Land Cultivated
Cotton	19.5	Potato	14.3	Coffee	18.5
Rice	10.4	Maize	12.1	Rice	12.3
Maize and Sorghum	10.4	Barley	10.0	Maize	12.3
Sugarcane	9.0	Wheat	8.0	Erythroxylum coca	9.2
Vegetables	8.0	Lucerne	5.0	Cassava	5.0
Potato	3.0	Others	50.6	Oil palm	2.3
Others	39.7			Others	40.4
	100.0		100.0		100.0

4. PRESENT POSITION FOR RAISING SEEDLINGS IN PERU

As the climatic conditions in Peru are very diverse because of the size of the country, vegetable production also varies according to the place, climate, the preferences of the consumers of the region, and the period of plantation. In different regions of the country, the farmers sow some vegetables directory in the field, others are sown in nursery beds (Almacigo as it is known in Spanish) or seedling beds, and later they are transplanted to the field after the seedlings have been raised to a suitable size in the bed.

(1) Practices for Raising Seedlings

a) Nursery beds (Almacigo) are specially prepared for sowing vegetables, generally done in the open field.
b) The nursery bed (Almacigo) usually measures 0.90 to 1.20m wide, 6 to 10m long and 0.20m deep approximately, and it is covered with straw or similar materials after sowing.
c) On the coast, most farmers make nursery beds (Almacigo) in the months from April to July, then transplant to the field April to September, and harvest September to December.
d) The average cultivation season is 9 months (coast) or all year (mountain).
e) Cultivation in plastic houses is not frequently undertaken.

(2) Problems Identified

a) Inadequate proportions of soil, compost and sand are mixed for the nursery beds (Almacigo), so the vegetable seeds do not reach standard germination.
b) Disinfection of soil for pathogensis not carried out.
c) Seed sowing rate is not correct.
d) When the seedlings are removed from the nursery bed, the ends of roots are broken off and this results in greater root branching. Transplanted plants have a much greater number of short branch roots.
e) Lack of appropriate investigation regarding raising seedlings.

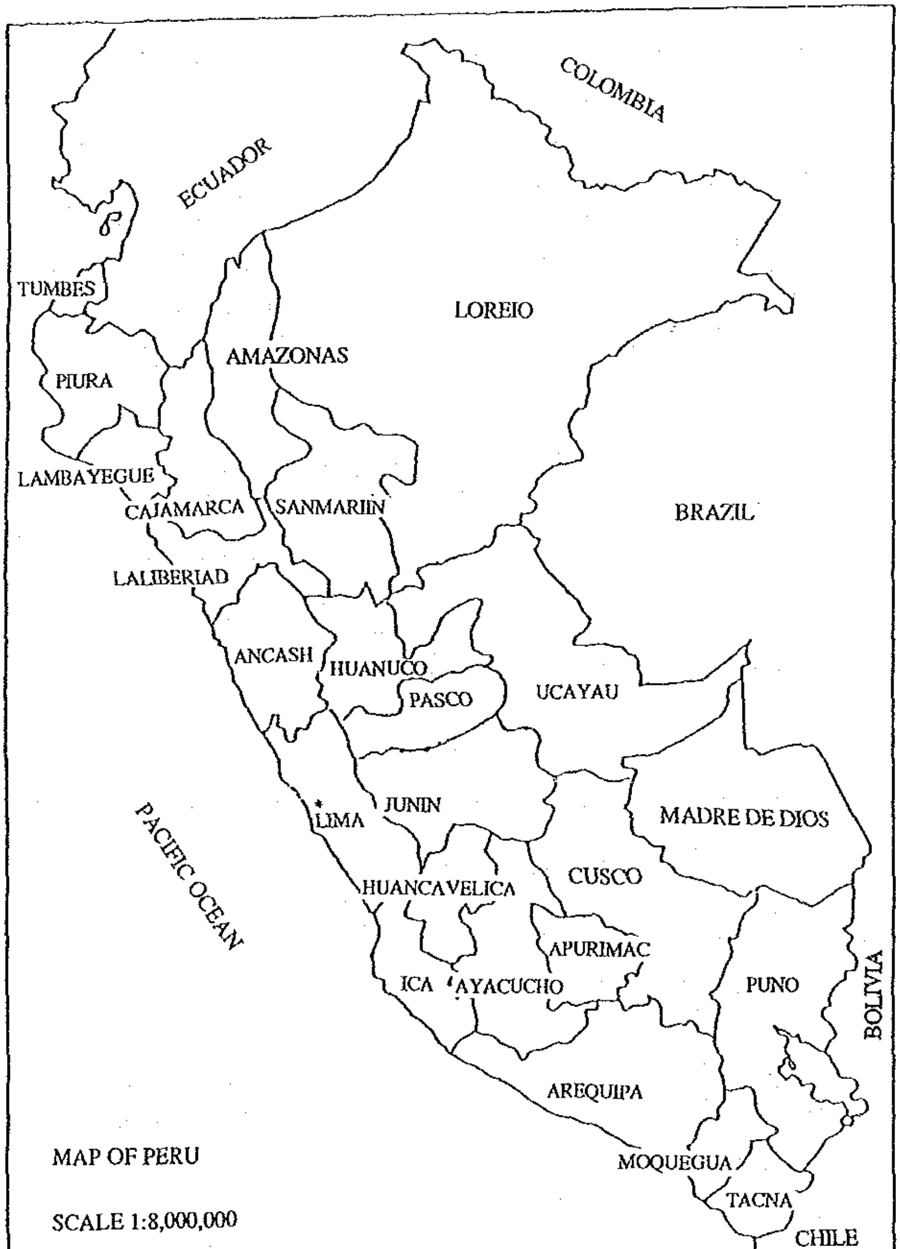


Fig.1 Republic of Peru

*Research and Training Horticultural Center, Huaral

5. IMPORTANCE OF RAISING SEEDLINGS

The distinct increase in vegetable production depends so much on the quality of seedlings. There is a principle that most of the total yield is controlled by the use of healthy seedlings. Besides, quick growth and early harvest in the field can be achieved by raising good seedlings, coupled with the right transplanting method so that they can grow immediately within a few days.

In vegetable cultivation, there are two types of planting method; one is direct sowing, in which the seeds are sown directly in the field, and the other is transplanting, whereby the seeds are sown in the nursery and then the seedlings are transplanted to the field after the seedlings have been raised to a suitable size in the bed.

(1) Advantage of Transplantation

a) Growing conditions can be controlled to produce suitable plants, due to small area of the seed bed.
b) Management such as disease and pest control, watering, weeding, protection from cold and hot weather, can be easily controlled.
c) Saving of seeds and a maximum number of plants can be obtained from costly seeds.
d) During the raising period, the field can be utilized for other crops.

(2) Disadvantages of Transplantation

a) The main disadvantages of transplanting are the extra labor required and the check in growth that results from taking up and resetting the seedlings, which eventually delays the growth of the plant and in some cases reduces yield.
b) It requires specialized management methods.
c) The seedlings of some vegetables, such as cucumbers, melons, and Chinese cabbage, are difficult to transplant because of weak root systems or slow regeneration of roots.
d) When the seedlings are removed from the seed bed, the root systems are usually disturbed.

6. RAISINGS SEEDLINGS IN JAPAN

Today's vegetable horticulture in Japan can be said to be at the top level in the world, that is in its intensive technology and know-how of F1-hibrid seed production, in its skillful and modernized plastic film horticulture and so forth. Therefore all the horticultural science and technology has developed in the field, and not merely in laboratories.

Japanese farmers in vegetable cultivation have a proverb "NAE HANSAKU", which means raising seedlings of any crop is half the cultivation. This proverb teaches us the importance of raising seedlings.

It is known that the quality of the seedlings affects the growth any yield of the plant. For a country like Japan, where many kinds of cultivation methods have been developed due to its natural conditions and yearly fluctuations of market prices, raising seedlings has become very important in order to get more money for shipping vegetables to market in early season.

Most seedling raising techniques originated in the accumulated experience of devoted farmers in Japan. Experienced technology is always adapted to the place where the devoted farmers carry it out, but it is not always adapted for other places. Moreover, devoted farmers are always thought to mix both right practises and wrong ones. Therefore a systematic experiment designed on scientific principles is necessary to confirm whether a devoted farmer's idea is right or not, and also an experiment is necessary for the application of an experienced technique from the devoted farmer's place to other places. Agricultural Science or applied science in Japan has been primarily developed in such a way.

7. JAPANESE METHODS OF RAISING SEEDLINGS (NERIDOKO) TO BE EVALUATED BY CICHH-PERU

In Japan many methods have been developed by devoted vegetable growers in the above way, based on their experience, since a few hundred years ago. Since 30-40 years ago the scientific technology for the seedling raising method has been developed step-by-step. Systemizing these farmers' techniques and referring to scientific principles was established thereafter (5).

(1) Neridoko and Its Importance

Neridoko, a term derived from two Japanese words "Neri", meaning kneading, and "Doko", a nursery, has acquired high response among Japanese farmers. Some time ago, vegetable crops, whose seedlings have shallow root systems and who thus could not adapt themselves to the shock of transplanting, were directly planted in the main field. Some farmers tried to invent alternative ways using the optimum number of seeds required to be sown in the field. Among these alternatives, Neridoko were introduced.

Neridoko is the production of vegetable seedlings on small soil blocks each consisting of one seedling. Based on the above information, seedlings with shallow root systems, specially Chinese cabbage, are produced using this technique; this is a kind of cold bed and is utilized in the hot and dry summer season when it is difficult to transplant the seedlings in the field.

Neridoko becomes relatively important for growing solanaceous vegetables like eggplant, tomato and sweet pepper, which are recommended for transplanting in the dry season. Thus they are made more resistant to heat by neridoko, because of its robustness and its ability to conserve moisture.

(2) Advantages and Disadvantages of Neridoko in Japan

a)Advantages

1) This method can be used during the dry season.

2) Uniform growth of seedlings can be managed and unacceptable seedlings can be avoided.

3) Specially for seedlings which are weak against transplanting, like Chinese cabbage.

4) This method does not require expensive materials like polyethylene pots.

5) Good root system development, holds together roots of seedlings firmly.

b) Disadvantages

1) This method needs skill to avoid hardening or cracking of the soil block.

2) More labor is required in the process of preparation.

3) This method is not advisable for use during the rainy season.

(3) Materials for Neridoko

1) 10cm-wide board for frame.
2) Field soil and matured compost to a ratio of (1:1). When soil is light, add clay soil. If soil is clay add sandy soil. This is necessary to meet the requirement of better aeration and water retention.
3) Chemical fertilizer: this depends upon the nutrient content of the soil. The following are based on the experience in the Tsukuba International Agricultural Training Centre (TIATC):
N:40, P_2O_5:50, K_2O:50 (g/3.2M^2)
This rate of fertilizer should be a adjusted through laboratory analysis.
4) Fungicide PCNB (10kg/10a) is used for soil disinfection in TIATC.

(4) Procedure to Make Neridoko

1) Construct the wooden frame desirable for producing the required amount of seedlings; also the frame may be made of other building materials.
2) The frame extends to the bottom of the bed. Spread rice straw or sand thinly on the bottom, in order to cut the connection between the kneaded soil and the ground soil, so that the seedling can be easily taken off when transplanting.
3) Make a good mixture of the soil and compost, and add chemical fertilizers at the recommended rates, and fungicide. Mixing of soil and compost will affect the subsequent water management and even growing of plants. This is important to consider, because too much clay results in hard soil when dried up, or less aeration. Another case is poor roots and cracking of the bed when the soil is too dry due to insufficient mixing of soil and compost.
4) Add water, then the mixture is kneaded with a grab hoe first and then kneaded well by hand for about 30 minutes; notice that excess kneading causes bad aeration in the soil by plugging air porses. The kneaded soil is put in the wooden frame and the surface is well levelled.
5) The kneaded soil must be dried up gradually to avoid cracks on the surface of soil; it is left for about half a day on a sunny day or about a whole day on a cloudy day.
6) Cut the kneaded bed, when the soil comes to be like a soft cheese. Cut the soil with a knife in small blocks of about 10cm x 10cm, previously putting two

boards on the soil to prevent the kneaded soil from sticking to the knife (Fig. 2).

7) Make a shallow hole with the mouth of a bottle on each block (Fig. 3).

8) Sow 2 or 3 seeds in each hole and fill up with covering soil which contains organic matter. Spread rice straw or husks after sowing.

9) Some method of shading the seed bed is required to prevent excessive drying and increase of soil temperature. Sacks, cloth such as cheese cloth and straw mats are among the materials used for shading the young plant.

10) After germination, when the seedlings are at the 1-2 true-leaf stage, the first thinning is done, and then repeat at the 2-3 true-leaf stage by using scissors, leaving 1 plant per block.

11) The seedlings raised with Neridoko and soil blocks are usually set in the main field at the 4-5 true-leaf stage (Fig. 4).

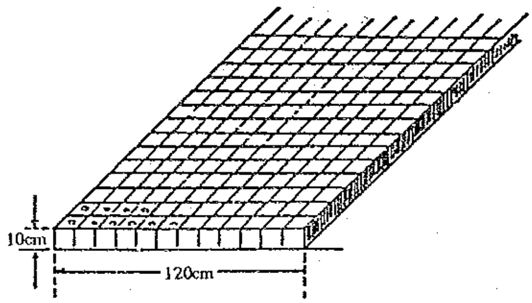


Fig. 2 Neridoko bed

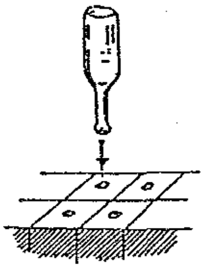


Fig. 3 Sowing-holes being made on the soil blocks

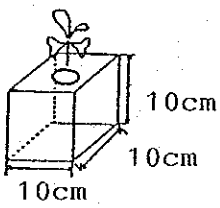


Fig. 4 A neridoko seedling

8. SUMMARY AND RECOMMENDATIONS

It has been known that raising seedlings is half of the cultivation. That's why it is imperative that seedling care and management should be taken into account. With proper seedling management seed losses will be minimized and relatively good production can be obtained.

When the seedlings are removed from the nursery bed (Almacigo), the bare-rooted plants can be severely shocked.

The method of raising seedlings (Neridoko) and the benefit derived from it are insufficiently known in Peru. Related to the topic of raising seedlings, it has been recommended that an evaluation of "Neridoko" be carried out, comparing it with other methods of raising seedlings, such as nursery beds (Almacigo), direct sowing, paper pots, plastic pots and other materials.

For further trials it is necessary to give adequate proportions of soil, compost, clay and sand, depending upon the number of expected transplantation, the kind of vegetable grown and the requirement of the farmers. It is recommended to adjust this proportion as follows:

Case A: 50% mature compost and 50% general field soil.

Case B: 50% mature compost and 30% light field soil and 20% clay.

Case C: 50% mature compost and 30% heavy field soil and 20% sand or sandy soil.

Other aspects will be according to needs for the execution of normal experimentation.

The results obtained in the trials can certainly help to realize the outline of performance of respective vegetables under Huaral conditions, and suffice to be applied into the design of their prospective cropping patterns because those reflect actual conditions in Huaral-Peru. At all events this should not be taken from books.

This paper is to be taken as the basic design of the proposal.

Regarding the possibility of extending "Neridoko" under Peruvian conditions, it can be sounded out through the first trials, then confirmed and diffused through appropriate methods.

Proposal for

THE DEVELOPMENT OF SEED PRODUCTION OF MAIN VEGETABLES IN PERU

by Cesar Apolitano Sanchez

CONTENTS

1. INTRODUCTION

The area of Peru is 1,285,216 square kilometers, of which 23,545,148 ha (18.3%) represents the total surface of Peru for use as agriculture areas, including cultivation lands (15.7%), natural pastures (64.3%), forestslands (7%) and others (7%).

7,609,000 ha may be added when an irrigation system is available in combination with suitable climatic conditions. Within the arable land area about 3,000,000 ha (2.3% of the total national land area) is actually cultivated, with 26% in the coastal area, 63% in highland areas and 12% in the lower Amazon jungle area. These areas involve food crops such as vegetables. At present 29 kinds of vegetables are raised and shipped to markets in Peru. 14 vegetables among of them are cultivated widely (Table 1) and 5 major vegetables such as onion, tomato, squash, hot pepper and cabbage are shipped to markets in large quantities all year round.

Peru imports an average of nearly 113.06 tons of vegetable true seeds yearly (tomato, carrot, onion, Italian squash, cauliflower, table beet, watermelon, melon, lettuce, spinach, cucumber, celery, radish, snap beans, Chinese cabbage, eggplant, leek, pepper, asparagus, broccoli, etc.) from the U.S.A., Holland, Italy and so on (Table 2). This represents around 90% of the total seeds required for sowing in the total horticultural area, and the remainder of around 10% is produced in several areas of the country such as Arequipa, Lima, Canete, Tarma, Huancayo, etc,but with a low technical knowledge level. The commercialization and distribution of the imported seeds are achieved through private companies.

Seed production problems are mainly scarcity of technical knowledge in order to start a program for developing seed production in Peru.

All Peruvian natural regions include 24 Departments, 1 Constitutional Prefecture, 180 local Prefectures and 1,765 Districts (Fig.1). Those are spread evenly between altitudes varying from 0 to more than 5,000 m above sea level. They are divided into three natural regions: coastal, highland and Amazon jungle (Fig.2).

In Peru there are 103 different climate conditions and 17 transitory living areas, which have wide variations in climate conditions, although favorable weather conditions for growing and seed production of several vegetables are present. Also this has been proved due to the fact that Peru has a center of original species of some important vegetables like tomato, potato, squash and hot pepper. If we have technology, we can produce open varieties and F1-hybrid seeds because environmental conditions are good.

Table 1 Production of main vegetables in Peru 1974-1984 period

(kg)

Crop	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Tomato	69954	70469	69467	75478	63088	62359	66701	65274	96374	104842	104302
Hot pepper	14254	13287	14604	11461	10415	11362	13610	14103	14969	16076	16286
Strawberry	2095	3753	3816	3735	3632	3414	2750	2927	2619	3094	2938
Squash	48185	51528	51745	53410	50427	55786	58813	71895	73538	74248	96389
Cabbage	45145	34930	34476	32893	31765	31144	32732	44226	47338	43324	56224
Cauliflower	13145	12460	14548	13062	12718	12557	11873	15733	14760	13402	14311
Celery	6358	8654	10075	8563	9215	9092	8207	12322	9582	9179	9308
Bulb onion	148767	141593	153902	157400	140873	146933	128478	125685	135132	121612	114079
Carrot	28358	36239	38198	27769	24461	29503	52750	57706	63363	50785	48902
Green beans	12898	10573	9248	8606	8537	8565	8330	11264	14604	11679	12763
Snap beans	4542	5084	5410	5176	5111	4827	3979	4643	4690	4938	6359
Melon	8247	8370	9151	8382	8114	6302	5500	5633	4075	5791	8356
Watermelon	36654	29148	29878	34248	34505	35502	36356	36347	35363	39263	46341
P. cucumber	925	2104	1950	1944	1994	2001	1683	2290	2155	2120	2291
Lettuce	24969	23204	24828	13797	14920	14898	21948	28223	29401	28151	28473
Garlic	10369	11284	12729	9163	11786	13181	10884	10334	15011	12922	12316
Asparagus	2723	2715	2745	4171	5465	7079	4427	7574	8292	6941	11392
Radish	2198	4056	4044	3831	3836	3755	3602	4856	7711	8605	9734
Cucumber	3778	4756	5142	4652	3862	3392	3311	3913	5259	5392	5271
Sweet corn	151796	157798	145167	134327	135180	129033	116830	124294	144828	117229	129489
Table beet	2010	2930	2976	2362	2335	2089	3328	4088	4733	4194	5128
Leek	2586	3436	3385	4080	3448	3275	3363	4128	3691	4140	4875
Small Radish	978	1477	1424	1342	1495	1525	877	2408	2256	2142	2575
Caigua	340	530	545	551	522	575	576	768	832	831	2706
Sweet pota.	146197	162064	162546	157663	153251	149269	142395	155297	151075	156713	165683
Cassava	468915	399698	402485	413968	409982	402563	554824	486361	513544	509741	527827
Broad bean	27178	33358	33560	36518	34157	33092	31656	39586	44773	38070	43839
Pallar bean	0.0	8.69	8.97	13.68	22.51	35.26	49.36	126.98	174.71	430.01	815.24

Table 2 Vegetable seed imported by Peru (tons)

Crop	1983	1984	1985
Vegetables	115.260	132.280	91.64
Sorghum	109.696	321.404	93.23
Pasture and forage	33.470	124.766	15.80
Soy bean	250.000	–	–
Flowers	–	–	0.45
Alfalfa	–	–	13.90

Source: Ministry of Agriculture-PERU

Fig.1 Republic of Peru

2. OBJECTIVES

Objectives of this proposal are as follows:

1) To motivate systematic seed production
2) To establish a seed production strategy

3. TOPOGRAPHY AND VEGETATION CHARACTERISTICS IN PERU

The physiography of Peru present a very rough surface. This singular characteristic is basically due to the Andes chain which extends across the whole country. The distinctive features from the coastal desert to the Andes is that Peru has a desert area on the coastal plain, and part of the desert area is used as agricultural land where rivers can supply water. The desert extends about 2,000 km on the coastal plain with a width of 150 km and up to 1,000 m in altitude.

The land of Peru is roughly divided into three zones which are named as follows:

(a) Natural coastal region (Coasta), between 60 and 750m above sea level, about 11.2% of Peruvian territory.
(b) Natural highland region (Sierra), between 800 and 3,600m above sea level. It represents 25.5% of Peruvian territory.
(c) Natural Amazon Jungle region (Selva), between 250 and 1,200m above sea level. It covers about 62.3% of Peruvian territory (Fig. 2).

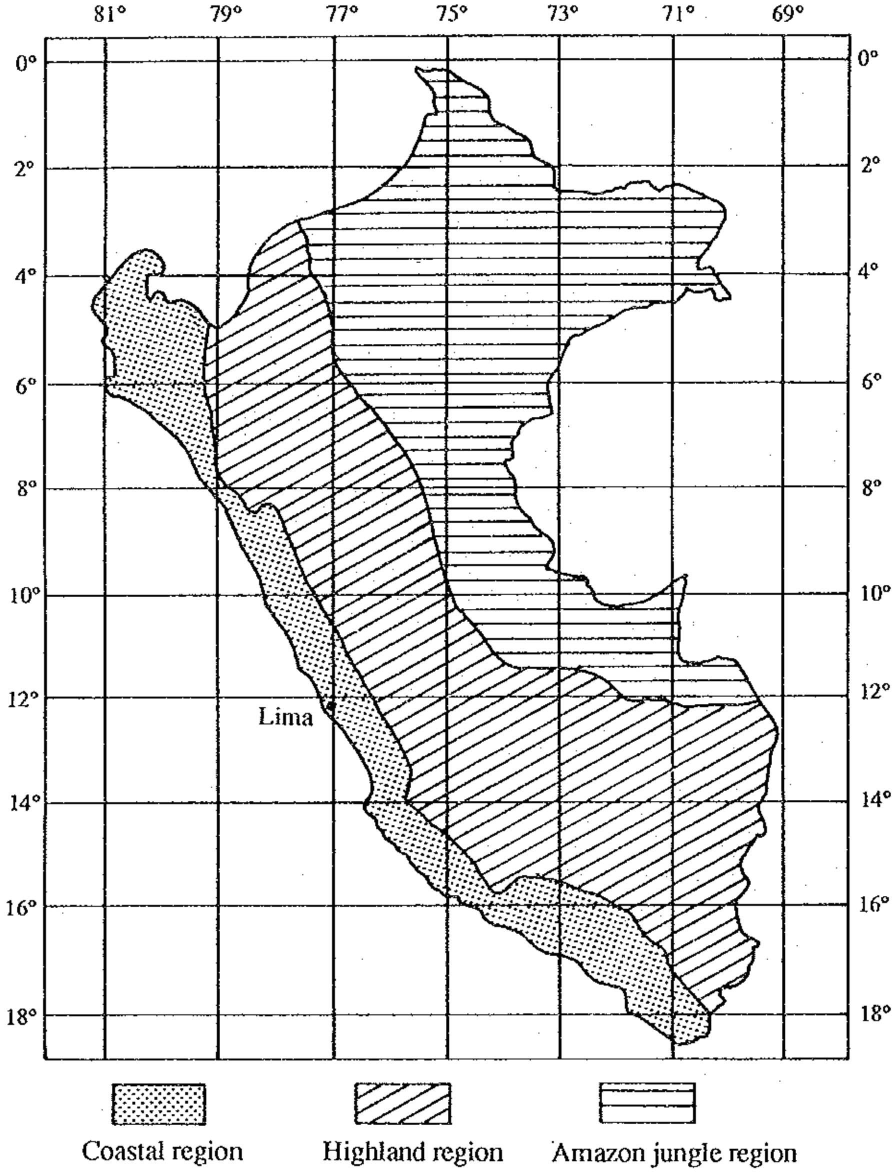


Fig. 2 Natural ecological divisions of Peru

4. ENVIRONMENTAL CONDITIONS IN PERU

(1) Humidity (Rainfall)

Moisture refers to both precipitation (rain and snow) and atmospheric humidity. Rainfall is directly related to the circulation of the atmosphere. Because of topographical variation, a marked difference in rainfall may occur between points relatively close together. This may explain the close proximity of the coastal desert land area, the rainy highlands and the Amazon forest in Peru. A map of average annual precipitation of the world, including Peru, is represented in Fig.3. The effectiveness of precipitation is higher in low temperature and cool areas such as the highlands, which require less rain for plants than the Amazon jungle hot area. The extremes of precipitation result in drought and flood such as in the coastal and Amazon areas in Peru. Irrigation is practiced in the coastal area for horticultural crop production.

(2) Light (Day length)

The quantity of light is an important climate factor and is a significant part of the plant environment. Day length is the most obvious difference between climates. The world distribution of plant species is greatly determined by their photoperiodic response. It is useless to attempt to grow susceptible day length plants for flowering or setting fruits. Peru is located between 0° and 18° south latitude just south of the equator (Fig.2). According to Fig.4, varieties of vegetables actually sown in Peru belong to a short and neutral day, for example onion and tomato varieties respectively.

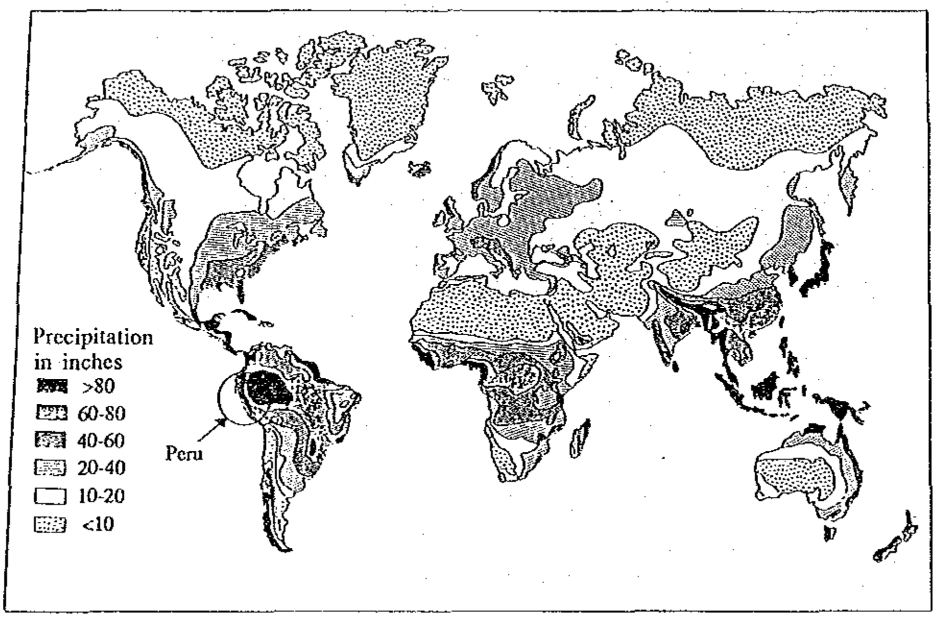


Fig. 3 World average annual precipitation

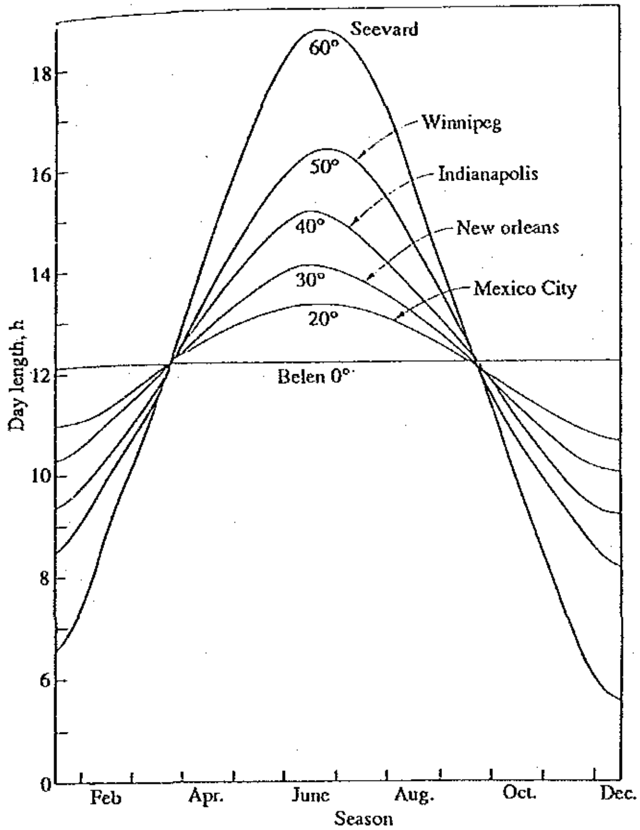


Fig. 4 As latitude increases, the annual variation in day length increases dramatically

(3) Soil

The distribution of the major soil groups can be interpreted through broad climate types based on weathering and vegetation. In world terms Peru is included in sierozems, desert and red desert soil, and also soil of mountains and mountain valleys (Fig.5). In Peru soil types from the coastal area to the Andes can be classified as follows:

(a) Coastal plain and hilly area :

1) calcic yermosols	2) luvic xerosols	3) pellic vertisols
4) eutric regosols	5) orthic solonchacks	6) entric fluvisols
7) lithosols		

(b) Irrigated area : 1) eutric fluvisols 2) gevic solonchaks

(c) Hilly area: eutric, lithosols and regosols

(d) Rudimentary plain :

1) vitric andosols 2) calcic thermosols 3) entric regosols

(e) Occidental flank of Andes :

Lithosols and lithic formation

The Amazon jungle is located on the lower east side of Peru on underdeveloped territory with pleistocene soil types, which is composed of kaolinitic clay and quartz sand. It has the soil types of acrisols, humic podosols and dystric gyeisols, which have a small cation exchange capacity and a base saturation of lower than 35 percent.

(4) Climate

There are various of ways of classifying climatic regions. We are all familiar with the climatic classification by temperature into tropical, temperate and polar zones, using precipitation effectiveness and temperature efficiency. Thornthwaite has divided climate into regions associated with a characteristic vegetation (for example grassland, forestal and rainforest). Peru's climate presents a wide variation of climate types into world classification (Fig.6). Around 103 climates and 17 transitory living areas are present in Peru.

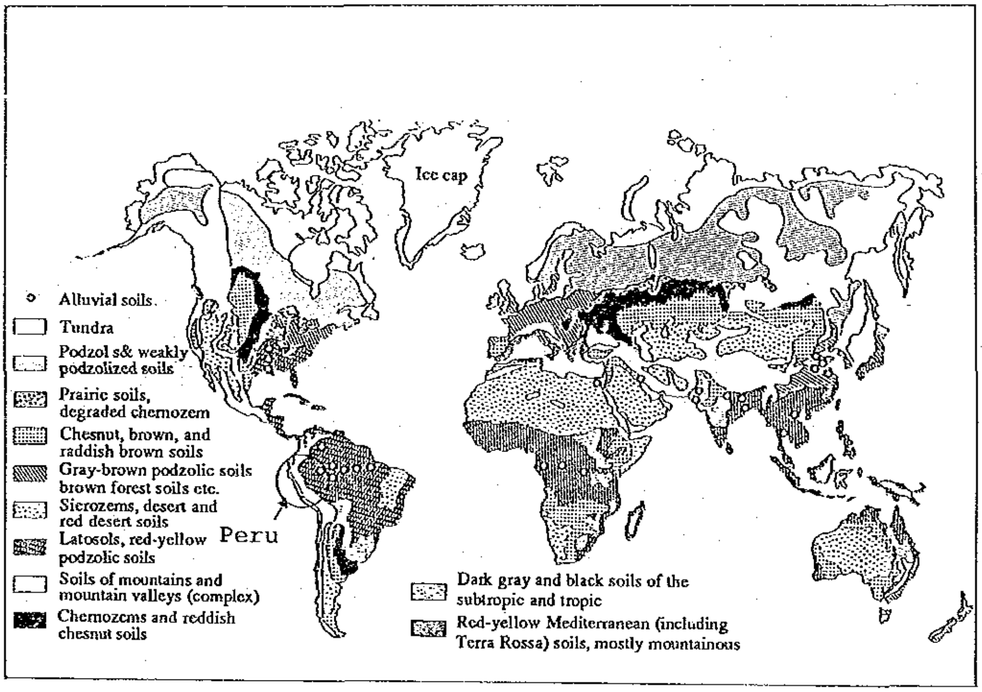


Fig. 5 The major soil groups of the world

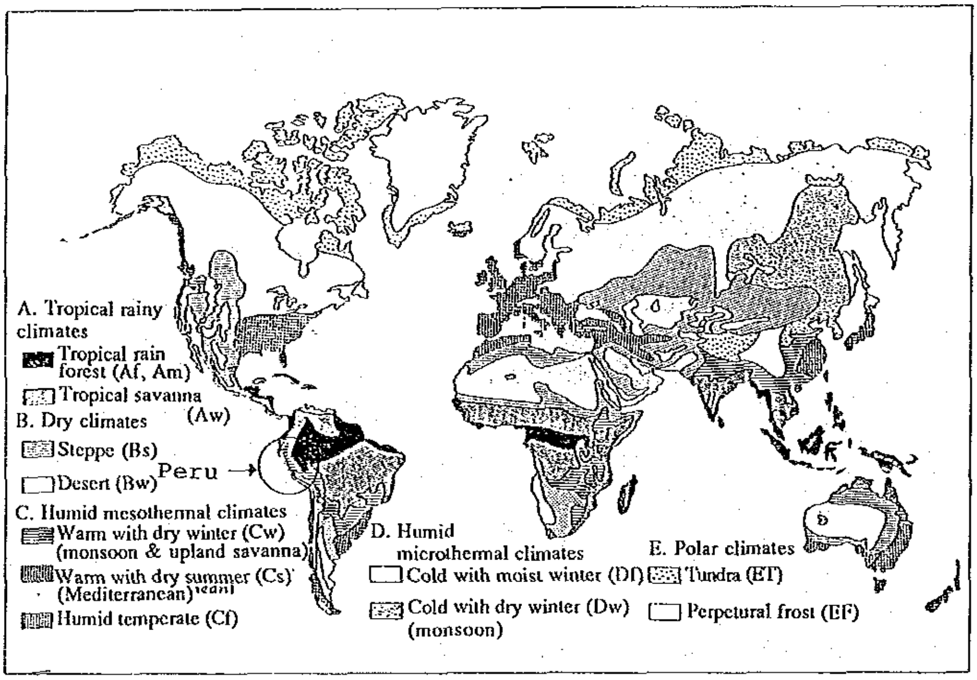


Fig. 6 World climates

(5) Vegetable Ecology in Peru

The effect of climate upon quality and appearance pays an important role in the natural location of the vegetables in Peru. Climatic environment determines the type of vegetable plant development. For example, vegetables which require lower temperatures for growing, flowering and fruit setting are located in the highlands. Sowing time starts at the beginning of rainfall from July to November, and during the first development stage, vegetable growth is under low winter temperature (Fig. 7) in the case of carrot, lettuce, onion, broad beans, and sweet corn.

While those vegetables that need a temperate climate are in coastal regions such as tomato, squash, melon, hot pepper, cucumber, some adapted varieties of common cabbage and radish, their growing, flowering and fruit setting are very good; sowing time starts at the beginning of the mild temperature condition (Fig.8) and harvesting is during the warm temperature condition from December to January.

Excessive rainfall and very hot temperatures in the Amazon jungle region makes it not possible to sow vegetables on a large scale at this moment (Fig.9).

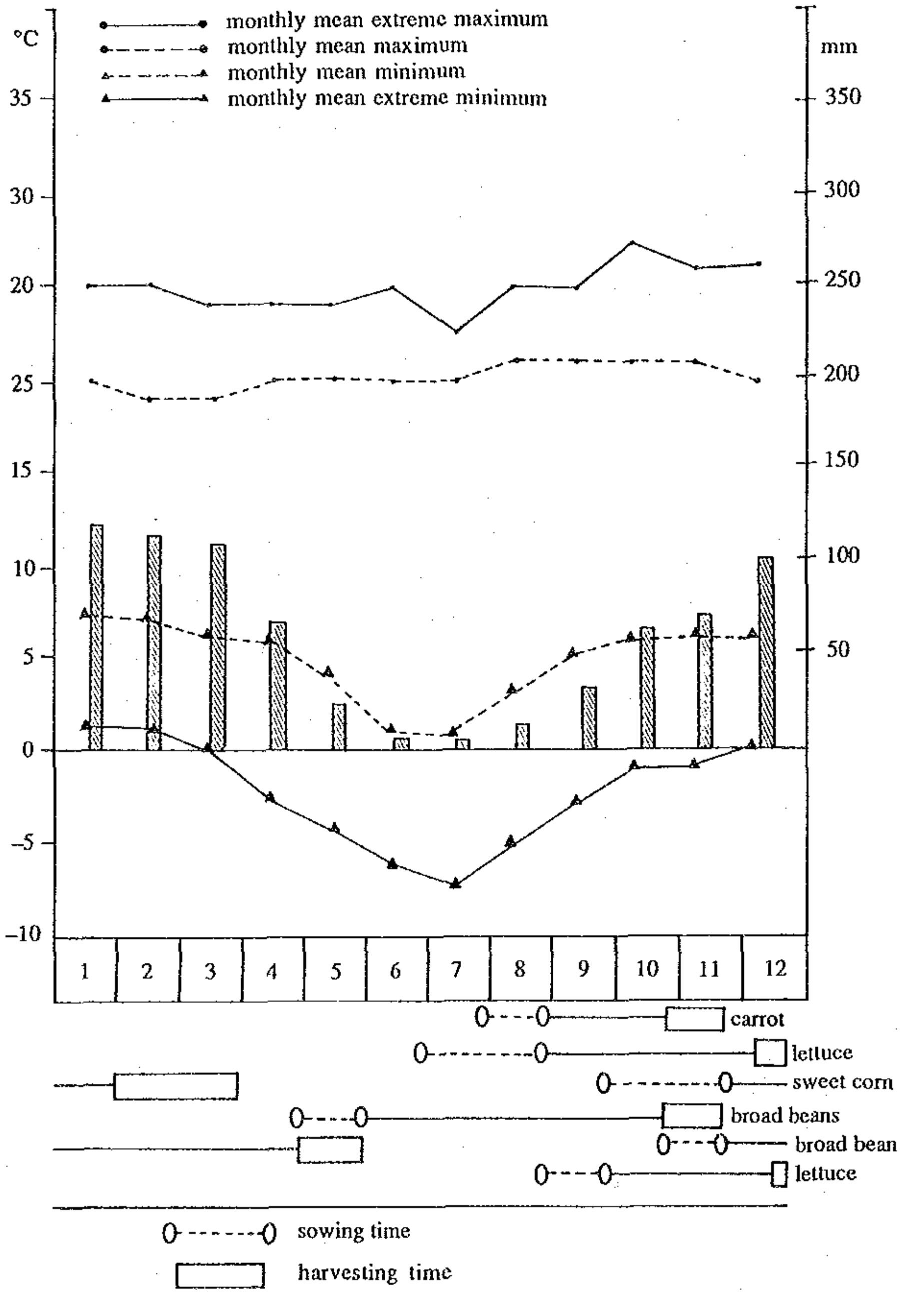


Fig. 7 Precipitation and temperature variations in the Highland Region in relation to vegetable cultivation

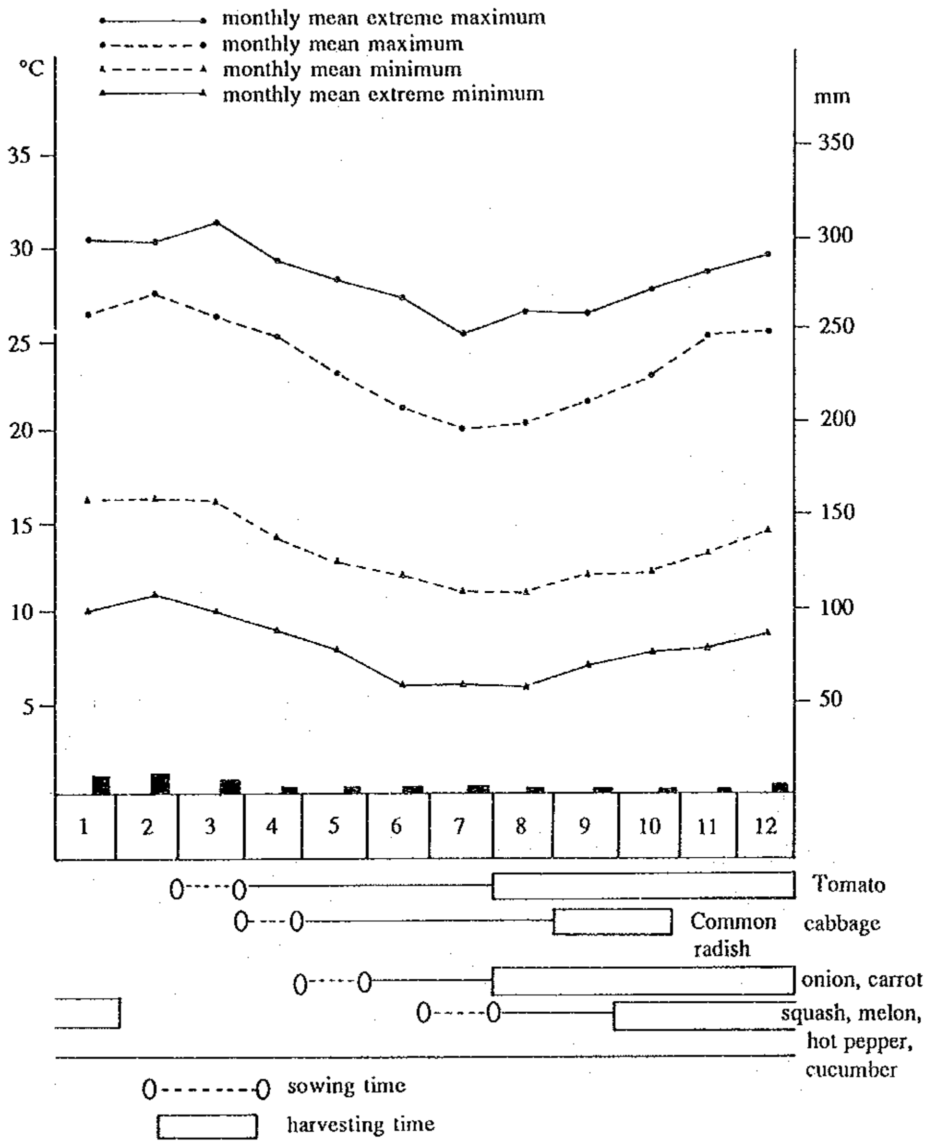


Fig. 8 Precipitation and temperature variations in the Coastal Region in relation to vegetable cultivation

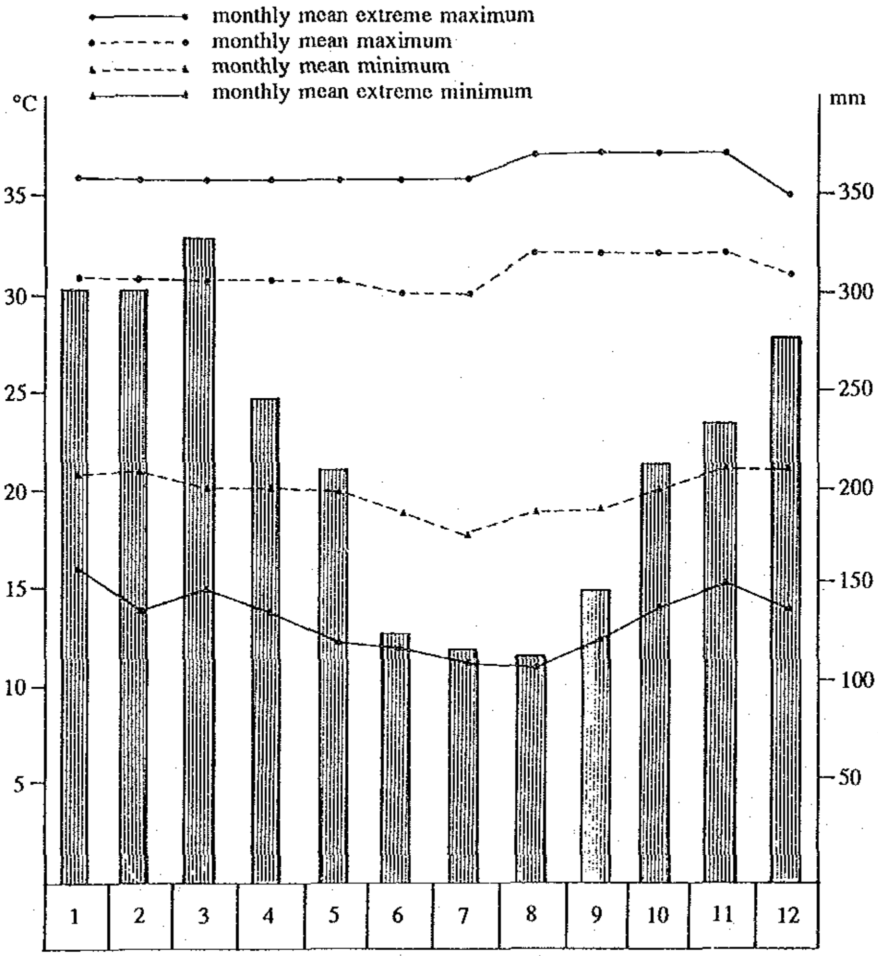


Fig. 9 Precipitation and temperature variations in the Amazon jungle region

5. SEED PRODUCTION STRATEGY IN PERU

According to analysis of environmental conditions, Peru presents extensive appropriate areas for seed production of vegetables, and some measures are needed to promote them, such as follows:

1) To determinate adequate climatic areas for commercial seed production.
2) Developing cultivars with wide adaptation to optimal weather conditions and technology for seed production.
3) Training for private growers in seed production.
4) Establishing seed production systems with participation of research institutes, private growers and seed production companies, and the Ministry of Agriculture.

(1) Adequate Climatic Areas for Seed Production

As mentioned above, Peru presents three different geographic and climate regions. The monthly mean temperature in the coastal region ranges from 12°C to 24°C, with an insignificant amount of rainfall throughout the year. Month of lower temperatures are from May to August and more light hours occur during the October-February period. This region presents optimal weather conditions for seed production of tomato, hot pepper, squash, cucumber, sweet melon, watermelon, lettuce and radish, specially in the Huaral valley (Fig.10), where flowering and setting of fruits must be produced for good quality of seeds.

On the other hand, highland region temperatures are lower than in the coastal region, ranging from nearly-10°C to 20°C, and frequently frost occurs. Low winter temperatures and lowest precipitation occur during some month of the year, which are adequate for seed production of over-winter and green plants such as onion, carrot and some other cruciferous plants. Arequipa (Fig.11) and Huancayo (Fig. 12) valleys present adequate weather conditions for seed production of onion and carrot respectively. Commercial seed production patterns of onion and carrot are shown in Fig.11 and 12.

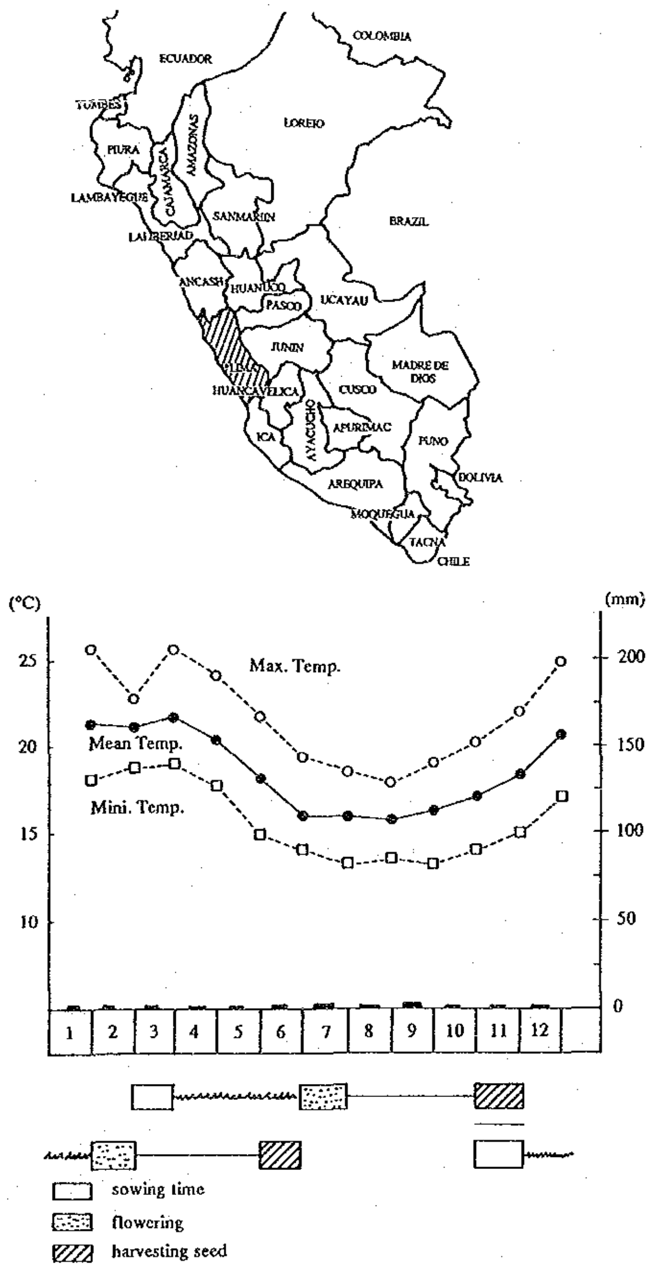


Fig. 10 Precipitation and temperature variations in the Huaral Valley (Experimental Station, Peru, 1986-1988) according to seed production patterns of tomato

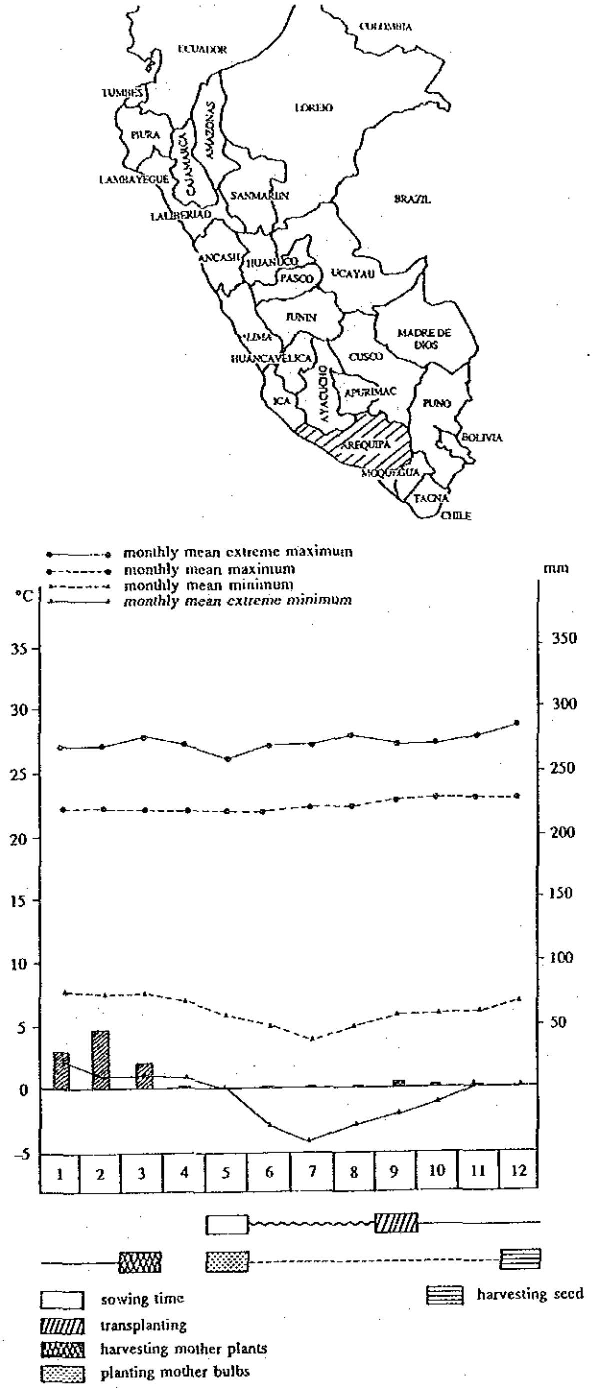


Fig. 11 Precipitation and temperature variations in the Arequipa valley according to seed production patterns of onion

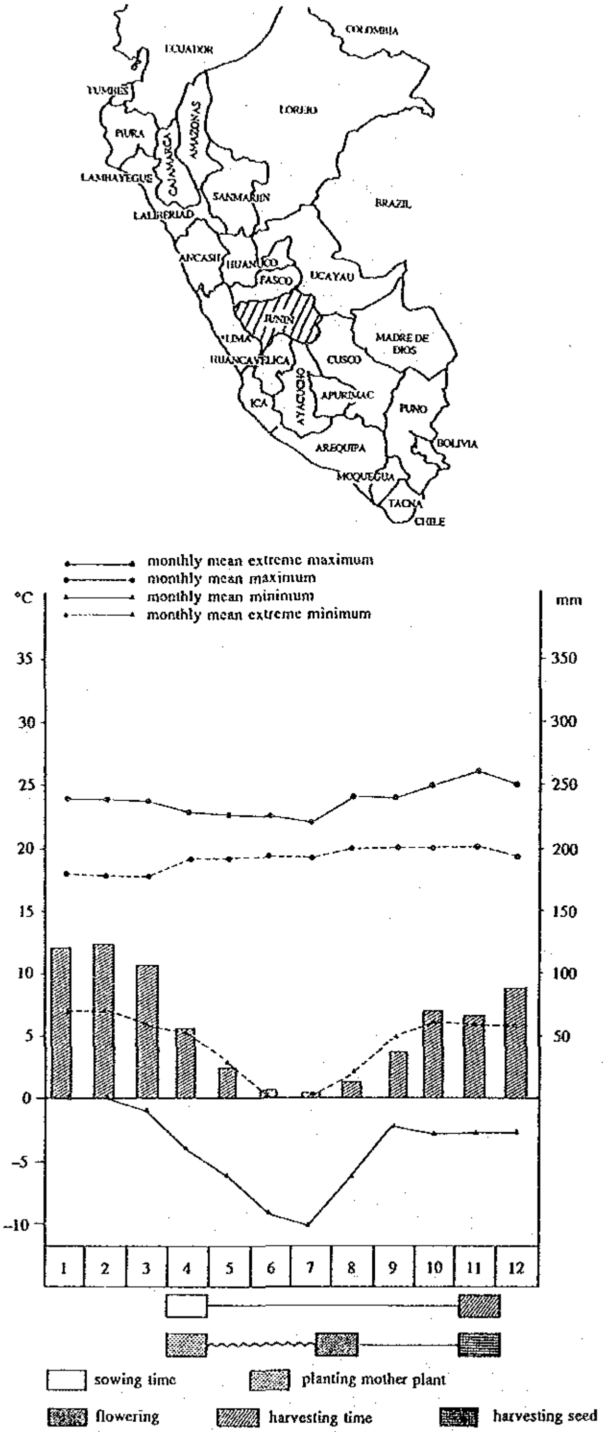


Fig. 12 Precipitation and temperature variations in the Huancayo valley according to seed production patterns of carrot and some another cruciferous vegetables

(2) Developing Cultivates and Technology for Seed Production

At present all varieties of vegetables which are originated in Peru show narrow ecological adaptation and low yields of production with bad quality of fruits mainly because of susceptibility to diseases such as viruses, soil pathogens and foliage diseases. New technology of plant breeding by using self-incompatibility, male sterility and vigour hybrid should be carried out in advance. In the near future, development of F1-Hybrid must be the main goal in plant breeding.

Seed production technologies such as:

(a) Soil bed preparation and fertilization for raising seedlings.

(b) Studies on forcing, semi-forcing, tunnel culture and mulch cover for seed production of crops which require hot temperatures for germination, flowering and fruit setting, such as cucumber, hot pepper, melon, watermelon and tomato, that permit production of seeds around the year.

(c) Studies on low temperature for bolting and flowering of over-winter and green plants such as onion, carrot, common cabbage, etc.

(d) Management technologies of crops in the open field for seed production including:

1) Soil preparation
2) Fertilization
3) Seedling stage to planting
4) Emasculation and pollination methods
5) Training and pruning methods
6) Harvesting time and methods of extracting seeds
7) Methods of drying and storing seeds
8) Studies of post-harvesting
9) Storing period effect
10) Studies on storage materials and apparatus under different weather conditions.

(3) Training for Private Growers in Seed Production

Technologies developed in breeding stations should immediately be transferred to private growers, in terms of both practices and basic knowledge about important points of seed production, involving for example:

1) Crop management
2) Emasculation and pollination methods
3) Training and pruning methods
4) Harvesting time and seed extraction methods
5) Seed drying
6) Seed selection and storage.

Finally, the organization of private growers associations and cooperatives on seed production must be carried out in the future.

(4) Establishing Seed Production Systems

Seeds, which have the character of public amenities, need to be produced by well-experienced farmers and they need to suit public tastes. Therefore, the responsibility for seed production in vegetables should be entrusted to decentralized public government. Furthermore, the central government shares responsibility with private seed production companies and is obliged to subsidize the decentralized government for seed production under the vegetable crop seed law. Figure 13 and 14 present the patterns of production, distribution and marketing systems for seed production in Peru, including private and non-private seed companies. These patterns should be reviewed by Peruvian public government personnel.

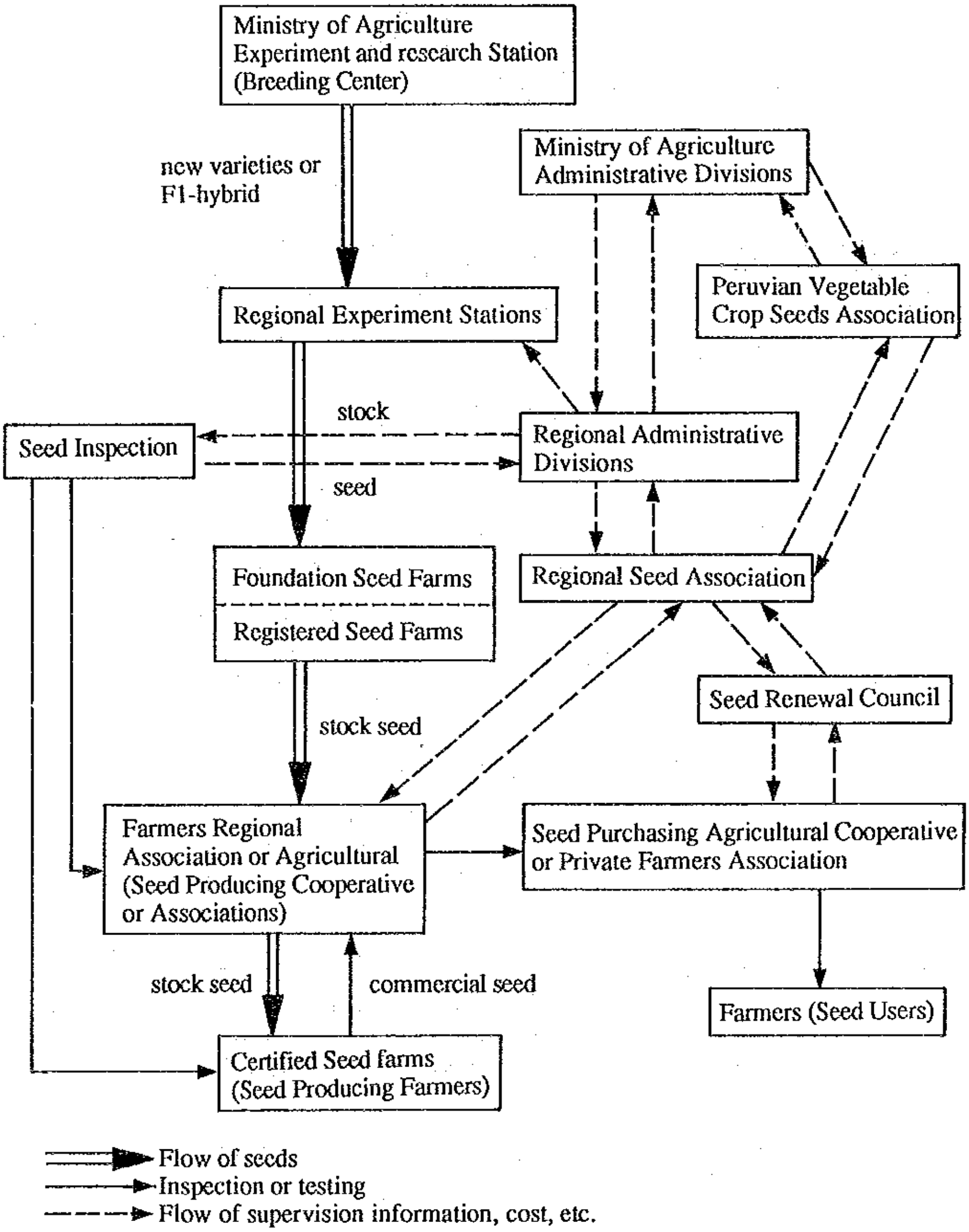


Fig.13 Production and distribution system patterns for vegetables not including private seed companies

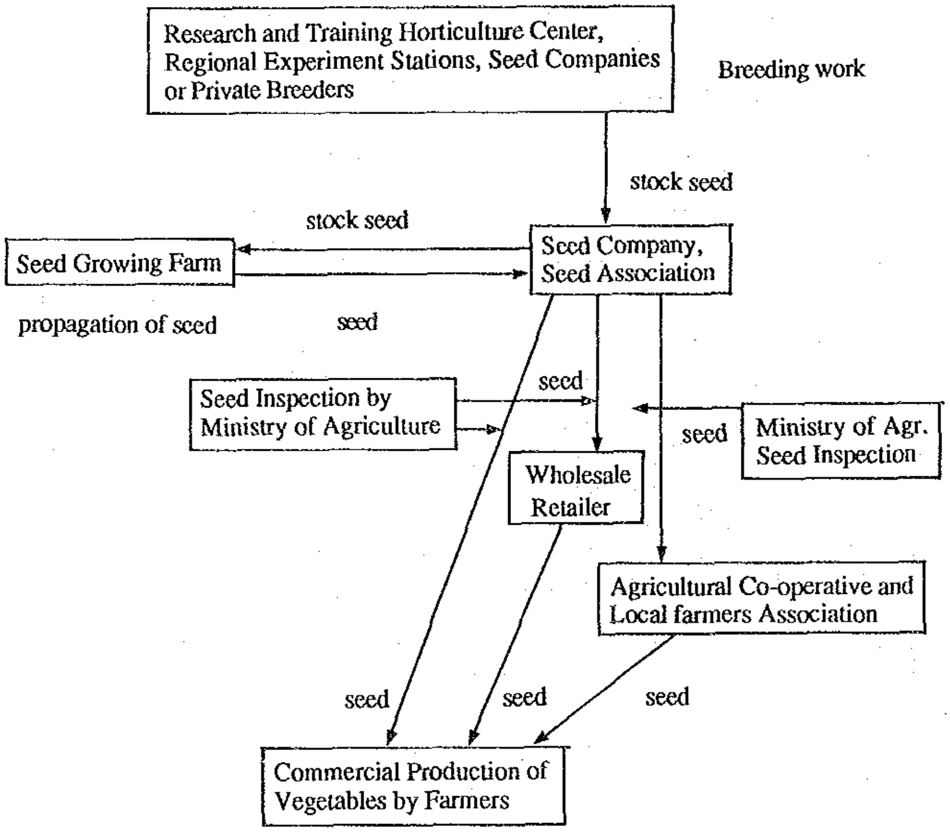


Fig. 14 Production, distribution and marketing systems patterns for vegetables seeds, including private seed companies

REFERENCES

Gordon H.R. and Barden J.A. 1979. Horticulture, p.697. McGraw-Hill Book Company.

Dale J. 1984. Plant physiology in relation to horticulture, p.138. Horticultural Society and Horticultural Education Association. MacMillan, London.

Otarola S.R. 1989. Peru. Country Report.

Nunez CH. G. 1989. Actual situation and principal limiting factors of melon and watermelon cultivation in Peru. Country Report.

Salazar N.G. 1988. Vegetable production and vegetable seed production in Peru. Country Report. TIATC.

Shinohara S. 1984. Vegetable seed technology of Japan elucidated with respective variety development, histories, particulars. Vol. I. Tokyo.

ANNEX : TABLES

Climatic table for Chiclayo, Peru

Latitude 06°47'S, longitude 79°50'W, elevation 31m

Month	Mean sta. press (mbr)	Temperature (°C) mean max.	Temperature (°C) mean min.	Temperature (°C) extreme max.	Temperature (°C) extreme min.	Mean relat. humid (%)	Precipitation mean (mm)	Precipitation max. (mm)	Precipitation min. (mm)	Precipitation max. in 24h (mm)	Wind aver. speed (knots)	Wind preval direct.
Jan.	1010.5	28	19	34	13	73	10.3	105.4	–	105.4	11	S
Feb.	1010.2	30	20	35	15	73	2.3	17.0	–	5.4	10	S
Mar.	1010.2	30	20	34	15	73	7.8	70.0	–	70.0	10	S
Apr.	1010.9	28	19	33	15	75	2.8	11.9	–	4.2	11	S
May	1011.8	27	17	32	13	75	0.2	2.0	–	1.6	11	S
June	1013.0	25	16	31	13	76	–	–	–	–	10	S
July	1013.1	24	15	29	12	80	0.1	1.2	–	1.2	10	S
Aug.	1013.2	23	15	29	10	80	–	–	–	–	11	S
Sept.	1013.0	24	15	29	12	79	0.4	4.0	–	1.0	11	S
Oct.	1012.6	24	15	33	10	79	1.1	6.0	–	3.0	12	S
Nov.	1012.6	25	16	29	13	77	4.0	26.0	–	23.0	11	S
Doc.	1011.7	27	17	33	14	76	1.5	18.0	–	18.0	12	S
Annual	1011.9	26	17	35	10	76	30.5	115.9	0.4	105.4	11	S
Rec[1] (yrs)	10•	16	16	16	16	16	16	16	16	10•	16	16

[1] 1954 - 1969
• 1960 - 1969

Climatic table for Lima airport, Peru

Latitude 12°00'S, longitude 77°07'W, elevation 11m

Month	Mean sta. press (mbr)	Temperature (°C) mean max.	Temperature (°C) mean min.	Temperature (°C) mean daily[3]	Temperature (°C) extreme max.	Temperature (°C) extreme min.	Mean relat. humid (%)	Precipitation mean (mm)	Precipitation max. (mm)	Precipitation min. (mm)	Precipitation max. in 24h (mm)	Wind aver. speed (knots)	Wind preval direct.
Jan.	1011.5	26	19	21.5	31	15	83	1.2	10.5	–	8.2	7	S
Feb.	1011.0	26	19	22.3	30	15	83	0.4	2.4	–	1.2	6	S
Mar.	1011.2	26	19	21.9	29	15	84	0.6	3.4	–	1.9	6	S
Apr.	1012.1	24	17	20.1	28	11	85	0.1	0.5	–	0.5	6	S
May	1013.2	22	16	17.8	27	10	86	0.5	1.7	–	0.9	5	S
June	1014.4	19	15	16.0	25	8	85	0.8	3.0	–	1.3	4	S
July	1014.5	18	14	15.3	23	9	85	2.0	8.1	–	5.0	5	S
Aug.	1014.5	18	14	15.1	23	10	87	2.3	9.6	0.9	3.3	6	S
Sept.	1014.2	19	14	15.4	22	12	87	1.2	3.7	–	0.7	6	S
Oct.	1014.0	20	15	16.3	23	13	85	0.4	1.4	–	0.9	6	S
Nov.	1013.8	22	16	17.7	27	10	83	0.4	1.5	–	1.5	7	S
Doc.	1012.5	24	17	19.4	28	13	83	0.4	1.5	–	1.5	7	S
Annual	1013.1	22	16	18.2	31	8	85	10.0	20.4	3.0	8.2	6	S
Rec[2] (yrs)	10	10	10	30	10	10	10	10	10	10	10	10	10

[2] 1961 - 1970
[3] 1931 - 1960

Climatic table for San Juan, Peru

Latitude 15°22'S, longitude 75°12'W, elevation 30m

Month	Mean sta. press (mbr)	Temperature (°C) mean max.	mean min.	extreme max.	extreme min.	Mean relat. humid (%)	Precipitation mean (mm)	max. (mm)	min. (mm)	Wind aver. speed (knots)	preval direct.
Jan.	1010.9	26	18	29	13	77	0.3	1.9	–	10	S
Feb.	1010.3	27	19	29	15	76	0.3	4.0	–	10	S
Mar.	1010.6	26	18	29	15	75	0.1	0.8	–	10	S
Apr.	1011.6	25	17	28	13	75	0.3	4.2	–	10	S
May	1012.8	22	16	26	12	76	0.1	1.5	–	11	S
June	1014.2	20	14	23	11	78	1.3	11.3	–	11	S
July	1014.5	18	13	22	10	78	0.3	1.9	–	11	S
Aug.	1014.5	18	13	21	8	79	0.7	6.5	–	12	S
Sept.	1014.0	19	13	22	11	79	1.6	6.8	–	12	S
Oct.	1013.7	20	14	23	11	79	1.5	10.1	–	12	S
Nov.	1013.2	22	15	25	10	78	0.9	4.5	–	11	S
Doc.	1011.8	24	17	27	12	78	0.4	1.3	–	10	S
Annual	1012.7	22	16	29	8	77	7.8	31.6	0.1	11	S
Rec[1] (yr)	12•	14	14	14	12•	14	14	14	14	14	14

[1] 1957-1970
• 1959-1970

Climatic table for Arequipa, Peru

Latitude 16°19'S, longitude 71°33'W, elevation 2,525m

Month	Mean sta. press[2] (mbr)		Temperature (°C) mean daily[3]	mean max.	mean min.	extreme max.	extreme min.	Mean relat. humid (%)	Precipitation mean[3] (mm)	max. (mm)	min. (mm)	max. in 24h (mm)	Wind aver. speed (knots)	preval direct.
Jan.	788.2	(761.3)	13.9	22	8	27	2	57	31 (30)	150	–	27	8	W
Feb.	788.0	(762.1)	13.9	22	8	27	1	63	48 (46)	173	1	59	7	W
Mar.	788.2	(762.1)	13.5	22	8	28	1	59	19 (15)	184	–	44	7	W
Apr.	788.5	(762.5)	14.1	22	7	27	1	48	– (4)	6	–	5	7	W
May	788.9	(762.9)	13.8	22	6	26	0	37	– (1)	3	–	3	8	W
June	788.8	(762.9)	13.2	22	5	27	-3	29	– (0)	1	–	1	9	W
July	788.6	(762.9)	13.1	22	4	27	-4	27	– (1)	–	–	–	9	W
Aug.	788.6	(762.9)	13.8	22	5	28	-3	26	– (0)	–	–	–	9	W
Sept.	788.7	(762.6)	14.4	23	6	27	-2	29	1 (0)	9	–	6	8	W
Oct.	788.6	(762.1)	13.6	23	6	27	-1	30	– (1)	3	–	2	8	W
Nov.	788.4	(761.9)	13.9	23	6	28	0	34	1 (1)	8	–	5	7	W
Dec.	788.3	(761.8)	14.1	23	7	29	0	44	4 (9)	19	–	13	8	W
Annual	788.5	(762.3)	13.8	22	6	29	-4	40	104 (108)	466	13	59	8	W
Rec[4] (yr)	21	(4)	33	21	21	21	21	21	21 (37)	21	21	21	21	21

[1] Values between brackets given by KNOCH (1930) for Arequipa (16°22'S 71°36'W, elevation 2,451m). Period 1892-1895.
[2] Given by KNOCH, 1930 . Period 1888-1920.
[3] See footnote 1. Period 1888-1924.
[4] 1950-1970

Climatic table for Tacna, Peru

Latitude 18°04'S, longitude 70°18'W, elevation 558m

Month	Mean	Temperature (°C)				Mean	Precipitation				Wind	
	sta.	mean		extreme		relat.	mean	max.	min.	max.	aver.	preval
	press (mbr)	max.	min.	max.	min.	humid (%)	(mm)	(mm)	(mm)	in 24h (mm)	speed (knots)	direct.
Jan.	1013.3	27	16	31	9	65	0.5	4.0	–	4.0	5	S
Feb.	1012.9	28	16	31	7	65	0.8	16.0	–	6.0	5	SW
Mar.	1013.2	27	15	33	6	66	0.3	7.0	–	5.0	5	SW
Apr.	1014.5	25	12	30	4	70	0.8	12.3	–	3.0	5	S
May	1015.7	22	10	29	3	76	2.8	27.0	–	8.0	5	SW
June	1016.9	20	9	28	2	79	3.6	30.0	–	5.0	4	SW
July	1017.3	19	8	25	2	78	5.3	32.0	–	6.0	4	SW
Aug.	1017.3	20	9	28	4	78	8.5	41.0	–	8.0	4	SW
Sept.	1016.8	21	10	29	1	77	14.0	40.0	–	11.0	4	SW
Oct.	1016.1	22	11	27	5	74	5.2	39.5	–	6.5	5	SW
Nov.	1015.3	24	13	32	6	70	0.9	12.6	–	5.0	5	S
Doc.	1014.1	26	14	30	7	67	1.0	7.8	–	5.0	5	S
Annual	1015.3	23	12	33	1	72	43.7	114.1	–	11.0	5	SW
Rec[1] (yrs)	14*	19	20	20	20	20	21	21	21	21	20	20

[1] 1950-1970
* 1957-1970

Climatic table for Cajamarca, Peru

Latitude 07°08'S, longitude 78°28'W, elevation 2,621m

Month	Mean	Temperature (°C)				Mean	Precipitation				Wind	
	sta.	mean		extreme		relat.	mean	max.	min.	max.	aver.	preval
	press (mbr)	max.	min.	max.	min.	humid (%)	(mm)	(mm)	(mm)	in 24h (mm)	speed (knots)	direct.
Jan.	777.6	22	8	26	0	67	89	165	33	31	3	S
Feb.	77.6	21	7	27	0	67	89	183	4	51	3	S
Mar.	778.0	21	7	25	0	72	114	235	16	41	3	S
Apr.	778.5	21	7	25	0	69	96	212	15	38	3	S
May	778.6	22	5	25	0	64	32	72	1	26	3	S
June	778.9	22	3	26	0	58	8	25	–	12	5	N
July	778.9	22	3	25	0	55	5	26	–	13	6	NE
Aug.	778.6	22	4	26	0	55	11	44	–	10	6	E
Sept.	778.2	22	5	26	0	57	25	65	3	18	5	E
Oct.	778.0	22	7	29	1	64	85	126	23	29	4	SE
Nov.	777.8	22	6	25	0	64	79	143	20	40	3	S
Doc.	77.6	22	6	25	0	64	79	143	20	40	3	S
Annual	778.2	22	6	29	0	63	716	924	441	51	4	S
Rec[1] (yrs)	8*	12	12	12	12	12	12	12	12	12	12	12

[1] 1959-1970
* Dec '62-Oct. '70

Climatic table for Huancayo, Peru

Latitude 12°07'S, longitude 75°20'W, elevation 3,380m

Month	Mean sta. press (mbr)	Temperature (°C) mean max.	Temperature (°C) mean min.	Temperature (°C) extreme max.	Temperature (°C) extreme min.	Mean relat. humid (%)	Precipitation mean (mm)	Precipitation max. (mm)	Precipitation min. (mm)	Precipitation >0.1 mm (days)	Precipitation max. in 24h (mm)	Mean daily cloudiness (oktas)	Mean monthly sunshine (h)
Jan.	687.2	18	7	24	0	73	119	200	52	22	43	6	177
Feb.	687.6	18	7	24	0	78	123	203	43	22	46	7	152
Mar.	688.0	18	6	24	-1	77	107	185	39	21	54	7	173
Apr.	688.5	19	5	23	-4	72	55	94	23	13	29	6	195
May	689.0	19	3	23	-6	65	25	63	1	7	34	4	228
June	689.2	19	0	23	-9	57	8	35		3	19	3	254
July	689.0	19	0	22	-10	56	8	23	–	3	19	3	258
Aug.	688.9	20	5	24	-2	61	40	95	19	11	37	5	197
Sept.	688.5	20	5	25	-2	61	40	95	19	11	37	5	197
Oct.	687.8	20	6	25	-3	64	69	125	26	14	38	5	205
Nov.	687.3	20	6	26	-3	62	67	115	33	14	37	6	207
Doc.	687.0	19	6	25	-3	68	89	144	19	18	39	6	204
Annual	688.2	19	4	26	-10	66	724	902	575	153	54	5	2,488
Rec[1] (yrs)	20	20	20	38•	38•	20	20	20	20	20	36••	20	16•••

[1] 1948-1951 and 1955-1970
• 1930-1951 and 1955-1970
•• 1931-1933, 1935-1951 and 1955-1970
••• 1955-1970

Climatic table for Cuzco, Peru

Latitude 13°33'S, longitude 71°59'W, elevation 3,312m

Month	Mean sta. press (mbr)	Temperature (°C) mean max.	Temperature (°C) mean min.	Temperature (°C) extreme max.	Temperature (°C) extreme min.	Mean relat. humid (%)	Precipitation mean (mm)	Precipitation max. (mm)	Precipitation min. (mm)	Precipitation max. in 24h (mm)	Wind aver. speed (knots)	Wind preval direct.
Jan.	706.8	19	7	25	1	64	151	253	57	38	5	NW
Feb.	706.9	19	7	24	2	66	139	196	69	43	5	E
Mar.	707.3	19	6	24	1	65	106	165	37	47	5	NE
Apr.	707.7	19	5	24	1	61	39	82	10	20	4	NW
May	708.5	19	3	23	-3	55	12	27	–	14	4	W
June	708.6	19	1	25	-4	48	2	15	–	8	5	NW
July	708.6	19	1	23	-4	47	5	42	–	38	6	NW
Aug.	708.4	20	2	25	-4	46	6	24	–	11	7	W
Sept.	707.8	20	5	26	-3	51	27	48	10	22	7	NE
Oct.	706.9	21	6	26	0	51	52	84	22	26	7	NE
Nov.	706.5	21	6	27	-1	52	77	183	32	37	6	W
Doc.	706.5	20	7	27	3	59	134	254	40	47	6	W
Annual	707.5	20	5	27	-4	55	750	982	390	47	6	NE
Rec[1] (yrs)	17	17	17	17	17	17	17	17	17	17	17	17

[1] 1954-1970

Climatic table for Iquitos, Peru

Latitude 03°46'S, longitude 73°20'W, elevation 104m

Month	Mean sta. press (mbr)	Temperature (°C) mean max.	Temperature (°C) mean min.	Temperature (°C) extreme max.	Temperature (°C) extreme min.	Mean relat. humid (%)	Precipitation mean (mm)	Precipitation max. (mm)	Precipitation min. (mm)	Precipitation max. in 24h (mm)	Wind aver. speed (knots)	Wind preval direct.
Jan.	1010.4	32	22	36	17	80	256	361	109	160	2	NE
Feb.	1010.6	31	22	36	15	81	276	719	63	144	2	NE
Mar.	1011.0	31	22	36	17	82	349	1,069	90	201	2	NE
Apr.	1011.8	31	22	36	18	84	306	553	176	135	2	NE
May	1012.7	31	21	36	16	83	271	620	153	192	2	S
June	1013.8	31	21	36	15	82	199	838	61	198	2	S
July	1014.4	30	20	35	14	81	165	345	25	90	2	S
Aug.	1013.3	32	21	37	11	79	157	656	34	247	2	S
Sept.	1012.3	32	21	37	15	78	191	336	51	114	2	NE
Oct.	1011.2	32	21	37	18	79	214	410	99	105	2	NE
Nov.	1010.0	32	22	37	18	80	244	620	75	201	3	NE
Dec.	1009.0	32	22	36	16	80	217	439	86	150	2	N
Annual	1011.8	31	21	37	11	81	2,845	5,621	2,259	247	2	NE
Rec[1] (yrs)	22	22•	22••	22•	22••	22	22	22	22	22	22	22

[1] 1949-1970
• Excluding January 1949
•• Excluding year 1949

Climatic table for Tingo Maria, Peru

Latitude 09°08'S, longitude 75°57'W, elevation 665m

Month	Temperature (°C) mean max.	Temperature (°C) mean min.	Temperature (°C) extreme max.	Temperature (°C) extreme min.	Mean relat. humid (%)	Precipitation mean (mm)	Precipitation max. (mm)	Precipitation min. (mm)	Wind aver. speed (knots)	Wind preval direct.
Jan.	30	19	36	15	81	394	796	229	1	N
Feb.	30	19	35	13	81	359	585	126	1	N
Mar.	30	19	35	13	81	353	618	47	2	N
Apr.	31	19	36	13	80	319	579	63	1	N
May	31	19	35	14	78	238	419	26	2	N
June	31	18	34	12	79	119	252	5	2	N
July	31	18	34	10	78	132	240	–	2	N
Aug.	31	18	36	11	76	125	278	47	2	N
Sept.	31	18	36	12	77	158	308	71	2	N
Oct.	31	18	37	10	79	280	455	130	2	N
Nov.	31	19	36	13	78	278	422	169	2	N
Dec.	31	19	35	12	80	317	550	137	2	N
Annual	31	19	37	10	79	3,072	3,860	1,994	2	N
Rec[1] (yrs)	14•	16	14•	16	16	16	16	16	16	16

[1] 1954-1969
• July '54-June '59; 1961-1969

Climatic table for Puerto Maldonado, Peru

Latitude 12°38'S, longitude 69°12'W, elevation 256m

Month	Temperature (°C)				Mean relat. humid (%)	Precipitation			Wind	
	mean		extreme			mean	max.	min.	aver. speed	preval direct.
	max.	min.	max.	min.		(mm)	(mm)	(mm)	(knots)	
Jan.	31	21	36	15	80	262	372	160	5	N
Feb.	31	21	36	14	81	271	488	184	5	N
Mar.	31	20	36	15	80	289	494	177	4	N
Apr.	31	20	36	77	118	395	33	5	E	N
May	31	19	37	7	76	119	420	20	4	E
June	29	17	39	10	76	54	187	4	4	E
July	30	16	38	10	72	55	99	6	4	E
Aug.	32	18	38	10	67	53	131	4	5	N
Sept.	33	19	38	14	72	140	201	74	5	N
Oct.	32	20	38	14	72	140	201	74	5	N
Nov.	32	21	38	14	74	173	267	89	5	N
Dec.	31	21	35	14	78	296	491	105	5	N
Annual	31	19	39	7	75	1,927	2,541	1,433	5	N
Rec[1] (yrs)	9	9	12•	12•	9	9	9	9	9	9

[1] 1961-1969
• 1958-1969

Acreage and yield of main vegetables of Japan in comparison with Peru.

Vegetable	Planted Area (ha)		Yield (Ton/ha)	
	Japan	Peru	Japan	Peru
Tomato	17,000	5,722	52.4	15.4
Cucumber	24,900	186	43.0	11.2
Water Melon	29,700	2,678	31.4	14.4
Squash	17,900	5,204	15.6	14.3
Cabbage	42,800	3,535	38.0	12.6
Lettuce	19,800	2,764	22.0	9.9
Welsh Onion	23,700	372	22.0	10.9
Radish	69,900	509	38.8	13.5
Carrot	24,400	4,036	25.7	13.6
Bulb Onion	29,400	6,570	42.8	19.0
Cauliflower	6,780	1,153	16.1	12.1
Celery	1,030	729	48.5	13.3
Strawberry	11,000	317	18.0	10.8
Melon	15,200	545	21.7	10.7

Varieties of vegetable imported from abroad and sown in Peru

Crop	Variety	Import source
Tomato	Rio Grande	U.S.A
	Rio Fuego	ditto
	Earlystone	ditto
Cucumber	Market More	ditto
Water Melon	Piacok improved	ditto
Melon	Alis Vees Jumbo	ditto
	Janejiu	ditto
	Esmeralda	ditto
Sweet Pepper	California Wando	ditto
Strawberry	Toyouga	ditto
	Tajo	ditto
	Trei	ditto
Cauliflower	Snowbell	ditto
	Crespa	ditto
Cabbage	Corazon de buey	ditto
	Charleston	ditto
	Wakefield	ditto
	Early Jorcey Wakefield	ditto
	Stein Flal Dutch	ditto
Celery	Golden Detroit	ditto
	Golden Self	ditto
	Branching	ditto
	White Pascual	ditto
Bulb onion	Red Creole	ditto
	Red Burgundy	ditto
	California Early	ditto
	Red Creole Italian	Italy
Garlic	Napuri Massone	U.S.A
Asparagus	Merry Washington	ditto
Welsh onion	Elefante	ditto
	Moustruotro de Carentan	ditto
Peas	Alderman	ditto
	American Blue	ditto
	Morte	ditto
	Neptun	ditto
	Resistent	ditto
	Early Perfection	ditto
Broad Beans	Gergona	ditto
	Triple White	ditto

Proposal for

THE DEVELOPMENT OF SEED PRODUCTION OF FRUIT VEGETABLES BY USING TRAINING AND PRUNING METHODS IN PERU

by Cesar Apolitano Sanchez

CONTENTS

1. INTRODUCTION

Private growers in Japan produce seed fruits by cultivating their crops carefully. Most vegetables, specially fruit vegetables, are trained and pruned, for example single stem with 5 clusters pinched for tomato, three vines training and fruits set on particular nodes for squash, to become bigger fruits and produce a better quality of seeds.

There are some differences in the method of cultivation of fruit crops between the purpose of market fruit production and seed production. Market fruit production is generally aimed to set more fruits per plant than seed fruit plants, to increase income by producing very good and large-sized fruits. But in the case of seed production, on the contrary, less fruits per plant are necessary to get more seeds per fruit and plant. The reason why farmers in Japan practice training and pruning their plant so carefully to produce seed fruit is as follows.

To ensure easy plant management such as effective disease and inset control, good fruit setting, easy harvesting in order to produce good quality seeds with a high yield.

Fruit vegetables such as tomato, cucumber, squash, and sweet melon normally sprout "suckers" or branches on each node or leaf axil along the main stem. This tends to make the plants somewhat close, so that fungicide and other sprays cannot penetrate as well or give coverage of the stems and leaves. This problem is overcome by using adequate training and pruning methods such as that carried out by Japanese farmers. Training and pruning methods to produce good seeds of fruit vegetables are not known in Peru and must be determined. Therefore, this is the motive for the present proposals.

2. OBJECTIVES

1) To examine training and pruning methods of seed fruit vegetables used in Japan.
2) To study proposals for training and pruning methods for seed production of tomato, squash, cucumber melon and hot pepper.

3. REVIEW OF TRAINING AND PRUNING PRINCIPLES

The direct control of growth by pruning is one of the oldest practices of horticulture. Growth may be purely controlled by physical methods. Physical techniques that directly control the shape, size and direction of plant growth are known as training. Training is used to utilize space effectively for plant growth. This may involve merely providing a support on which plants naturally grow, but in addition may include bending, twisting or fastening the plant to the support structure. (Fig.1)

Training is often combined with the removal of plant parts, or pruning. Pruning may also be performed for other purposes, for example, to adjust fruit load. The usefulness of such a special arrangement may result from the increased efficiency of light utilization or from cultural operations such as harvesting or disease control.

Furthermore, training and pruning may enhance production and quality, and specially vine plants are often trained to some degree. As plant size continues to increase without pruning, the control of growth through pruning becomes necessary.

Fig. 1 Training of leading plant in space is an integral part of the culture of many plants. Tomato vines are twisted around string to maximize growing space in forcing culture. Tomato grown for seed production may be trained to plastic stakes in glass or plastic greenhouses.

4. PHYSICAL AND PHYSIOLOGICAL CONTROL OF GROWTH

(1) Pruning

Pruning is the removal of plant parts such as buds, developed shoots, and roots to maintain a desirable form by controlling the direction and amount of growth. If the natural form of the plant is undesirable, growth can be directed to the desired form with a limited degree of pruning. Although pruning is an invigorating process, it is also a dwarfing process because growing points are removed and the total weight of a pruned plant is usually less than that of an unpruned plant. Growth is frequently quite rapid by pruning because the top-root ratio (balance) is temporarily altered, but this does not compensate for the removed portions of the plant. Removal of leaves and branches reduces stored carbohydrates and--more importantly--reduces the leaf area available for photosynthesis.

The new leaves which develop after pruning may be more active than the old leaves, but they will be fewer in number.

(2) De-budding

De-budding is the removal of vegetative or flower buds. Generally the terminal bud of the shoot is dominant. Shoots grow from the apical buds more rapidly than from the lateral buds. The removal of flower buds is also called "deblossoming". In some cases the balance of vegetative and reproductive growth is maintained appropriately and the growth of fruits is conducted fully by the deblossoming.

(3) PINCHING

Pinching is the breaking off of the terminal growing point, allowing the axillary buds to start to grow.

De-budding or deblossoming is the removal of flower buds, is done after the flower buds become visible.

Removal of the terminal bud as a source of auxin production allows lateral buds to develop. In turn, the uppermost lateral buds will grow into shoots and apical dominance again will be established on each shoot.

Pruning can influence the number and quality of flowers and fruits. For example, if fewer fruits are allowed to develop they will be larger in size and of better quality. Excessive vegetative growth can suppress flowering. Appropriate root training usually stimulates the induction of flower buds.

Root pruning results in a decrease in the amount of available nitrogen, other essential elements and water, which can be absorbed and thus utilized for growth. Cell division and enlargement, therefore, slow down and carbohydrates are stored rather than consumed. Accordingly, root pruning promotes the reproduction phase of growth. If growth initially is high, pruning may stimulate flowering and fruiting. Pruning is also utilized to remove diseased parts, insect-damaged parts and parts killed by winter damage.

5. REVIEW OF TRAINING AND PRUNING METHODS USED IN SEED PRODUCTION OF VEGETABLES IN JAPAN

Seed production of fruit vegetables such as tomato, cucumber, squash, melon and sweet pepper is carried out by using a wide variation of training and pruning techniques, which are as follows:

(1) Tomato

Tomato plants generally bear 3 to 5 fruits on a cluster, and the number of clusters are expected to be 5 for seed production.

(a) Single main stem
Pinch 6th cluster and leave 2-3 leaves above the last cluster; thus 3 fruits on 1st and 2nd cluster, 3-5 fruits on 3rd, 4th and 5th cluster, or in total 19 fruits are harvested for seed production. (Fig. 2)

(b) Two stems
Leave a main stem and a lateral branch below the first cluster on the main stem, pinch 4th and 3rd cluster respectively, and 11 and 8 fruits will be harvested from the main stem and the lateral branch for seed production. (Fig.3)

(2) Sweet Pepper

6-8 stems

Remove lateral shoots below the first flower; the flowers belonging to the first and second reproductive growing points are pinched, so it is possible to obtain 6 bigger and uniform fruits per plant for seed production. (Fig.4)
Plants are supported with sticks and all lateral shoots below the first and second flowers should be pruned from the stem.

(3) cucumber

(a) Training of the plant is done in order to check damage from the plants and vines falling down. All lateral buds up to the 6th-13th node are removed to be allowed to grow from the 7th-14th node up to the 20th node, and then the top is pinched. The lateral vines from the 7th-14th node of the main vine are also pinched after the 2nd node. The aim is to get fruits for seed production. (Fig.5)
(b) All lateral buds around the main stem are removed, only allowing fruits to grow on the main stem from the 6th-10th node. At harvest 8 fruits will be obtained for seed production. (Fig. 6)
(c) A certain single stem modification by training is carried out in very vigorous varieties. It allows two alternating lateral shoots to grow above fruits set on the main stem. (Fig.7)
(d) Fruits both growing on the main stem and lateral shoots of cucumbers result from another pruning method, which allows 10 fruits per plant for seed production. (Fig.8)

(4) Squash

(a) Single vine
No pinching of the main vine or fruit set on it. Single training of the main vine and pinching all lateral vines, allows 2-3 fruits per plant from the 8th-9th node for seed production. (Fig.9)
(b) Two vines
Pinching and training for female plants. At the 5 true-leaf stage, the female plants are pinched at their tips, and about 15 days after pinching the plants only

two strong vines remain, with all the other branches removed. The two remained vines are allowed to grow in the uniform direction at the right angle of the ridges as shown in Fig.10. Thereafter from time to time all the side vines are removed at a very young stage. Two fruits per one lateral vine are set, and in total 4 fruits per plant are harvested for seed production.

(c) Three vines

Pinching and training for female plants. At the 6 true-leaf stage, the female plants are pinched at their tips, and some time after pinching the plants only three strong vines remain, with all the other branches removed. 1 fruits per one lateral vine is harvested, so 3 fruits per plant are obtained for seed production. (Fig.11)

(5) Sweet Melon

(a) Single vine

When the plant has grown up to 7-8 true leaves, set the support and train the vine to climb up on the support. The training of the branches is as follows:

- Set one vine stem.
- All the branches sprouted from lower than the 10th node are removed at their youngest stage.
- The position for pollinating or fruit setting is suitable from 11th to 15th nodes. Therefore, at these nodes the branches grow, but pinch them leaving only two leaves on each, so that one stout and solid female flower per branch can develop.
- Finally the main vine is pinched at about the 25th node at an early stage. Three fruits per plant are harvested for seed production. (Fig.12)

(b) Two vines

Pinch the tip of main vines at the 5-6th node; select 2 strong first lateral vines and pinch the tip of the first lateral vine at 25th node. Female flowers come out on the first node of the second lateral vine; keep 2-3 leaves above the fruit and pinch the tip of vine. Two fruits per lateral vine are set, with 4 fruits in total per plant for seed production. (Fig.13)

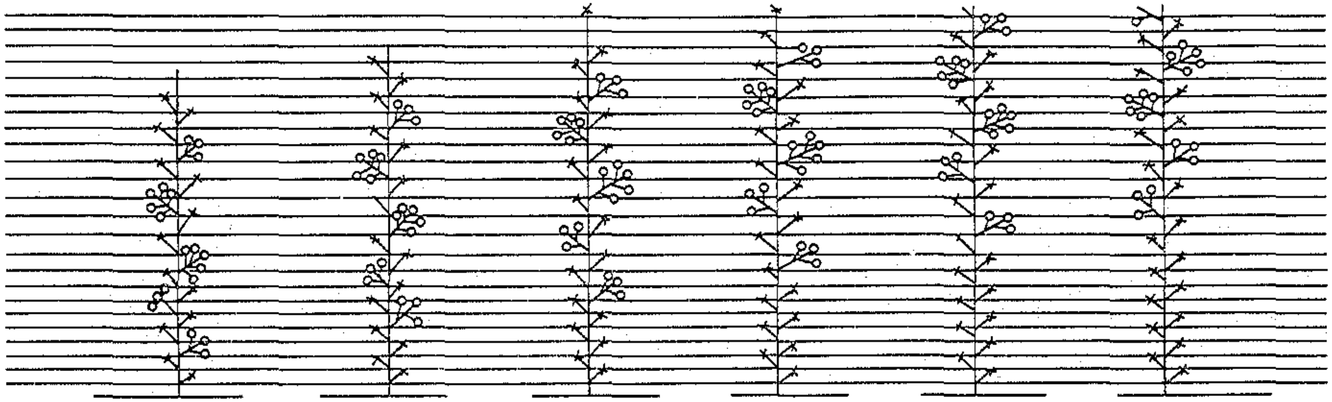


Fig.2 Training and pruning on a single stem for tomatoes

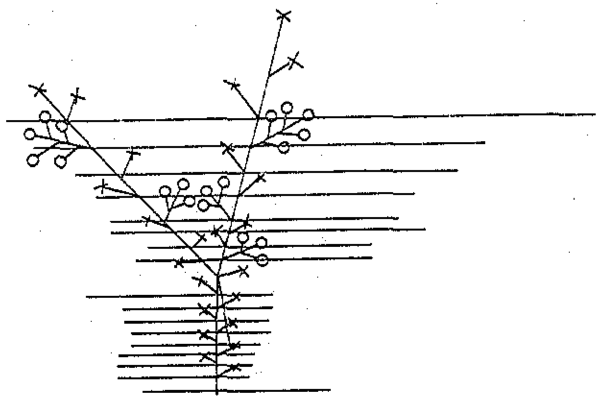


Fig. 3 Training and pruning on a double stem for tomatoes

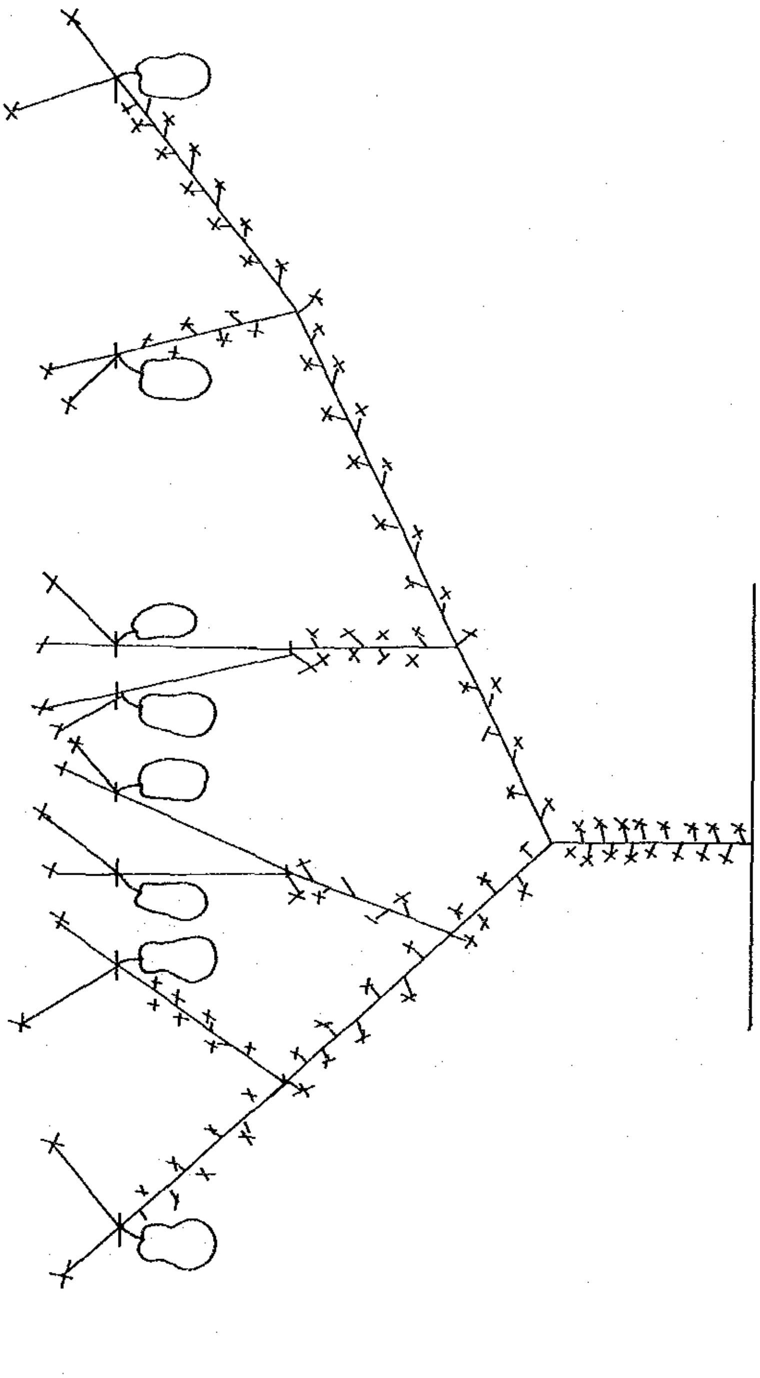


Fig. 4 Double stem trained and pruned for sweet peppers

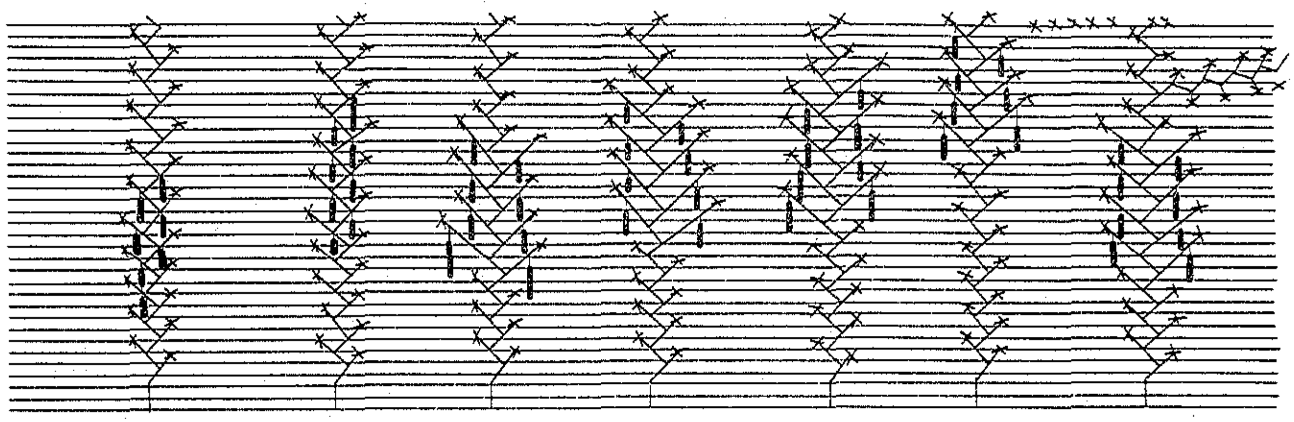


Fig. 6 Fruits set only on the main stem for cucumbers

Fig. 5 Fruits set on lateral shoots for cucumbers

Fig.7 Special training type for cucumbers

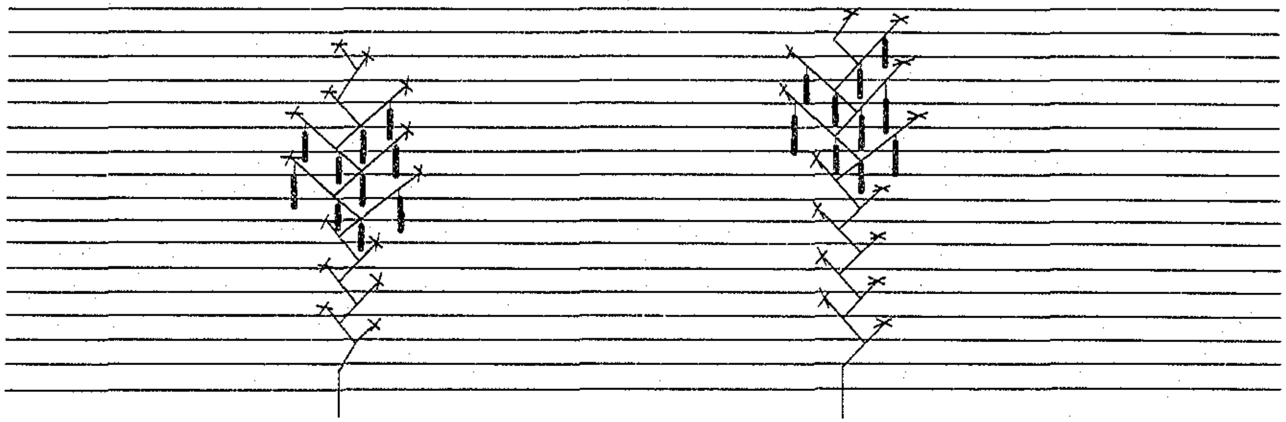


Fig. 8 Fruits set on main vine and lateral shoots for cucumbers

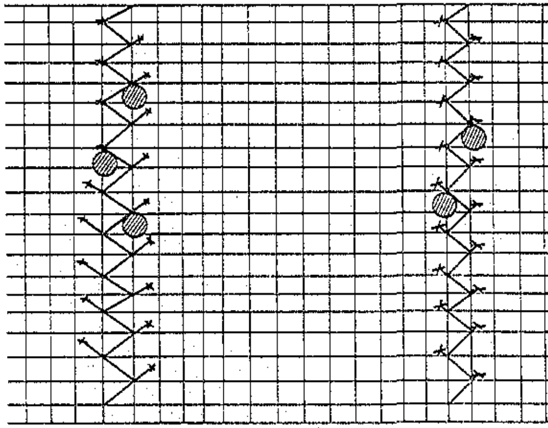


Fig. 9 Training and pruning on single main vine for squash

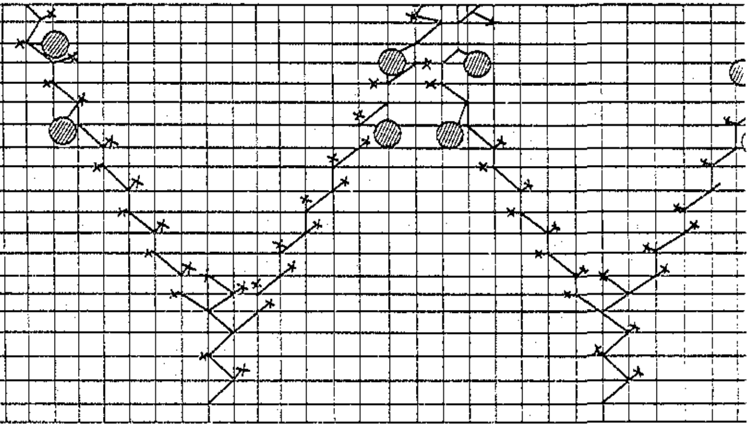


FIg. 10 Training and pruning on double lateral strong vines for squash

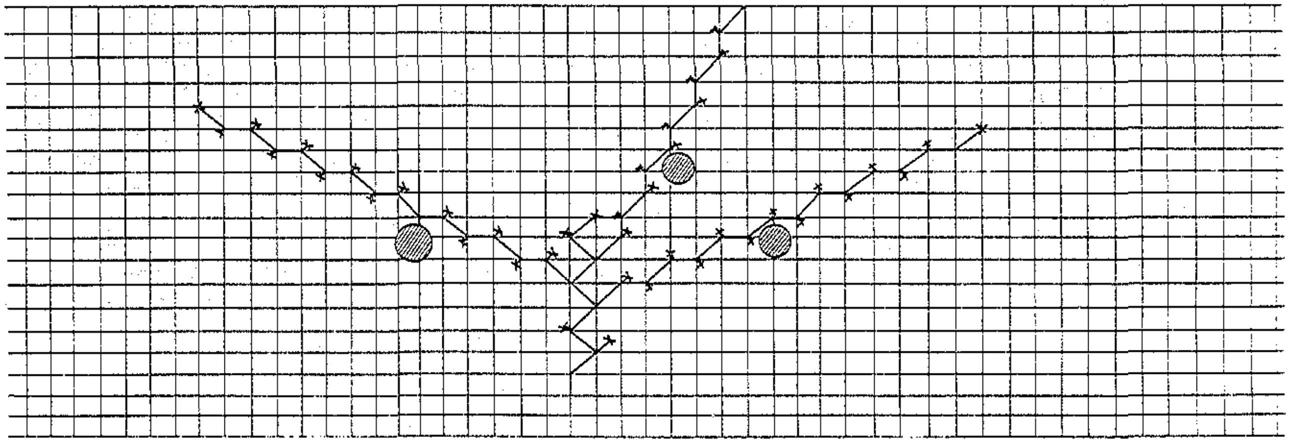


Fig.11 TRaining and pruning on triple lateral strong vines for squash

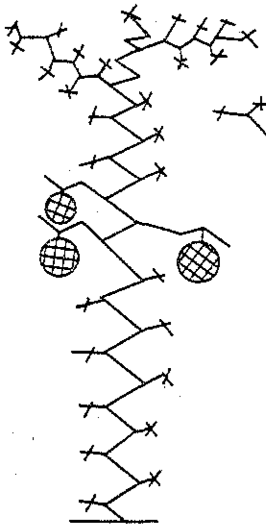


Fig. 12 Single vine trained and pruned for sweet melons

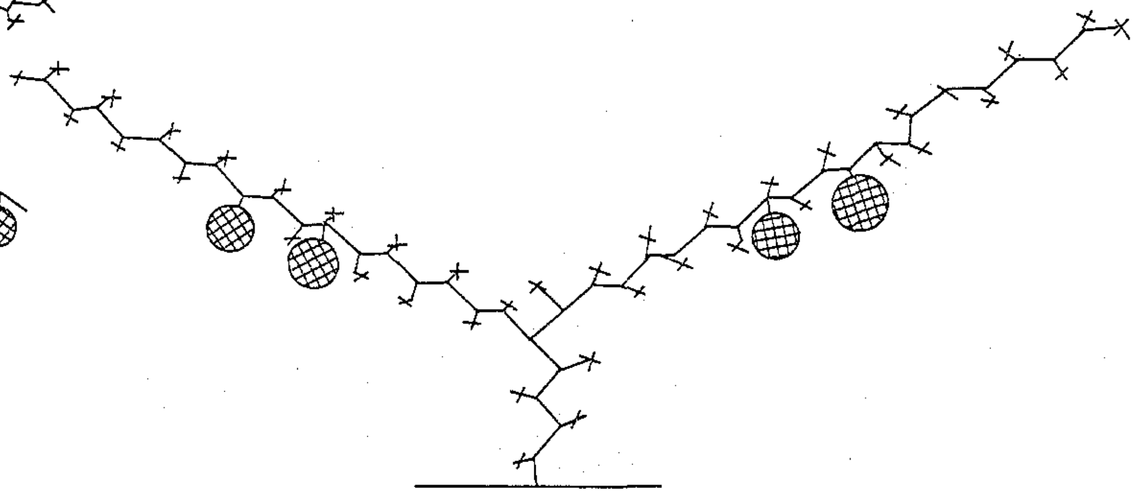


Fig. 13 Double lateral vines trained and pruned for sweet melons

6. COMMENTARY ON TRAINING AND PRUNING METHODS IN JAPAN

Several different methods of training and pruning are used in Japan, specially for fruit vegetables for seed production. These methods effect the size, form, and weight of fruits, which can influence the amount and quality of seeds. It is necessary to carry out research on this subject. However, it is not good to put too much emphasis on excessive training and pruning. It is necessary to discuss the training and pruning methods from the point of view of kinds of vegetable, their various characteristics, the aims of cultivation, natural conditions, and so on. For example, in the case of the tomato, in areas where there is much rain or a long rainy season, plants of non-trained tomato become very crowded, and this condition usually invites late blight (Phytophthora sp) and a late harvest with small fruits, so that a single-stem trained tomato is more beneficial.

7. ADVANTAGES AND DISADVANTAGES OF TRAINING AND PRUNING

In general there are advantages and disadvantages of training and pruning which may be listed as follows, in the case of intermediate types:

(1) Advantages of training and pruning

1) Fruits mature earlier.
2) Fruits are larger.
3) Fruits are cleaner.
4) Better spray coverage is secured and this reduces the chances of damage from disease and insect pests.
5) Plants may be spaced more closely when pruned and staked, and loss from soil rot disease is eliminated.
6) Per-acreage yields are generally higher, and a higher proportion of fruit is usually of No. 1 grade.
7) A larger amount of good quality seeds (size, number and uniform shape).

(2) Disadvantage of Training and Pruning

1) Much extra labor is required.
2) Pruned plants seem more susceptible to various physiological troubles than unpruned plants.
Blossom-end rot and stem-end cracking of fruits usually are worse in pruned plants than in unpruned ones.
3) Some diseases, especially viruses, can become serious, and can be transmitted to healthy plants by the pruners.
4) More damage from sunscald, since fruits are exposed.

Whether method of training and pruning for vegetable seed production are used or not must be decided by the growers, in consideration of climate condition, size of cultivation area, economic condition, kind of vegetables, and advantages and disadvantages as mentioned.

8. STUDIES ON TRAINING AND PRUNING TECHNIQUES OF FRUIT VEGETABLES IN PERU

Varieties of tomato, squash, cucumber, melon, watermelon and hot pepper in Peru differ from Japanese ones in growth habit and ecological performance. Studies about training and pruning will lead us to know aspects such as:

1) Number of flower nodes
2) Phenological stages of plant growth
3) Effects of diverse training and pruning on seed production and quality
4) Relationship between trained and pruned plants and cultivation methods such as fertilization, spacing and watering, etc.

Main characteristics which will indicate effects on training and pruning are as follows:

1) Fruit weight per plant
2) Number of seeds per fruit
3) Size of seeds
4) Germination percentage
5) Seed viability

REFERENCES

Bleas D.J. 1984. Plant physiology in relation to horticulture, p. 138. Horticultural Society and Horticultural Education Association. MacMillan Press. London. 1984

Halfacre G.R. and Bardeer J.A. 1979. Horticulture. McGraw-Hill book company. U.S.A.

Jules J. 1972. Horticultural science

Purdue University. San Francisco.

Mabesa R.C. Seed physiology. University of the Philippines.

Ogiwara S. Cultivation for seed production of cucurbit crops. Tsukuba International Agricultural Training Centre, Text book V.S. No. 7. JICA.

Shinohara s. Principles of vegetable seed production. Tsukuba International and Agricultural training centre, Text book V.C. No. 26. JICA

Shinohara S. 1979. Vegetables seed production methods in tropical and subtropical countries. Agricultural Consulting Engineer office. Reference No. 2. Tokyo. Japan.

TIATC. 1988. Report on experiments in vegetable seed production course Text book V.S. No 9. JICA.

TIATC. 1989. Report on experiments in vegetable crop production course. JICA.

TIATC. 1989. Reports on experiments in vegetable seed production course. Text book V.S. No. 14. JICA.

Yazawa S. 1987. Text book of vegetable production in Japan. Tsukuba International Agricultural Training Centre, Text book V.C. No. 38. JICA.

JICA