CURRENT SITUATION AND MAJOR CONSTRAINTS ON MELON AND WATERMELON CULTIVATION IN PERU

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ABSTRACT

Peru is situated between 0°and 18°south latitude. The country has three distinct climatic zones : the coastal plain, the highlands and the jungle. Watermelon and melon, as well as other vegetables, are cultivated in the coastal region, characterized by a sub-tropical to temperate climate with very little precipitation and high evaporation rate. Although the production of melon amounts to only 5,500 tons, watermelon with a production of 38,734 tons, is an important summer vegetable. In the coastal region, irrigation systems are well developed, but the soil contains less than 2% organic matter and the pH is high (8.0-8.5). Seeds are sown directly in September, when the mean air temperature reaches 15°C. Yields are low and vary from year to year. The fruit quality of melon is not satisfactory. The poor quality and low yield are due to the climatic and soil conditions and to the large number of pests and diseases. The major constraint is that adapted cultivars and cultivation methods have not been developed. Many cultivars are imported, and the application of agricultural chemicals and fertilizers is inadequate. Therefore, research to solve the above-mentioned problems should be actively promoted along with the dissemination of appropriate technology and development of education programs for the farmers.

Introduction

Peru is situated between 0° and 18° South latitude on the West coast of South America. The land is divided into three distinct climatic zones : the coastal plain, the highlands and jungle. Each region has peculiar flora and soil.

Almost all vegetables as well as major crops are cultivated in the coastal region and highlands according to the elevation above sea level as follows : (a) In the coastal region (60 to 750 m), rice, potato, vegetables, cotton and maize ; (b) In the middle highlands (1500 to 2500m), broad bean, lentil, green pea ; (c) In the high highlands (2500 to 3500 m), potato, wheat, maize, tomato, carrot, radish, onion. Coffee is exclusively cultivated in the high jungle area. Recently vegetable production has been increasing, but still the yield is low and varies from year to year, and the quality of some vegetables is not satisfactory. Low and unstable production and poor quality are due not only to natural conditions, but also to the low level of technology.

In this paper, the present conditions and factors limiting vegetable production are described with melon and watermelon which are important summer vegetables as examples.

Present situation

1 General situation

Vegetable production has markedly expanded in the coastal region where almost all the vegetables can be grown, due to the favourable climatic conditions, water availability,

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high technical level of growers, transportation conditions and vicinity to the main consuming centers. The cultivated acreage, total production and average yield of main vegetables are shown in Table 1.

Most of the vegetables have been cultivated under a crop rotation system. In the central coastal region, tomato, pumpkin, cucumber, melon, watermelon and carrot are cultivated in rotation with main crops such as cotton, maize and potato. Generally the main crops are planted in the summer when the weather conditions are not suitable for growth of leafy and root vegetables. In the northern coastal region, legumes, pumpkin, lettuce and tomato are combined with rice, the main crop. In the highlands, carrot, radish, green pea and beans cultivated as combined rotation crops with potato, maize and wheat.

The trend of vegetable production from 1974 can be divided into two different periods by observing changes in the production, as shown in Fig. 1 (Office of Agroeconomy and Rural Trade, 1987). (a) Until 1978 : The production of fruit and root vegetables remained stationary, while that of leafy vegetables, especially lettuce, tended to decrease. (b) After 1978 : The production of all the three groups of vegetables significantly increased, due to the expansion of the cultivated area, and increase of yield. During this period new vegetables such as asparagus were introduced, and their production has been increasing year by year with the increase of exports (Statistical Agrarian Section, 1988).

2 Production of melon and watermelon

The changes in the production and yield from 1974 to 1984 are shown in Fig. 2 (Office of Agroeconomy and Rural Trade, 1987). The production and yield of melon which decreased from 1979 to 1982 have been increasing since 1983. In the case of watermelon,

Table 1 Main vegetables produced in Peru

Number	Kind of vegetable	Total acreage (ha)	Total production (ton)	Acreage yield (t/ha)
1	Sweet corn	20404	126534	6.19
2	Green pea	15876	48056	3.02
3	Sweet potato	14152	154233	10.95
4	Broad bean	14236	39584	3.52
5	Tomato	6569	124999	19.03
6	Onion	5721	87498	15.35
7	Pumpkin	5204	74977	14.34
8	Carrot	4036	54701	13.56
9	Cabbage	3535	44769	12.57
10	Lettuce	2764	27239	9.88
11	Hot pepper	2750	15009	5.46
12	Watermelon	2678	38734	14.44
13	Asparagus	2233	7725	3.41
14	Garlic	2206	12293	5.77
15	Kidney bean	1239	4922	3.95
16	Cauliflower	1153	14015	12.14
17	Pallar bean	815	2839	3.40
18	Caigua	736	4294	5.82
19	Celery	729	9719	13.29
20	Melon	545	5471	10.66
21	Radish	509	6902	13.47
22	Leek	372	4039	10.93
23	Strawberry	318	2865	9.07
24	Radish-Rabanito	190	2051	9.87
25	Cucumber	186	2108	11.24

Average value from 1980 to 1985.

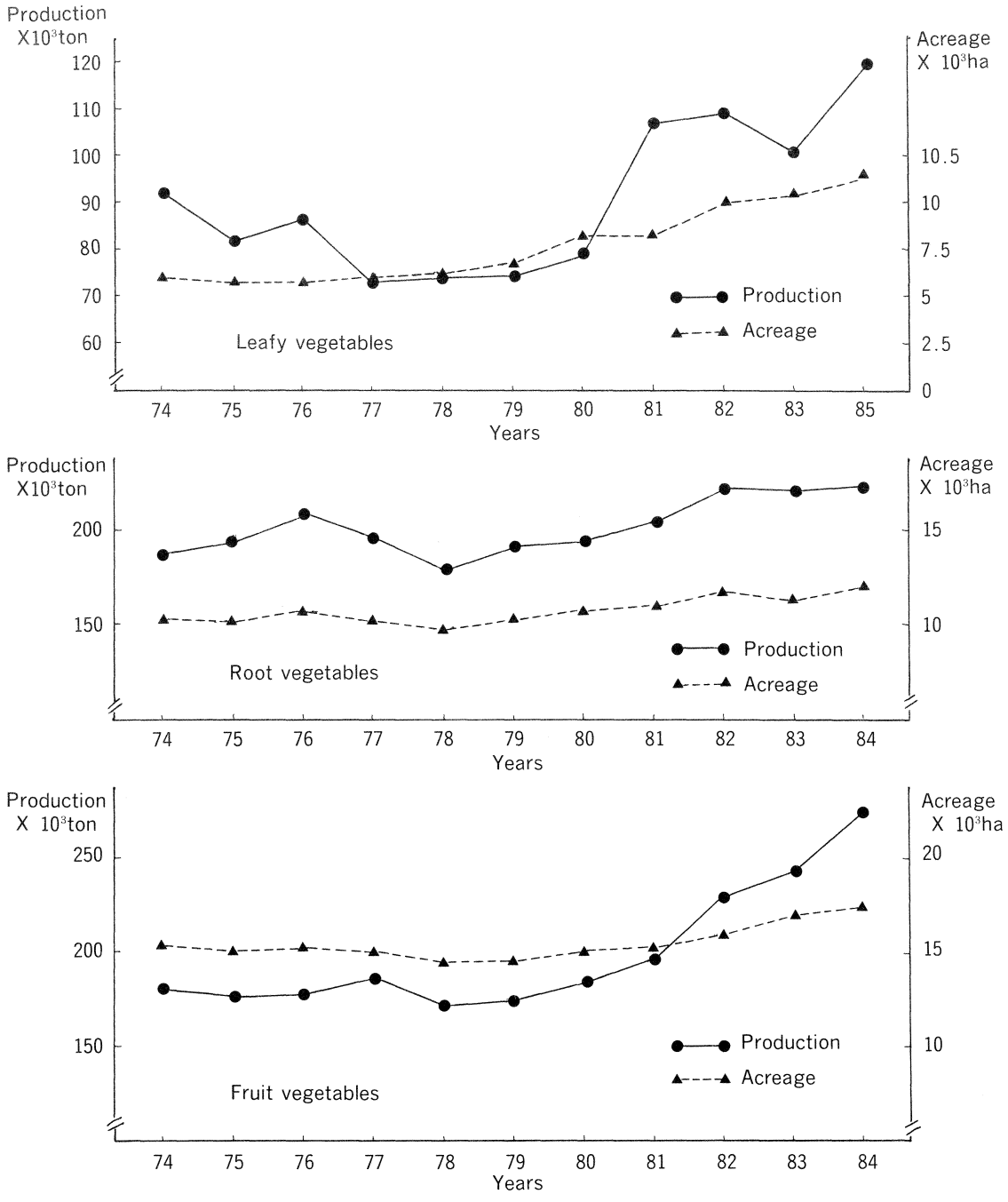
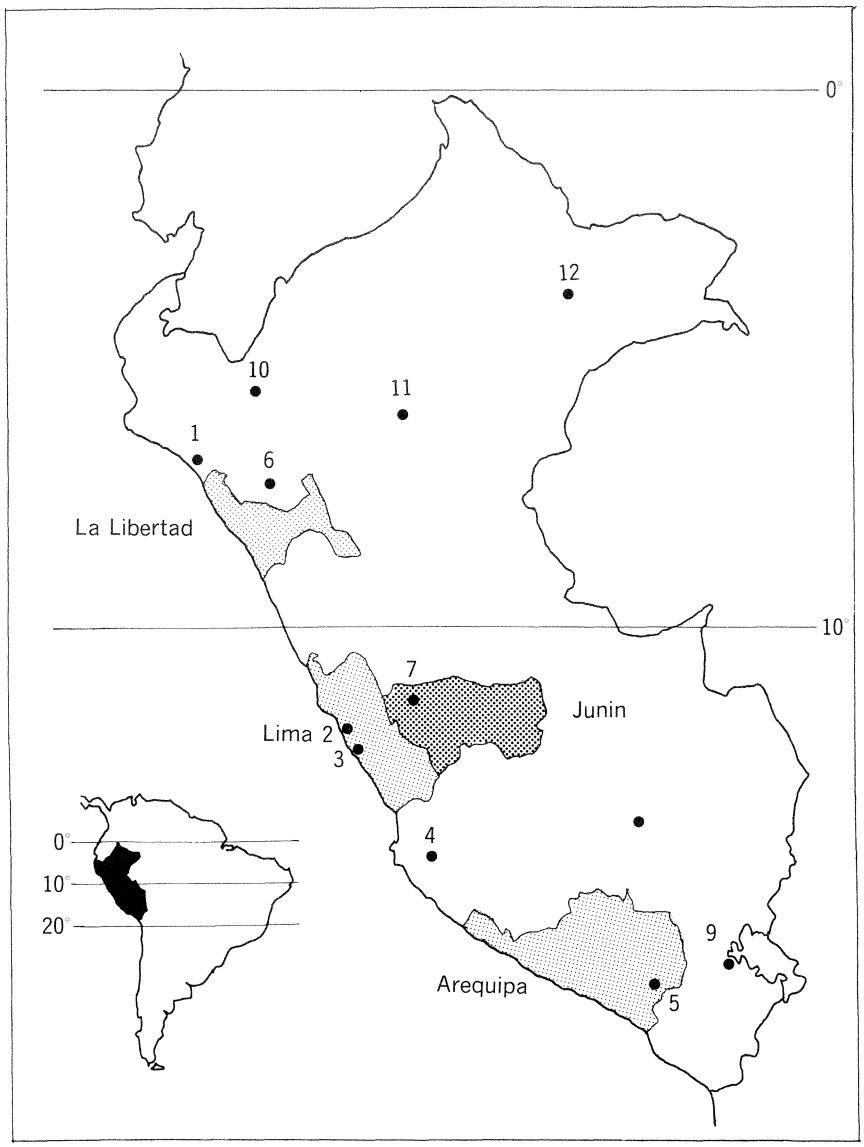


Fig. 1 Changes in the production and acreage of leafy, root and fruit vegetables from 1974 to 1984



: main melon and watermelon producting departments in coastal region

: main vegetable producting departments in highlands

Agricultural research stations are located in the following areas:

Coastal region	Highlands region	Jungle region
1. Chiclayo	6. Cajamarca	10. Amazonas
2. Hural	7. Junin	11. Yurimaguas
3. Lima	8. Cusco	12. Iquitos
4. Ica	9. Puno	
5. Arequipa		

Fig. 2 Main producing areas of melon, watermelon and other vegetables in Peru

the production and yield from 1977 to 1982 which were relatively stable, have significantly increased. Main producing regions of melon and watermelon are shown in Fig. 3 and Table 2. In 1984, about 8,300 tons of melon and 46,000 tons of watermelon were produced by the cultivation of 662 ha and 2,810 ha, respectively. Three main departments, Lima, Arequipa, La Libertad, accounted for about 45% and 55% of the total cultivated acreage of melon and watermelon corresponding to about 75% and 60% of the total production, respectively. The yield in the other regions is significantly lower than that in the three departments.

The main varieties of melon are Hales Best Jumbo, Honey Dew and Esmeralda with

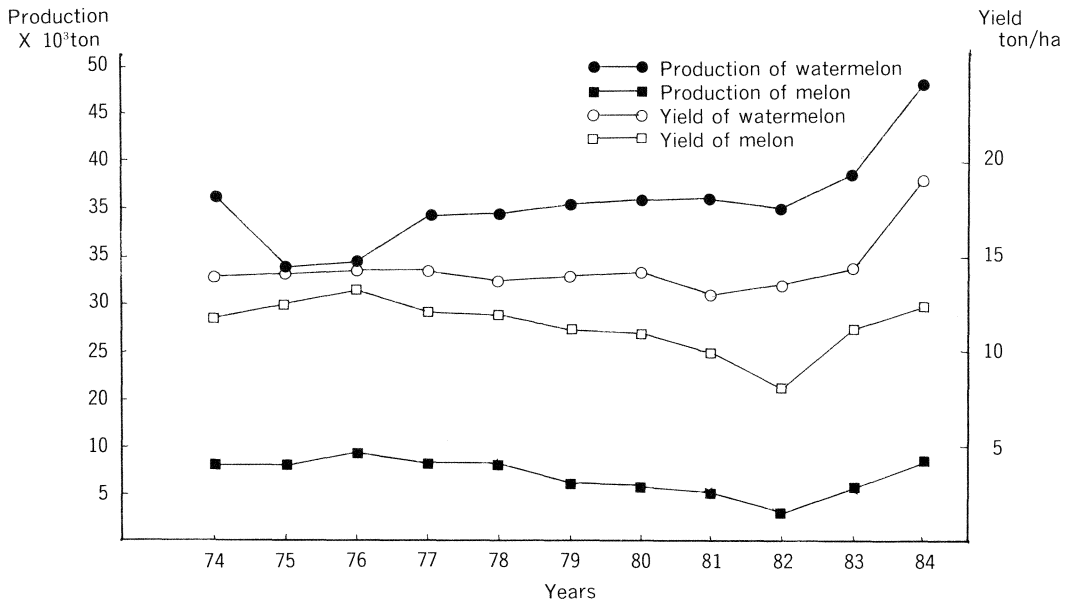


Fig. 3 Changes in the production and yield of melon and watermelon from 1974 to 1984

Table 2 Production of melon and watermelon in main Departments in 1984

Department	Acreage (ha)	Production (ton)	Yield (t/ha)
Melon			
Peru	662(100%) a	8356(100%) a	12.6(100) b
Lima	180(27.2)	2610(31.2)	14.5(115)
Arequipa	105(15.9)	1510(18.0)	14.4(115)
La Libertad	92(13.9)	2098(25.1)	22.8(181)
Others	285(43.0)	2138(25.6)	7.5(59)
Watermelon			
Peru	2810(100%)	46341(100%)	16.5(100)
Lima	945(33.6)	15120(32.6)	16.0(97)
Arequipa	295(10.5)	5956(12.9)	20.2(122)
La Libertad	281(10.0)	7699(16.6)	27.4(166)
Others	1521(54.1)	17566(37.9)	11.6(69)

a : Percentage of production in each department to whole country.
b : Ratio for whole country as 100.

orange, green and orange flesh, respectively. However the fruit quality is not satisfactory (low soluble solid contents and poor aroma). Hales Best Jumbo, an American variety, is mostly used. In the case of watermelon, three varieties, Peacock Improved, Sugar Baby and Charleston Gray are cultivated with Peacock Improved being mostly used (Terakado, 1988).

3 Cultivation practices

1) Sowing time and planting system

Seeds of watermelon and melon are directly sown in the field after the air temperature reaches 15°C, generally in September. Mulching and transplanting are not performed. Around 4 to 5 seeds are sown per hole, and after emergence the young seedlings are thinned to one. Although the plant density shows marked differences among the growers, commonly the width of the bed ranges from 6.0 m to 8.0 m, seeds are sown on either side of a bed, and the distance between the plants in a row varies from 2.0 m to 3.0 m. Furrow is used for irrigation. Pinching, training of vines, artificial pollination and thinning of fruits are not practiced.

2) Fertilization

Research on fertilizer application to vegetables under the prevailing soil conditions is not well developed. The total amount of fertilizer applied as N : P_2O_5 : K_2O is usually 180 kg, 100kg, 150kg per hectare, respectively. Application is divided into two or four times and 15 to 20 ton/ha of chicken manure is also applied by some growers.

Factors limiting vegetable production

1 Physical constraints

1) Climate

Although Peru is situated immediately south of the equator, the monthly mean temperature in the coastal region ranges from 12°C to 24°C,as shown the Fig. 4. Temperature in the highlands is lower than in the coastal region, ranging from 10°C to 15°C, and frequently frost occurs. As a result, the vegetable-producing areas in Peru extend from the

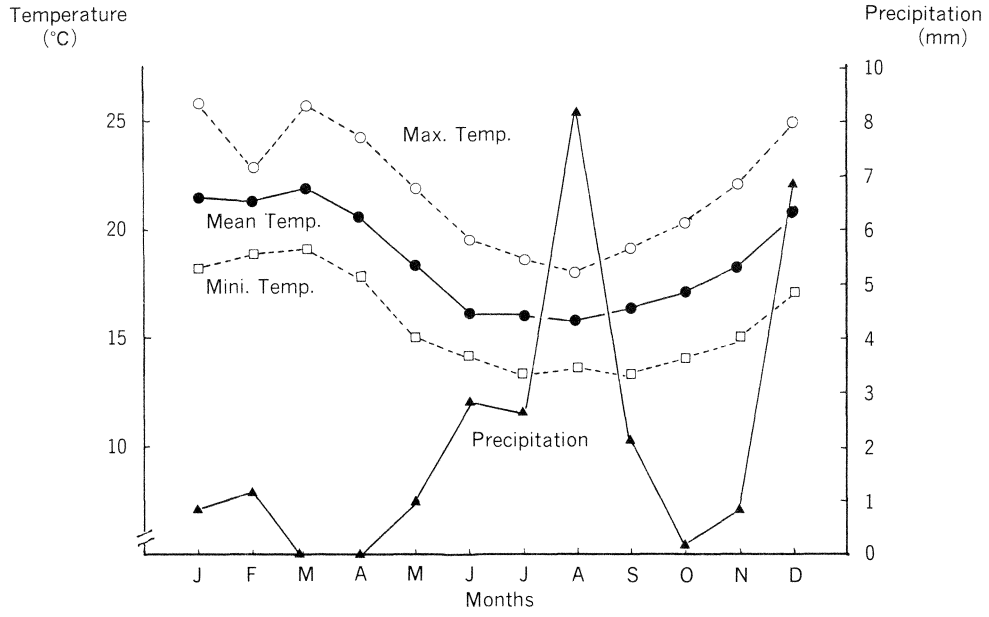


Fig. 4 Precipitation and temperature variations in the Huaral Valley (Experiment Station Peru, 1986 to 1988)

sub-tropical to the temperate zone and the temperature is not a major constraint.

However, in the coastal region the amount of precipitation is very low (less than 50 mm/year, Fig. 3), and the evaporation rate is also very high (Meteorological Observatory, 1988). This drought condition is therefore an important constraint on agriculture, and a well developed irrigation system is necessary. Actually a large area of uncultivated land is reclaimed by using dykes for the water supply. However in many areas the water supply is insufficient, leading to water stress. On the other hand, since the coastal region in winter is affected with fog, the level of solar radiation is low.

In the highlands, the annual precipitation which ranges from 400 to 900 mm in summer, is very low in winter. Accordingly almost all the cultivated land in winter experiences drought conditions.

2) Soil

The soils in the coastal region were classified as Fluvent soils (Zamora, 1970). Although this soil group has no problems in itself, in the area near the sea its characteristics are as follows : poor drainage, aridity, alkalinity (pH 8.0-8.5), salinity, low percentage of organic matter (less than 2%), phosphate fixation by carbonates.

On the other hand, the soils in the highlands are Mollisols and Inceptisols (Zamora, 1970), with a high susceptibility to water erosion. These soils are acid (pH is lower than 5.0) and have a low availability of nitrogen, phosphorus and potassium.

2 Biological constraints

1) Varieties and seeds

In Peru, as the technology for breeding and seed production of vegetables is not well developed, varieties that are improved in foreign countries are cultivated. In the case of melon and watermelon, 90% of the seeds are imported. Since these varieties are not well adapted to the prevailing climatic and soil conditions, the production is low and unstable and the quality is poor. The use of F_1 hybrid varieties, also imported, is uncommon due to their high price. On the other hand, some growers have produced their own seeds with traditional technology, by selection of the best fruits.

2) Pests and diseases

The main pests and diseases of melon and watermelon are listed in Table 3 and Table 4 (Chupp *et al.*, 1960 ; Hill, 1987). Since research on the identification of pests and diseases is insufficient, other pests and diseases may possibly be present. On the other hand, the incidence of soil-borne diseases, virus diseases and nematodes that cannot be controlled adequately by agricultural chemicals, has increased in some areas where vegetable production is developing.

3 Grower's cultivation practices

Compared with advanced countries, the technical level of the growers is low in relation to the implementation of practices to obtain higher yield and better quality. Generally, transplanting, mulching, pinching, training of vines are not practiced, and fertilizers are applied without a detailed knowledge of the nutrient requirements of plants and amount soil. Agricultural chemicals to control pests and diseases are applied after the damage reaches the economic injury level. Such problems could be solved by the improvement of the level of technology and education.

Current research activities

1 Organization and system

The National Research Institute of Agricultural and Agro-Industry (INIAA), operates twelve experimental research stations, located in Chiclayo, Huaral, Lima, Arequipa, Ica, Puno, Cusco, Amazonas, Cajamarca, Iquitos, Yurimaguas, Junin. Only four of these experimental stations have a vegetable section. The main research activities relating to vegetables have been carried out at the Vegetable Cultivation Technical Center attached to The Agricultural Experimental Station Huaral.

Table 3 Main pests of melon and watermelon in Peru

Scientific name	Common name	Season of occurrence
Feltia spp.	Cutworm	Spring
Agrotis ypsilon	Cutworm	Spring
Diaphania hyalinata	Melon worm	Spring to Summer
Diaphania nitidalis	Pikle worm	Spring to Summer
Tetranychus spp.	Spider mite	Summer
Aphis gossypii	Aphids	October to December
Trialeurodes vaporariorum	Glasshouse white fly	Spring to Summer
Lirionayza huidobrensis	Pea leaf miner	Winter to Spring
Meloidogyne spp.	Nematoda (cyst eelworm)	Spring to Summer

Table 4 Main diseases of melon and watermelon in Peru

Scientific name	Common name	Season of occurrence
Fusarium oxysporum f. *niveum*	Fusarium wilt	August to October
Fusarium oxysporum f. *melonis*	Fusarium wilt	August to October
Rhizoctonia solani	Damping off	August to October
Sphaerotheca fuliginea	Powdery mildew	October to December
Pseudoperonospora cubensis	Downy mildew	October to December
Cucumber mosaic virus	Mosaic	Spring to Summer
Watermelon mosaic virus	Mosaic	Spring to Summer

The Vegetable Cultivation Technical Center was established by the joint project between Japan International Cooperation Agency (JICA) and INIAA. Actual research was started in 1987.

2 Main research subjects

1) Introduction of new vegetables and varieties

Many kinds of vegetables and varieties have been introduced from foreign countries, and many characteristics are investigated, while commercial aspects are being evaluated. Domestic varieties and native species are also collected and investigated. These varieties and lines are utilized for actual cultivation or preserved as breeding materials.

Disease resistance and characteristics relating to adaptability to natural conditions, especially tolerance to drought and alkali soil, are investigated. The Esmeralda variety which was imported 20 years ago shows high adaptability to the country, and its characteristics are investigated in detail.

2) Improvement of varieties

The general breeding objectives are as follows : disease resistance, adaptability to drought and to low solar radiation, tolerance to alkali and saline soil, ecological traits to extend the cropping season, and quality. Research is carried out to obtain fixed varieties, and plans are made to obtain F_1 hybrids. In melon and watermelon, as a systematic breeeding program has just started, no new improved varieties have been developed yet. Breeding for disease resistance to Fusarium wilt, powdery mildew and mosaic is the most important objective. Enhancement of adaptability and tolerance to climatic and soil conditions is also important to increase the yield and improve the quality.

3) Seed production

Research has recently started on the following subjects : (a) Selection of parental

plants; (b) Growing methods for flowering, (c) Prevention of natural crossing; (d) Harvesting and processing; (e) Storage conditions; (f) Quality control (germination rate and uniformity).

4) Cultural practices

(1) To extend the cropping season, the effect of the sowing time and covering material on young plant growth is investigated in relation to the temperature. For transplanting culture, methods to raise seedlings are also being developed.

(2) Effect of transplanting and planting density under different field conditions on yield is examined to enhance and stabilize the production.

(3) To establish a rational system of fertilizer application under drought conditions, the effect of the amount and application time, especially nitrogen, phosphorus and potassium, in various fertilizer sources and in different types of soil is investigated in relation to the nutrient demands of each vegetable.

(4) The use of new materials, for example various kinds of plastic films, cheesecloth and irrigation tubes, is examined in order to protect plants from drought, high temperature, and insect attacks.

5) Pest and disease control

Plant protection research emphasizes the following subjects : (a) Identification of diseases and pests; (b) Ecological studies; (c) Protection methods. Pathological research is not carried out due to the lack of plant pathologists specialized in vegetables problems. However in the field of entomology, some research about the identification, chemical control and semi-chemical control (by artificial pheromone) is being carried out.

Future prospects

The vegetable industry in Peru is confronted with many problems and the productivity is low, mainly due to limiting natural conditions and the low level of technology. However, there are many countries where vegetable production is more advanced in spite of more severe constraints.

Actually the national program to improve vegetable production, referred to as National Horticultural Program has been organized. However systematic research has just started, as the number of researchers and technicians is still very low. Therefore technology including materials must be introduced from foreign countries and young researchers must be trained. On the other hand, the diffusion of technology is also important. In our institute, there are two training courses, one for extension agents, the other for the growers.

In the future, it is anticipated that many kinds of vegetables with good quality will be abundantly produced, and that the consumers also will be able to consume vegetables all the year round.

Acknowledgement

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Discussion

Ram Phal (India) : Why is the spacing between rows/furrows of melon so wide (6-8 m)? What is the length of the vines which requires so much spacing? Could the spacing be reduced to economize land use?

Answer : As the seeds are sown on either side of the bed, the width between rows is 3 -4 m ; in fact the width of the bed (6-8 m) is divided by two. We are currently investigating means of reducing the distance between musk melon plants.

Ozawa,K. : Why are melons planted at the edge of the beds?

Answer : To enhance the efficiency of water utilization. Indeed, in Peru melons are cultivated in the coastal are under irrigation. The plants are grown on the side of the beds because the furrow for irrigation is located in the center of the beds.