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Med. No. 451

# SOME REMARKS ON THE MEXICAN GREENHOUSE FLOWER INDUSTRY

Two papers



Oktober 1991

Agricultural Economics Research Institute (LEI-DLO)
The Hague, The Netherlands

ABSTRACT

SOME REMARKS OF THE MEXICAN GREENHOUSE FLOWER INDUSTRY; TWO PAPERS
Verhaegh, A.P.
The Hague, Agricultural Economics Research Institute (LEI-DLO), 1991
Mededeling 451
ISBN 90-5242-135-8
39 p., 8 tab., 8 fig.

Mexican growers have been able to build up a greenhouse sector in a very short period of time and have introduced several new crops and techniques. Greenhouse production is mainly oriented on exporting to the market in the USA.

World markets for flowers, the competition on these markets and the comparative advantages of Mexico are described. The author also goes into the physical and social environment desired for flower production destined for luxery consumer markets such as the USA. Particular questions concern the adequacy of the physical environment - radiation, minimum and maximum temperature - in Mexico to produce flowers in greenhouses.

Mexico/Flowers/Greenhouses/Export/Competition/Comparativeadvantage/Technology/Expertise/Physical environment/Social environment/Radiation/Minimum temperature/Maximum temperature

CIP-GEGEVENS KONINKLIJKE BIBLIOTHEEK, DEN HAAG

Verhaegh, A.P.

Some remarks on the Mexican greenhouse flower industry :
two papers / A.P. Verhaegh. - The Hague : Agricultural
Economics Research Institute (LEI-DLO). - Fig., tab. -
(Mededeling / Agricultural Economics Research Institute,
ISSN 0166-8129 ; 451)
ISBN 90-5242-135-8
NUGI 835
Trefw.: bloementeelt ; Mexico / bloemenhandel ; Mexico.

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# Preface

CODAGEM (Gobierno del Estado de Mexico) and ANAPROMEX (Asociacion Nacional de Productores y Exportadores de Ornamentales de Mexico, A.C.) supported by different organizations, organized the 'Second Mexican International Flower Exhibition' from 12-15 June, 1991, in Toluca, Mexico. Connected to this exhibition a seminar was organized on June 12-14.

Of the total 117 stands 15 presented 23 Dutch exporters of production inputs like plant material, seeds and packing material. The Dutch Ministry of Agriculture, Nature Management and Fisheries organised a second seminar 'Seminario Holandes' on the evening of June 13.

On the first seminar the present author presented the paper 'Prospect and structure of the Mexican Flower Business'. On the second seminar he presented the paper 'Production and environment in the greenhouse flower industry of Mexico'.

On request of the Dutch Ministry of Agriculture, Nature Management and Fisheries A.P. Verhaegh together with J. Goedegebure visited Mexico from January 21 to February 8, 1991 to give a picture of the Mexican horticulture with emphasis on the protected crop sector. Their report, 'Tuinbouw (beschermde) in Mexico' is published by the Directorate Industry and Trade of the Dutch Agricultural Ministry and will also be translated in to Spanish by this Ministry.

The director

The Hague, September 1991 L.C.Zachariasse

# Prospects and structure of the Mexican flower business

To understand the prospects of the Mexican cutflower sector, an outlook has to be made on the basis of an analysis of the big consumer markets for flowers in the world, with regard to the competition and comparative advantages of Mexico and the preferences of the consumers in these markets. Knowledge of the determinant factors for economic growth will be important to assess the desired structure of the cutflower sector. These aspects will be discussed successively.

*World market of flowers*

The world market for cut flowers globally consists of three large consumption centers. These are Europe, Japan and the United States of America. The total turnover for cut flowers in these markets is 23, 10 and 10 billion Dutch guilders respectively, against consumer prices. The turnover on wholesale level is for exporters and producers a more important indicator, because retail margins constitute a substantial part of the consumer price and retail margins are not comparable in the mentioned centers. The turnover is now 9.8, 3.0, and 3.5 billion Dutch guilders respectively, against wholesale prices. The turnovers of these centers offer substantial market perspectives for the supply of cutflowers. Of still more importance are the expectations for the future. Market specialists expect a yearly increase in demand for cutflowers of 3-4 percent in Europe. In the United States of America it may even be 8 percent. This constitutes a fantastic development and great possibilities for cutflower exporters, also for new-comers, on these flower markets to earn hard currency. These markets can develop in different ways. Should the supply remain constant, the prices will increase. On an elastic market, as we expect the market in the USA to be, an increase in supply will go together with an increase in turnover. Worldwide, over the past decade, production, consumption, and trade of flowers and plants have grown faster than the general economy. This development is expected to continue in future. In this field, experts refer to the United States as 'the largest underdeveloped market in the world for flowers'. If this market will really developed exporters will have an enormous market to sell flowers.

*Competition*

More and more people in the world are aware of these market possibilities. Let us have a look at the flower market in the USA. Firstly, the domestic floriculture sector in the USA itself and secondly the imports of flowers into the USA.

Total cash receipts received by the flower growers in 1980 for the domestic floriculture sector in the USA amounted to 953 million US dollars and in 1988 2238 million. An average annual growth of 17 percent - one of the fastest growing sectors in agriculture. The 2.24 billion US dollar can be broken down as follows; potted flowering plants 494, foliage plants 477, bedding plants 724 and cut-flowers and decorative greens 545 million, (1). Roses clearly have the highest wholesale value of all cut flower crops in the USA. In 1988, domestic production of roses was valued at 182 million, almost three times that of carnations, the second highest. Chrysanthemums were third highest, valued at 52 million, just 10 million less than carnations. These three crops constitute 296 of the total wholesale value of 453 million or 65 percent of the total.

Imports are substantial. In 1988 the total import of flowers in the USA amounted to 451 million US dollar. Cut flowers had a share of 62 percent (284 million). In 1988 the imports of cut-flowers in the USA showed a 16 percent increase as compared to 1987. Colombia provides the largest share of US imports of horticultural products, an amount of 176 million or 39 percent, and The Netherlands the second largest share with 32 percent. Almost all of the in US purchases from Colombia were cut flowers.

In 1988 the US bought for 143 million US dollar horticultural products from The Netherlands. Approximately 64 million was for cut flowers. The trade between The Netherlands and the USA is strongly dependent upon the value of the US dollar and with the fall of the dollars' purchasing power the Dutch exports to the USA have fallen. The Dutch supply, at present, only completes the assortment available on the USA market. Dutch perspectives depends therefore on a further development of the flower market in the USA. The relative demand for standard products such as rose, carnation and chrysanthemum will then decrease while the demand for other types of flowers will increase. The Dutch can benefit from such a development, but it will never be an important market for them. The fluctuation of exchange rates did not affect trade between Colombia and the USA, since the Colombian peso is tied to the US dollar. The Colombia economy is effectively a full dollar economy.

Other major exporters of horticultural products to the United States of America in 1988 were Canada, with sales totaling almost 68 million US dollar, Costa Rica with 13 million and

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1) Differences in figures are caused by using different sources e.g. data from cash receipts are derived from the 37.300 horticultural operations in the United States by the USDA's Economic Research Service. Data about turnover on consumer level are derived from consumption at household level.

Mexico at slightly more than 8 million dollar. The imports from Mexico, were mainly cut flowers, 7.3 million of the 8.1 million. Small suppliers were Israel, Guatemala, Ecuador, Thailand, France, Swaziland, Jamaica, Dominican Republic and Kenya. As you can see, countries from all over the world.

The above mentioned imports in turnovers are from 1988. The number of flowers can also be given from 1990. In 1988 the number of flowers imported in the USA amounted to 1.7 billion. In 1989 it was again 1.7 billion. In 1990 the imports rose to 2.1 billion, an increase of 23 percent in two years. The imports of carnations increased from 932 million to 1058 million. This is an increase of 13 percent. Roses increased from 286 million in 1988 to 423 million in 1990: 47 percent more. The main reason of this growth is the increase of the number of retail outlets in the USA from 51.000 in 1986 to 65.500 in 1989.

By an increase of the supply equal to the increase of the demand the price will be the same. Is the increase of supply greater than prices will go down. Too strong increase will destroy the market. Nobody can produce too long for too low prices. So the market will recover. The question is, however, 'How will the grower survive this period ?'

By a temporary oversupply of roses on the market in the USA Mexico will suffer most. The reason behind this is 'quality'. In comparison with Columbia the average price of roses for the Mexican produce is less. In general by oversupply the second quality will suffer most.

Apart from incidental market disturbances we can draw the conclusion that the growing flower market in the USA is economically attractive for many flower exporting countries.

*Comparative advantages*

The question is now 'What is the competitive position of Mexico among the suppliers to the USA'? In comparison with other exporters to the USA, Mexico has obvious advantages;

- Mexico is the most northern country with enough light to produce good quality flowers in the winter period;
- Except for Canada, Mexico has the shortest transport distances. To states such as California, transport can even be done by road, which is cheaper, more flexible and can be better controlled than air transport;
- Mexico has a good traffic-infrastructure and low labour costs;
- Mexico has a high frequency of air-cargo flights to important consumer areas in the USA;
- On the plateau within a circle of 200 kilometers around Mexico-city there is a large area with moderate maximum temperatures over a long period of the year;

- To heat its greenhouses, Mexico generates its own energy. In this way Mexico exports energy through flowers;
- Mexico and the USA have a long standing trade relationship;
- The economy of Mexico has slowly changed from a protected into a more open economy, important to improve the contact and communication with other countries;
- The creation of a free-trade zone among the USA, Canada and Mexico will go together with more comparative advantages for Mexico.

The conclusion is that in comparison with other competitors on the US market, Mexico has best conditions and strong comparative advantages. Further development of these advantages depends strongly on the organization of the floriculture sector in Mexico, which involves the human factor. When Mexico has the intention to become an important exporter of flowers to the USA, the success thereof will depend on decisions of policymakers and others.

The other two world consumer centers, Japan and Europe, are also interesting for Mexico but, in comparison with the flower market in the USA, of less importance. The comparative advantages for Mexico on these other markets are not so strong and other suppliers probably have a better position. Mexico has to focus primarily on the flower market in the USA and as a spin-off it may also have possibilities in the other centers.

*Mexican floriculture sector oriented on export*

The first greenhouses for commercial horticultural exports were constructed in Mexico fifteen years ago. Afther that, within a short period a flower sector has been created with a lot of energy. The total area protected with multispan greenhouses and specialized on the cultivation of flowers will be nearly 250 hectares. The average size of the multispan greenhouses is 2.7 hectares per holding. This average is very high. The greenhouse sector has a relatively great number of big holdings in Mexico. These holdings are the backbone of the Mexican flower industry. They have imported the technology and expertise, which were not existing in Mexico, by themselves. For setting up a greenhouse project in Mexico no help of a third party was available. Any grower therefore has to be a good organizer to collect information, to produce and to sell by himself. To collect knowledge and to sell abroad requires a certain standard and certain size of the holding. Understandably these holdings have an attitude of protection against other growers. At this moment several growers in Mexico are interested to co-operate in transport and marketing of the products and in the acquisition of farm inputs.

Beside the greenhouses the open field production of flowers cultivated for export is also growing in Mexico. Both sectors can have a positive influence on each other and will strengthen the whole floriculture export position.

*Economic growth*

Before we go into the subject of desired structure of the greenhouse sector the concept of economic growth needs to be explained. In the greenhouse industry, economic growth can be realized by enlarging the area of greenhouses maintaining the same input/output relation. Several countries have done this in the past, like Spain, Turkey, South Korea and others. Turkey now has nearly 10.000 hectares of multispan greenhouses and 12.000 hectares low and high tunnels. In South Korea the area for protected crops is about 25.000 hectares. This has resulted in an increasing supply with a decreasing market price. The increase in area will stop at the level where the growers' costs are no longer compensated. Stagnation is the end result. Further economic growth can only be realized by switching to new crops, e.g. to cultivate other types of vegetables or to switch from vegetables to flowers. Each time, however, this will end in stagnation. The above mentioned countries did or are doing so.

The greenhouse industry in The Netherlands is, as you might know, well developed and does not face stagnation. What are the differences with so many other countries that could explain this success? The tomato is a good example. What were the developments of this crop? The cultivation technique for tomatoes was on a low level in The Netherlands in the middle of the fifties. The production of tomatoes, cultivated in greenhouses, was only 8 kg per m2. In 1982, however, it was already 29 kg on average. A second feature was the reduced use of labour. The number of hours necessary to work a glasshouse area of 1.000 m2 tomatoes dropped from 1170 hours to 720 hours. In 1955 labour productivity amounted to 6.6 kg per hour worked, while in 1982 this was 40.3 kg per worked hour. This process of productivity increase has continued in the eighties. In this period the glasshouse sector with vegetables had a yield increase per m2 of 7.3 percent yearly; for cutflowers this percentage amounted to 4.6 and in the potted plants sector 5.4. Not only labour productivity increased, also capital and energy productivity increased enormously. The effect was a continuous drop in real prices. This advantage is mainly passed to the consumers. The price decrease encouraged the consumer in Europe to buy an increasing amount of Dutch horticultural produce, while the Dutch market gardener managed to maintain parity income, and could nevertheless reserve enough capital to ensure the continuity of his business enterprise and enlarge the area of greenhouses at the same time more growers could enter the business. This economic growth is achieved by intensification, this means an increasing the input/output relation by using more inputs on the same area.

In the whole process of productivity increase, the Dutch grower plays a central role. The Dutch grower collects information from multiple sources. His enterprise is the center of a network of relations. It is essential for the adequate functioning of a network to have colleagues in the direct neighbourhood and support from extension services and research. It is much harder to build up a successful network over large geographical distances. The enterprise will then have to be larger and management will have to be much sophisticated.

*Desired structure*

Mexican growers have been able to build up a greenhouse sector in a very short period of time and have introduced several new crops and techniques. This was only possible through the application of a great number of technological innovations. The result was a generally applauded economic growth. The recent technological progress is largely due to the efforts of the market gardeners themselves, with strong backing from the suppliers of seed, plant material and other farm inputs.

This proved to be a very favorable starting method for a protected crop industry, not only in Mexico but in other countries as well. The situation will change when the time comes for progress through productivity increase rather than enlargement of the total area of greenhouses. Technological progress on behalf of the intensification of the production process, requires a much broader support and greater know-how. In practice this is too much for market gardeners and suppliers to achieve on their own. Support will be needed for an upgrading of internal communication networks among market gardeners themselves and new networks need to be set up for market gardeners' groups to benefit from extension and research. The two dominant factors by these network developments are technology and expertness. Firstly, what is technology?

The developments in the international markets for flowers and fresh horticultural products proceed at a rapid pace and only top quality products will be able to compete successfully. Mexico will only be able to build up a competitive position if top quality products can be produced. High technology is an absolute must for producing top quality combined with a continuously increase of productivity. Flower production for the international market requires a high-tech industry. On the holdings, production conditions have to be optimal. The greenhouse and farm equipment has to be adequate to realize this level. In the circumstances of Mexico it means equipment for heating and cooling. Because of the higher costs for cooling, locations with lower maximum temperatures are preferable. The winter period offers Mexico most comparative advantages and this is also the most important period for exports. It is also a period to be careful with radiation, even in Mexico. Covering material of the greenhouses has to transmit a maximum of radiation. Shadowing of plants can be done with movable screens. Screens can also be used for isolation and to save fuel during cold nights and not only during frost. The equipment to control the greenhouse climate, to control fertilization, to protect the crop from insects and diseases, have to be modern. The plant material and seeds have to be the best in the world, your competitors are using them.

After creating optimal production conditions the Mexican growers must have also expertness to exploit these optimal conditions. Expertness means knowledge and experience. A lot needs to be done to increase the level of knowledge and experience.

Without order of importance I will sum up a number of possibilities to increase this level;

- To create demonstration and training projects at different levels;
- To invite specialists from abroad to give lectures;
- To follow courses abroad like the International Course on Glasshouse Crops organized by the International Agricultural Center in Wageningen (IAC) in The Netherlands or the International Vegetable Production Course from the same institute;
- To exchange researchers on the level of experimental stations;
- To set up courses in Mexico with support from specialists of foreign countries;
- To work for a short time on Dutch holdings (Individual programme of IAC);
- To translate and disseminate more international literature and trade journals;
- To increase the skill of reading and speaking English;
- To hire advice of experts and consultancy and management bureau's from abroad;
- To organize study groups at growers level;
- To do investigations e.g. into the competitive position of Mexican flowers on the USA market;
- To appoint more researchers and extension people and provide them with the necessary facilities;

Understandably this is too much to carry alone for a young sector like the greenhouse sector in Mexico. Others, like the Government, have to invest in this sector and earn back later. They have to create conditions in which the greenhouse sector can developed. Conditions in the field of extension, research, education, financial and last but not least in the marketing channel from the Mexican producer to the buyer abroad. In a chain the weakest link determines the power of the whole, as it is in the business of flowers. Economic growth depends on the decisions of many people. Flower production in Mexico has a very good potential on basis of the promising market in the USA and its comparative advantages. Economic growth in the greenhouse flower industry will be dependent on the decision makers of Mexico. I wish them a lot of success with this exciting task.

# Production and environment in the greenhouse flower industry of Mexico

*Introduction*

Greenhouse flower production is a high-technological economic activity. Characteristic for this activity is a high intensity of capital and labour, resulting in a high level of costs. High physical yields and top quality will have to cover these costs. To manage such a crop-intensive economy, a strong control of influential factors is an absolute necessity. Greenhouse flower production is also a strongly dynamic process in comparison with the traditional horticulture. Following new developments and changes makes keeping control even more difficult. Greenhouse flower production requires special attention, not only for the production process itself but also for the environment because of the great impact of the environment on the production process.

The environment can be divided into a physical and a social component. In this paper we will discuss both components with regard to the Mexican situation.

*Physical environment*

Temperature, radiation, humidity, water, soil, wind, rain, hail and $CO_2$ are the most important physical environment factors for greenhouse crop production. The principle of a greenhouse is to create a micro climate in which the crop development will be better than outside. How much better this micro climate will have to be depends on the entrepeneurs'goals. Is the purpose to harvest some weeks earlier, to have a somewhat higher temperature or to keep the crop free from frost: a simple greenhouse with plastic covering material will be sufficient. When the intention is to produce high quality roses for consumer markets such as the flower markets in the USA and in Europe, than top quality must be produced. Top quality can be produced only when the physical environment is fully adapted to the needs of the plant. The question is now 'How adequate is the physical environment in Mexico to produce in greenhouses flowers destined for luxury consumer markets such as in the USA'. Some of the above mentioned physical evironment factors will be discussed.

*Radiation:* in the Sixties, Dutch growers became aware of the importance of light on the production. Not only in winter when there is a shortage of radiation and the quantity of light is too low for producing of several crops, but also in the early season when there is in principle enough light for production. The result was, that on the one hand new greenhouses should have a higher light transmission while on the other hand chalked panes and fixed screens had to be replaced by movable screens, all with the intention to increase light transmission in the early season. Now Dutch growers use the rule of thumb that 1 percent light is equal to 1 percent physical yield. They do not only apply this rule in the winter period and in the early season but over the whole year. An illustration of the radiation during the whole year in the Netherlands is provided in appendix 1. The radiation in the winter period is very low, in December it is 43 cal/cm2 per day. The radiation in June is 443 cal/cm2 per day. The level of light in the summer period is ten times that of the winter-period in the Netherlands. In appendix 2A en 2B the radiation in January and in July is illustrated for the northern and southern hemisphere. The low level of light in the winter in the Netherlands can be found also for the USA and other regions of the northern hemisphere. In July the situation opposite with a maximum of light on the northern hemisphere and a minimum of light on the southern hemisphere. Mexico is somewhere in the middle and follows this seasonal movement, however with less pronounced fluctuations. In appendix 3, 4 and 5 the monthly solar radiation is illustrated for some places in Mexico. A seasonal pattern can be found with a minimum in the winter period.

It is clear that the radiation is also on a lower level during the winterperiod in Mexico. It amounts to 350 cal/cm2 day in December, January and February. Compared with the light circumstances in The Netherlands it is the period of end april and the beginning of May. Translated to Mexico it means that in Mexico too, growers have to be careful with the light transmission of the greenhouses. In practice a loss of light of 20 percent is easily realized if no precautions are taken to increase the light transmission. For in Mexico, the winterperiod is exactly the period of harvesting. Following the rule of thumb that 1 percent light equals 1 percent production, a loss of 20 percent light means a loss of 20 percent production. By a turnover of 40 US dollars per square meter of greenhouse, a reduction in light of 20 percent is equal to 8 US dollar. Besides the physical effect of light, there is also an effect on quality. More costs for investments in better covering materials and construction of greenhouses will therefore prove to be very lucrative also in Mexico.

Radiation in the different regions of Mexico is illustrated in appendix 6. No great differences exist among the regions.

*Minimum temperature:* in appendix 7 a temperature line is illustrated. On the left side below 0 degrees Celsius is the area of frost. In the middle the optimum temperature and in between the area of 'low temperature'. At frost the plant is suffering a lot and direct visible damage is the result. In the area of low temperature there is no direct visible damage. The damage however increases at a lower temperature. Its magnitude depends on the health of the crop. When a crop receives too much cold it will even come in a stress situation. In this situation the coldsum is too high and the damage is the highest.

One night frost can harm a crop of roses for the whole season, which causes the grower important economic losses. Several Mexican growers have had these bad experiences in the past years. In general, Mexican growers have now accepted that even light frost has to be avoided. Too much cold have also a very strong negative effect on yield and on quality. The number of roses which can be harvested are considerably less when the plant is cultivated by too much cold, moreover the number of harvested roses with top quality will be considerably less. In the Netherlands, growers with a crop of roses in production maintain a minimum temperature of 16 degrees Celsius in the greenhouses during the night. I do not say that Mexican growers have to go directly to this minimum temperature, but stress situations should be avoided anyway.

Days with frost and minimum temperatures are given for several important horticultural regions in Mexico in appendix 8. Toluca has yearly on average 96 days with a temperature below zero degrees. Puebla has on average 17 nights frost, Irapuato (GTO) 12, Zitacuaro (Mich) 10, Uruapan (Mich) 4 and in Culiacan (Sin) only one day in five years. The number of days with frost is strongly correlated with the altitude. Toluca is situated on 2720 metres, Puebla 2162, Zitacuaro 1981, Irapuato 1724, Uruapan 1634 and Culiacan on 84 metres.

The average minimum temperature in Toluca is in December 2.3 in January 1.8 and in February 2.8. In the others regions the avearge minimum temperature is with except Culiacan on a level of 7 till 9 degrees in this period. In Puebla the average temperature is in February 8.0 degrees Celsius. This means 14 days with a night temperature below 8.0 degrees. All these regions have too much cold and heating is necessary to avoid cold stress. In Culiacan the minimum temperature seems to be on an acceptable level.

*Maximum temperature:* the region with too high temperature is drawn on the right side on the temperature line, illustrated in appendix 7. After a very short period there will be visible damage. In the middle of the line, the region of optimum temperatures is situated and in between the region of high temperatures. In this region damage is not visible. Damage increases at higher temperatures. Its magnitude depends on the health of the crop. When the heat sum is too high, the plant will even come into a stress situation. Production losses will sharply increase. In The Netherlands we have only sometimes problems with too high temperatures and then only in the east of the country. Once in 3-4 years this region has 2-3 weeks outside temperatures of around 30 degrees Celsius. Growers, extension and other specialists are then complaining about the development of the crop. It is even possible that in Mexico plants are stressing through too much heat as well as through too much cold. A great temperature gradient exists in Mexico with high day and low night temperatures.

Average maximum temperatures are even in the winterperiod very high in Sinaloa, December 28.6, January 27.7 and February 29.3 (appendix 8). In Toluca the maximum average temperature seems to be ideal over the whole year. In December the average maximum temperature in Toluca is 16.9, the lowest, and the month april with 21.3 degrees Celsius has the highest average maximum temperature. South of Toluca most greenhouses of Mexico are situated.

It is very profitable for a grower when production circumstances are adequate for a long period during the year. It will be difficult to earn back the high investments and high direct costs in a short harvest period of some months. Cooling of greenhouses is very expensive, more expensive than heating. Greenhouses need therefore to be located in regions in which maximum temperatures are not too high.

*Humidity:* humidity has become a new field of interest in greenhouse climatization, since it is an essential climate factor. For a great number of crops the relative humidity is even a critical factor in plant development. In creating the right climate, it is therefore essential also to control humidity. Relative humidity is often extremely low during the winterperiod in Mexico.

Physical circumstances have to be organized in such a way that a grower can control climate factors like radiation, minimum temperature, maximum temperature, humidity, water and fertilizing systems and has the disposal over competitive inputs like desired seeds, plantmaterial, the right disease control and fertilizers. Only then the Mexican grower can bring a competitive product to the international market.

When the circumstances of production are under control, the grower will require knowledge on how to take the right decisions and to make a maximum use of the high investments, so he can cover the substantial fixed and variable costs. Besides technology, the grower must have expertise on how to grow the plant in a micro climate created by a greenhouse. To improve knowledge is a social factor. The social environment of (a) grower(s) has to be organized in such a way that a continuous process of increasing knowledge will be the result.

*Social environment*

In order to reach better results, a grower has to collect information from multiple sources. Even so, he will only be successful if his enterprise is the center of a network of relations. In appendix 9 a graph is presented of a network which roughly indicates how this is organized in the Dutch situation. In The Netherlands the organisation is built around the individual grower. He is the central point, because growers have to produce the right product, the right quality, the right quantum, in the right period and with the lowest costs. 'Our' grower, number one, is in the middle of the circles and nine other growers are scattered in the first circle around grower number one. These ten growers form a small club, called 'study club'.

Study clubs comprise of about ten growers, each member producing the same crop, visiting each other frequently to watch the crops and to discuss results. To increase the effect of the meetings, growers collect technical and economic data of their own crops which serve as a basis for the discussion. This system is strongly developed in The Netherlands. Study clubs are organized by the NTS (Netherlands Horticulture Study Clubs), a completely independent growers organization. Extension is involved in the activities of the study clubs as well as research in order to make the system more effective. It is essential for an adequate functioning of a network, that the geographic distances among growers are not too long. Personal contact in exchanging practical knowledge is an important condition.

In the second circle, on a short distance from the growers, the extension service is located. In a situation where new knowledge needs to be disseminated, extension is working with a group of 100 growers. The extension is closely situated to the growers. The extension workers have to constitute a link between practice and research: to pick up problems and new developments in practice and transfer these to the research and to transfer research results to the growers. On more distance in the third circle the experimental station is situated to do all kinds of applied research. There is also a direct line from the experimental station to the growers. In the board of the experimental stations individual growers and representatives of growers are dominating. On the same circle banking and suppliers of production inputs are situated. All these circles have been put in quadrangle to emphasize the geographical state. All these organizations have to establish in same area: the production area. Outside the quadrangle, on circle 4, we find universities and institutes to support the experimental station and to practice with scientific research in the field of breeding, plant protection, agrobiological research, mechanization and others. On the outside circle I have also drawn the market, which depicts the Dutch situation where there are auctions: roughly one auction on 1000 growers. In Mexico the situation is completely different. The main market is, as for the Dutch growers, abroad. However, in Mexico the grower has to organise the sales by himself, not only on the domestic market but also abroad, without the help of an adequate marketing infrastructure such as an auction. This is extremely difficult. Co-operation for local sales and exports would reduce these difficulties.

Greenhouse flower production is a dynamic process and not a static one. When a certain technology and expertise has been reached, it will always be necessary to develop further. Some of these changes will be discussed in short. Consumer markets are changing continuously and the production side will also undergo changes. Consumers are changing their taste and suddenly prefer other varieties or flowers. New markets are coming up. From the beginning, Mexican growers with roses are familiar with varieties like Visa, Vega, Madame Delbard, Sonia, Coctail, Candia, Lancome, Perle Blanche. At this moment some Mexican growers are also interested in varieties like Madelon, Jacaranda, Tineke, Pasadena, Frisco, Ilseta and others. There is also a growing interest for sprayroses such as Evelien, Joy, Porcelina and Nikita.

The USA are likely to import larger quantities of the major floral crops such as roses, carnations, chrysanthemums, statice, daisies, lilies, gladioli and others. But the USA will also import a wider diversity of crops such as orchids, callas, anthuriums, bird of paradise flower and others. The assortment of flowers is growing and continuously in movement. To offer a wider assortment will strengthen the Mexican market position.

Growers also have to follow changes in prices. Through the increased supply on the consumer markets, the real price of all products will decrease. Growers will have to follow this development, otherwise the competitor will take over. On the production side, real prices of production inputs will also increase and growers will have to eliminate these increased costs as well.

As an example it is illustrated in appendix 10 how Dutch tomato growers have solved the problem of increasing prices for labour and energy. The yield level was still very low in the Netherlands in the Fifties. In 1954 the production of tomatoes was 7.700 kg per 1.000 m2 and a grower needed on a yearly basis 1170 hours to prepare the soil, to take care of the plants and to harvest. In 1982, yields had strongly increased and amounted to 29.000 kg and the number of hours necessary to work a glasshouse area of 1.000 m2 tomatoes dropped to 720 hours. This means an enormous increase of labour productivity. In 1955, labour productivity amounted to 6.6 kg per worked hour, while in 1982 40.3 kg per worked hour. The increase of the physical production was realized by many factors. The production season was extended by means of advancing and prolonging the season, by introducing more productive varieties, by the introduction of newly constructed greenhouses with a.o. better light transmission, by introducing improved climate control systems especially in terms of temperature, radiation, carbon dioxide and humidity, by introducing better plantmaterial and improvements in areas like fertilization, watering, pruning, cultivation method, fruitsetting and growth of the plant. The emphasis was on a better harmonization of all the factors which influence the development of the plant, and in particular the production and the quality of the final product. Knowledge of the behavior of the plant increased strongly. In the eighties this development has continued in The Netherlands and resulted in a annual increase of the physical production of the greenhouse vegetable sector of 7.3 percent, in the greenhouse cutflowers sector of 4.6 and in the greenhouse potted-plant sector of 5.4 percent.

In Mexico, this development has only just started and must be continued, but can only be successful through the support of all institutional activities in the society such as extension, research, education, financing and policy making. Spain, a well known horticultural country and very promising years ago, did not do what many people expected. Spain had only enlarged the protected area without going into depth. This way of working limited the possibilities for an increased productivity.

*Conclusion*

The physical environment has to be adapted to the needs of the plants and the social environment of the greenhouse flower industry in Mexico has to be efficiently organized in order to maintain a healthy, growing business. Technology and expertise are the corner stones for this success. Concentration of the production in some not too large areas, specialization in production and co-operation in banking, selling, research and extension will have a positive influence on this development. Mexican growers have to act as colleagues and should not have the feeling that they are each others competitors. The growing flower market in the USA is big enough for thousands and thousands of Mexican greenhouse growers. However this can only be realized when productivity increases and producing top quality will have the highest priority.

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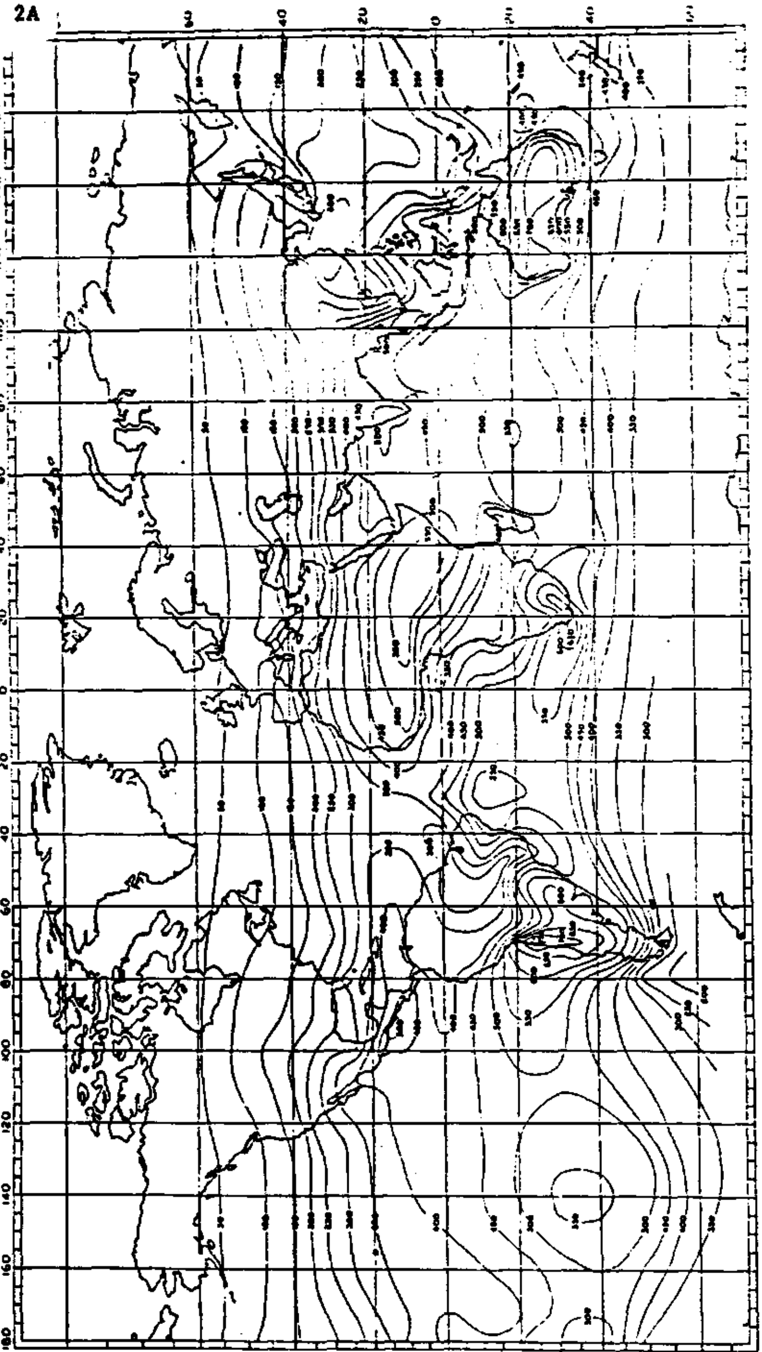
Appendix 1

Value of some climatological keyfigures in The Netherlands in the year 1990 (De Bilt)

| Month | Global radiation | | | Relative humidity | Min. temp. | Max. temp. |
|---|---|---|---|---|---|---|
| | J/cm2 | | cal/cm2 day 2) | | | |
| Jan. | 5296 | ( -1950) 1) | 56 | 86 (-3) | 3.5(+4.2) | 7.6(+3.2) |
| Febr. | 13056 | ( +128) | 110 | 78 (-8) | 4.3(+5.0) | 11.2(+5.8) |
| March | 29398 | ( +4137) | 194 | 76 (-5) | 4.5(+3.4) | 12.6(+3.8) |
| April | 47145 | ( +8549) | 306 | 72 (-6) | 3.9(+0.6) | 13.9(+1.4) |
| May | 64260 | (-11820) | 403 | 69 (-6) | 7.2(+0.2) | 19.9(+3.0) |
| June | 42971 | (-12837) | 443 | 78 (+2) | 10.6(+0.8) | 19.4(-0.6) |
| July | 58223 | ( +7213) | 392 | 72 (-7) | 11.4(-0.4) | 21.9(+0.8) |
| Aug. | 48598 | ( +3418) | 347 | 74 (-6) | 12.4(+0.4) | 24.3(+3.1) |
| Sept. | 25943 | ( -5644) | 243 | 82 (-1) | 9.0(-0.4) | 17.2(-1.5) |
| Oct. | 19525 | ( +634) | 145 | 82 (-4) | 8.0(+1.6) | 16.3(+2.0) |
| Nov. | 7148 | ( -1194) | 66 | 90 (+2) | 3.0(+0.1) | 9.1(+0.4) |
| Dec. | 4533 | ( -1093) | 43 | 86 (-3) | 1.6(+1.1) | 6.3(+0.6) |
| Tot. | 366096 | | 230 | 79 (-4) | 6.6(+1.4) | 15.0(+1.9) |

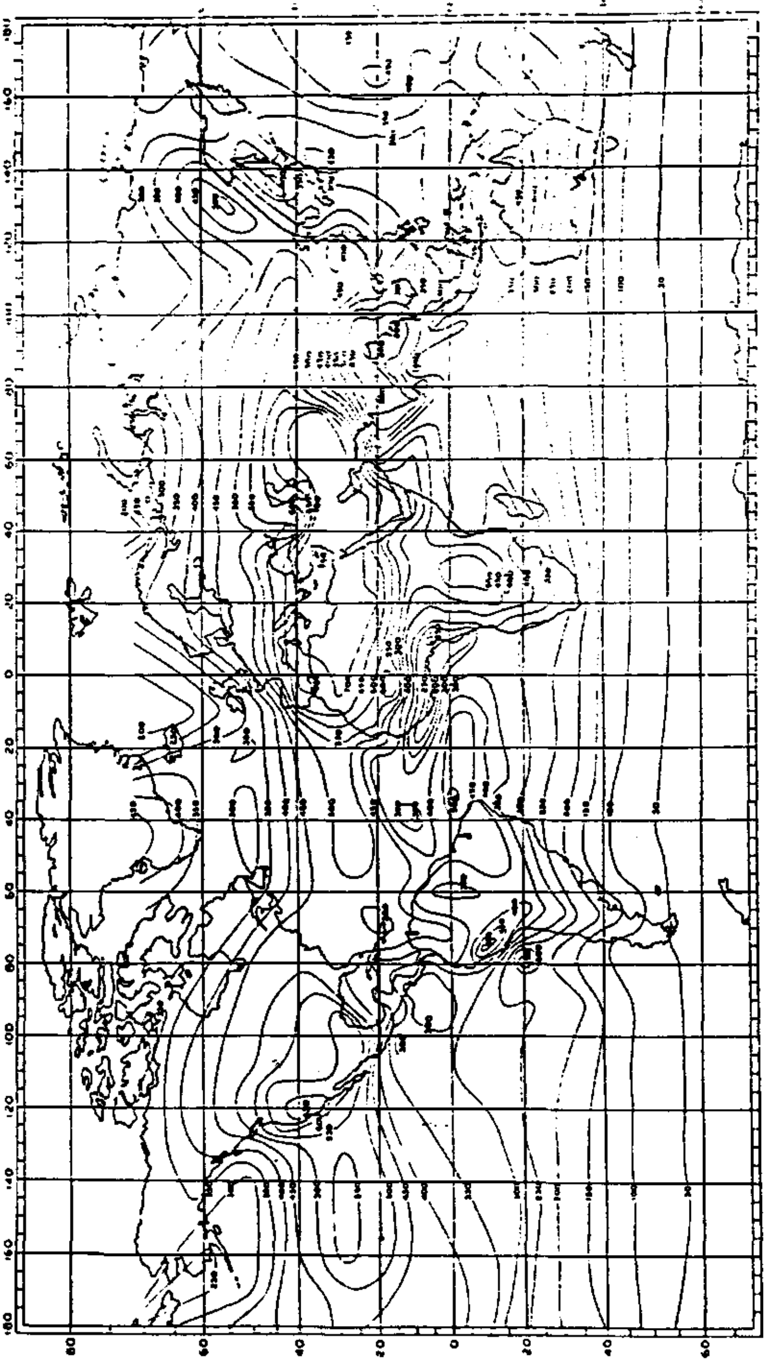
1) Between brackets the deviation of the normal (N). The normal is the average about many years.
2) The normal radiation per day (5296+1950=7246 7246:31=234 234:4.2=56).
Source: KNMI (De Bilt).

Appendix 2A



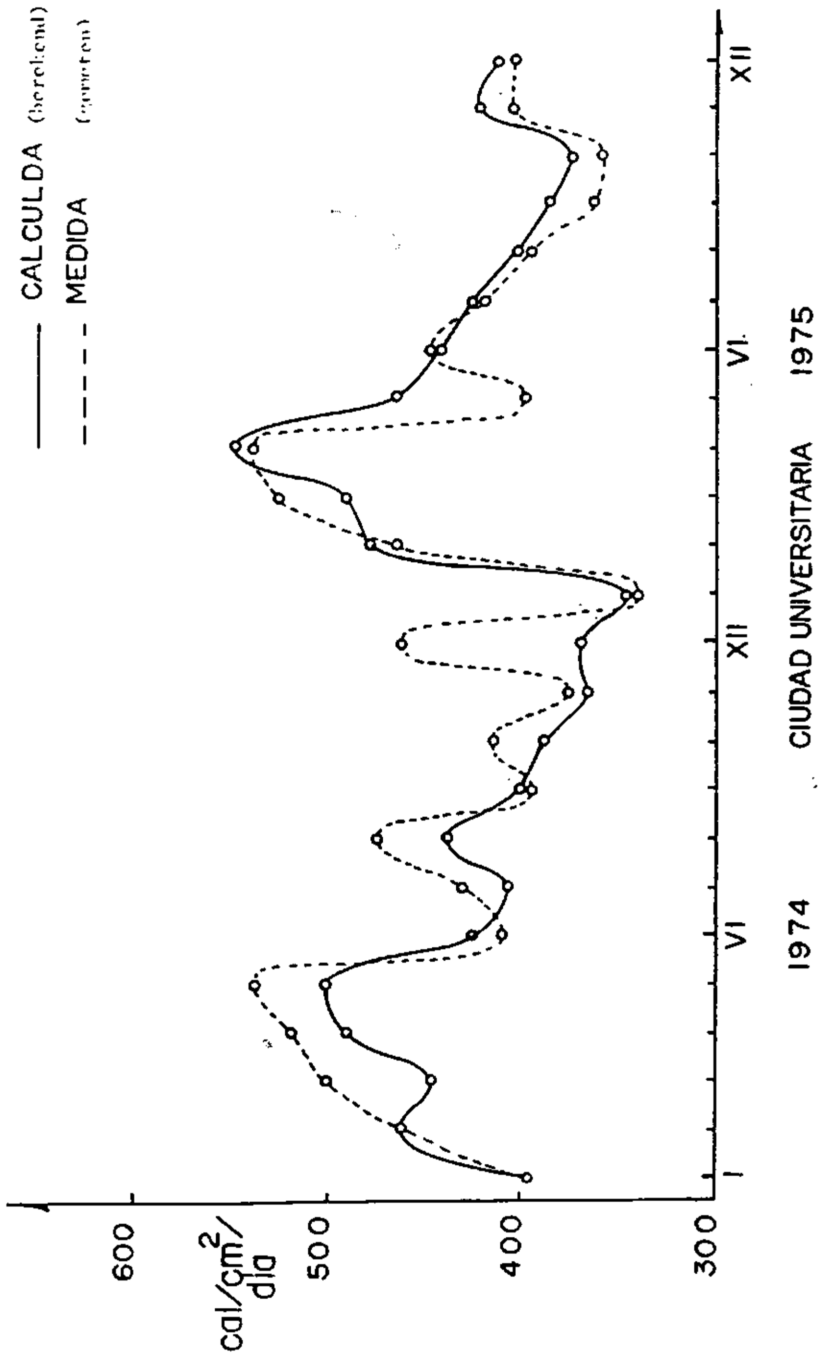
Isopleths of solar radiation (from sun and sky) on a horizontal surface, in gcal/cm² day: January

Appendix 2B

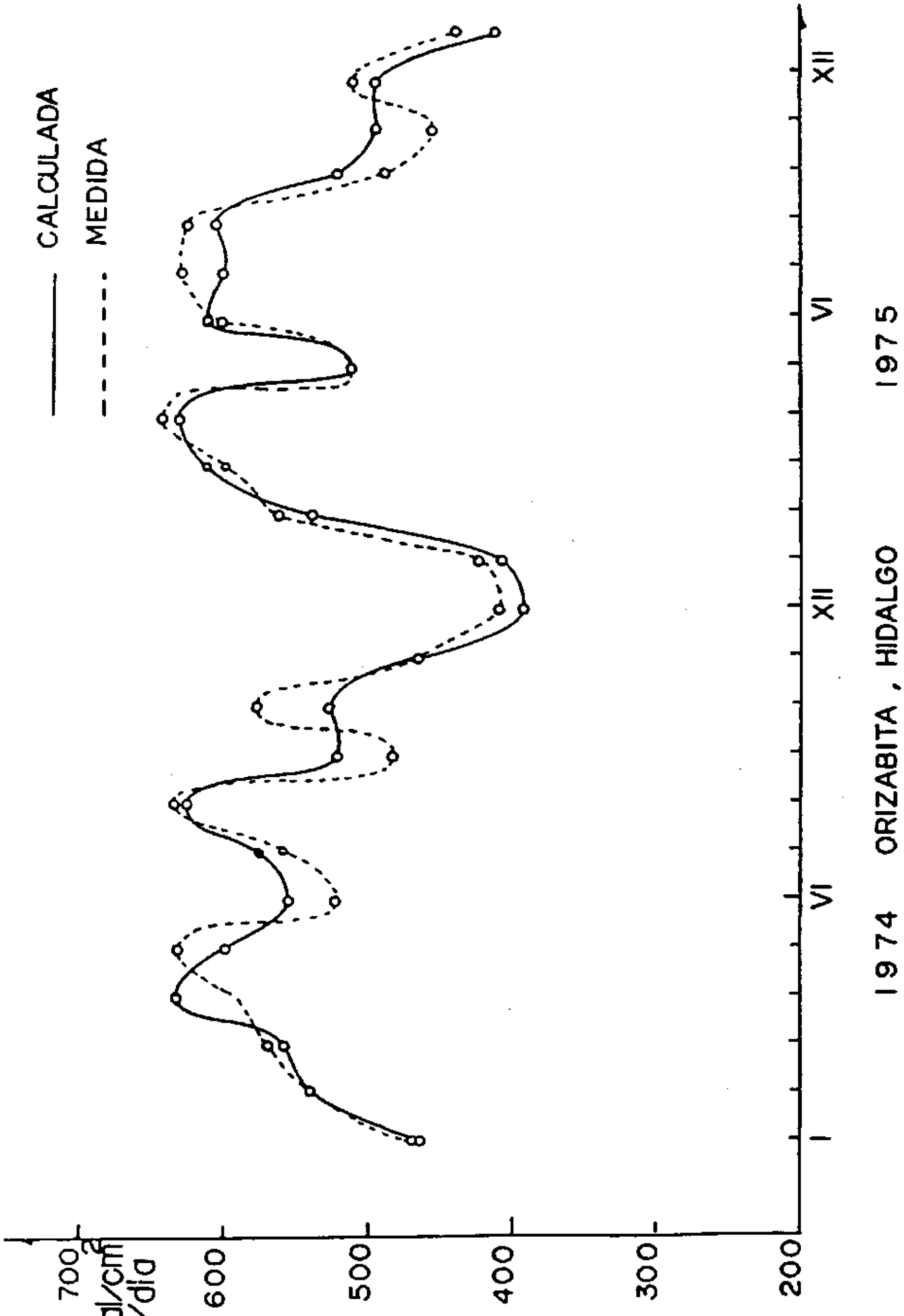


Isopleths of solar radiation (from sun and sky) on a horizontal surface, in gcal/cm$^2$ day: July

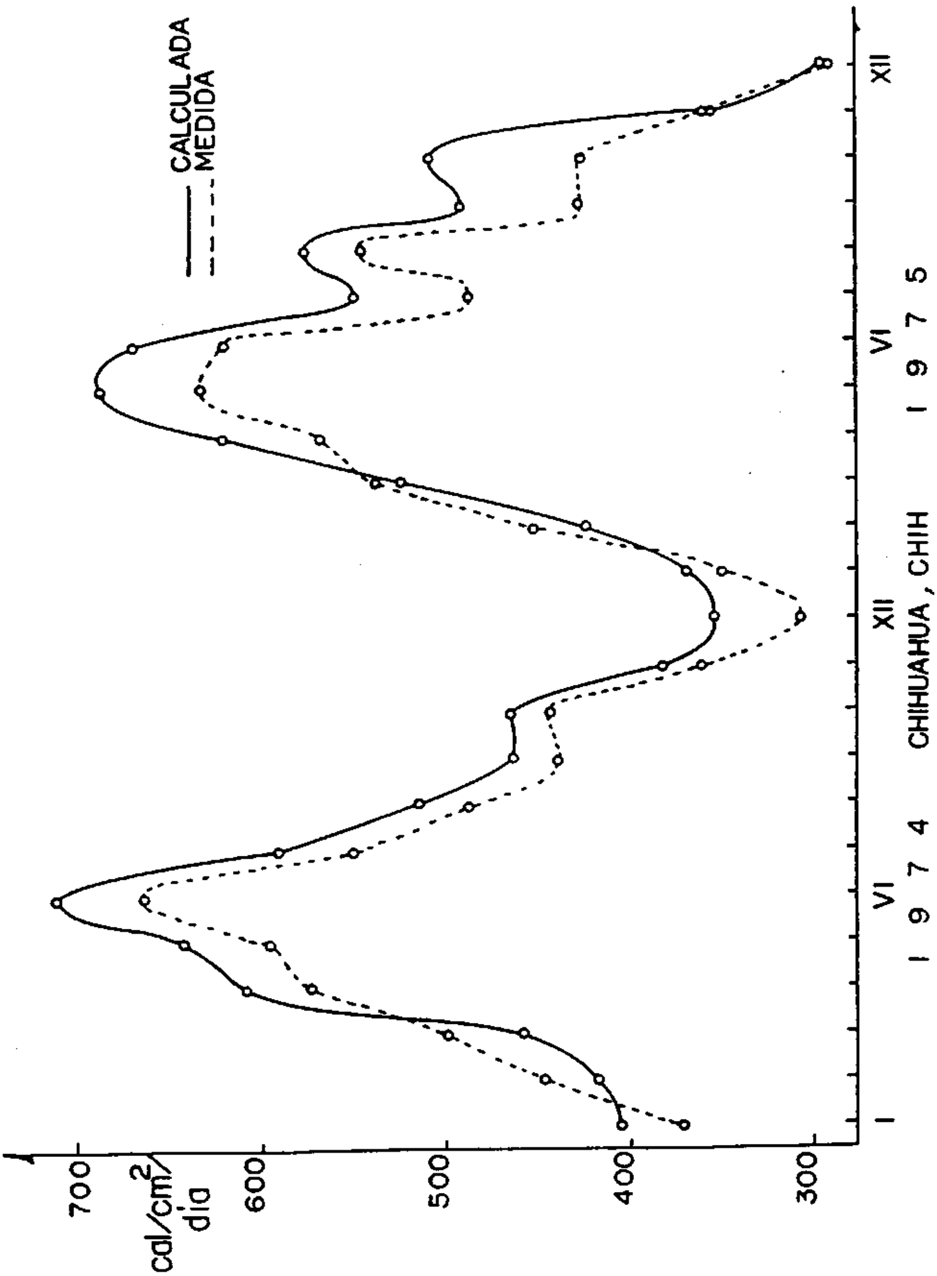
**Appendix 3 Global radiation**



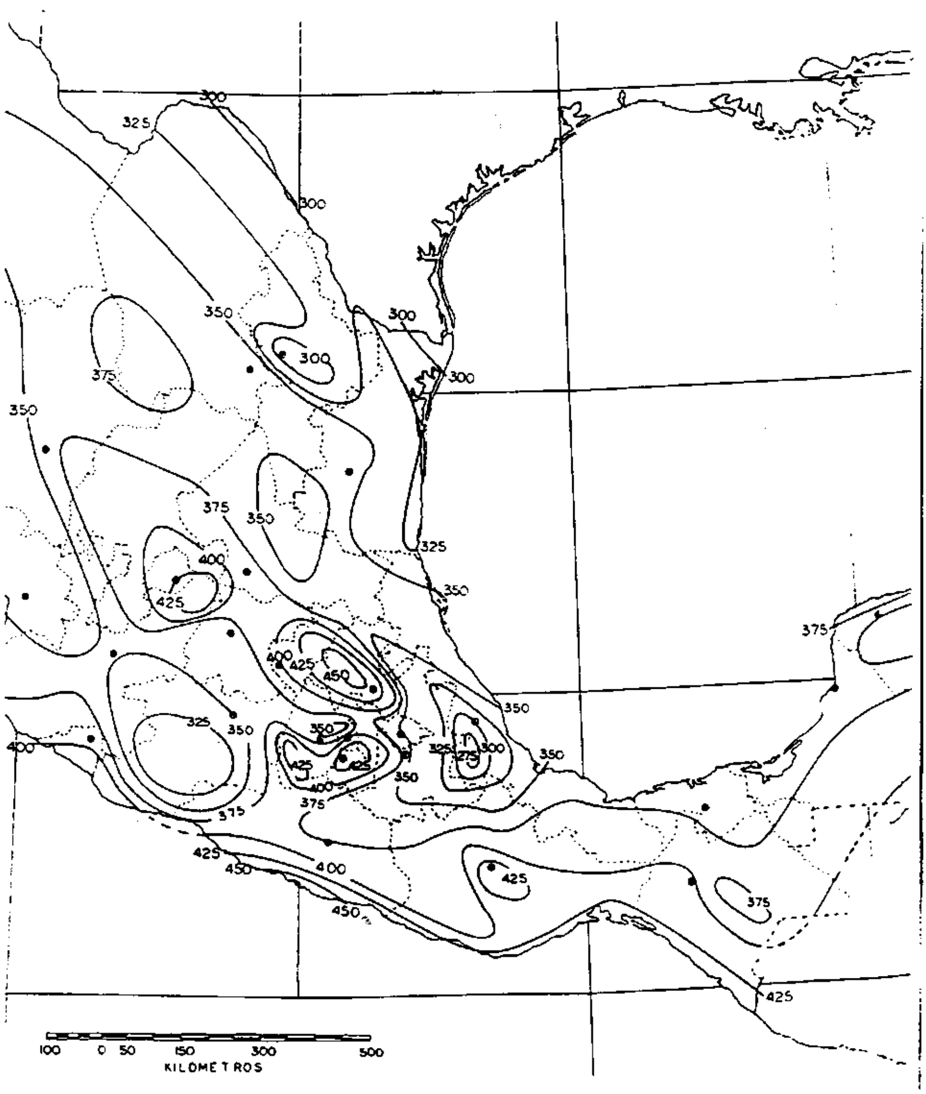
Appendix 4  Global radition



Appendix 5  Global radiation

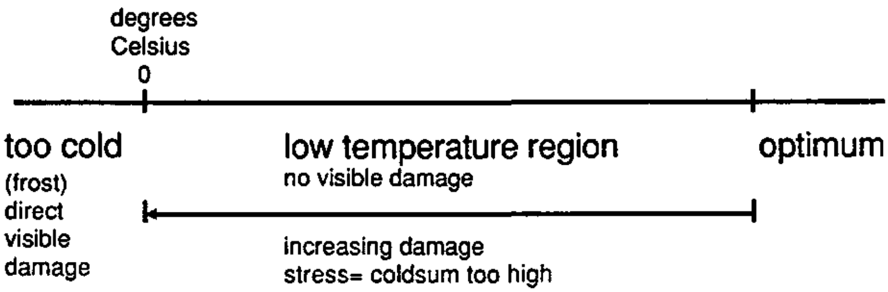


Appendix 6  Global radiation in the month January

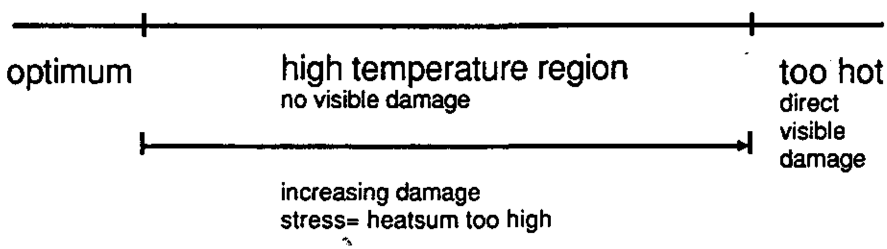


# SCHEMATIC SURVEY OF THE TEMPERATURE (TEMPERATURE LINE)

## Minimum temperature:




## Maximum temperature:



Appendix 8

NORMALES CLIMATOLOGICAS
1951-1980

Latitud 19-18 | Toluca, Mexico | OBS.SINOPTICO
Longitud 099-40 | Altitud 2720 MSNM | ORG.DGEIES-SMN

| PARAMETROS | ANOS | ENE | FEB | MAR | ABR | MAY | JUN | JUL | AGO | SEP | OCT | NOV | DIC | ANUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ---Temperaturas--- | | | | | | | | | | | | | | |
| Maxima extrema | 28 | 24.5 | 25.0 | 27.4 | 28.8 | 28.4 | 26.0 | 25.0 | 23.0 | 23.0 | 25.0 | 23.0 | 22.4 | 28.8 |
| Promedio de maxima | 28 | 17.0 | 18.1 | 20.4 | 21.3 | 21.1 | 19.5 | 18.0 | 18.3 | 18.1 | 18.3 | 17.6 | 16.9 | 18.7 |
| Media | 28 | 9.4 | 10.5 | 12.7 | 14.1 | 14.4 | 14.0 | 13.0 | 13.1 | 13.0 | 12.1 | 10.9 | 9.6 | 12.2 |
| Promedio de minima | 28 | 1.8 | 2.8 | 4.7 | 6.7 | 7.9 | 9.1 | 8.5 | 8.5 | 8.2 | 5.9 | 3.8 | 2.3 | 5.9 |
| Minima extrema | 28 | -7.3 | -7.0 | -4.0 | -5.0 | -.5 | .5 | .5 | 2.3 | -3.5 | -8.2 | -7.5 | -10.0 | -10.0 |
| Fecha (dia/ano) | | 12/79 | 26/76 | VS/VS | 08/73 | 02/78 | 15/79 | 09/79 | 28/78 | 30/79 | 21/69 | 27/74 | 28/75 | 28/12/75 |
| Humedad relativa media | 28 | 60 | 56 | 53 | 55 | 63 | 73 | 76 | 75 | 76 | 71 | 66 | 65 | 66 |
| Num. dias con helada | 28 | 23.77 | 19.03 | 11.11 | 2.67 | .78 | .14 | .03 | .10 | .67 | 4.07 | 13.03 | 20.32 | 95.72 |

Appendix 8 (continued)

NORMALES CLIMATOLOGICAS
1971-1980

Latitud 19-02 | Universidag de Puebla, PUE | OBS.SINOPTICO
Longitud 098-12 | Altitud 2162 MSNM | ORG.DGEIES-SMN

| PARAMETROS | ANOS | ENE | FEB | MAR | ABR | MAY | JUN | JUL | AGO | SEP | OCT | NOV | DIC | ANUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ---Temperaturas--- | | | | | | | | | | | | | | |
| Maxima extrema | 10 | 26.8 | 26.8 | 29.2 | 31.0 | 31.2 | 28.2 | 27.0 | 33.2 | 25.8 | 27.2 | 33.4 | 26.0 | 33.4 |
| Promedio de maxima | 10 | 21.3 | 22.3 | 24.9 | 25.7 | 25.8 | 23.4 | 22.7 | 27.9 | 22.5 | 22.3 | 22.1 | 21.1 | 23.3 |
| Media | 10 | 14.3 | 15.5 | 18.0 | 18.8 | 19.3 | 18.1 | 17.3 | 17.3 | 17.1 | 16.9 | 15.5 | 14.3 | 16.9 |
| Promedio de minima | 10 | 7.1 | 8.0 | 10.3 | 11.2 | 13.1 | 13.0 | 12.2 | 12.0 | 12.0 | 10.7 | 9.0 | 7.3 | 10.3 |
| Minima extrema | 10 | 1.4 | -1.0 | 2.6 | 5.2 | 7.8 | 7.4 | 7.5 | 6.7 | 4.1 | 5.0 | 1.7 | 6 | -1.0 |
| Fecha (dia/ano) | | 04/79 | VS/76 | 18/78 | 06/77 | 04/77 | 25/77 | VS/VS | 23/77 | 25/75 | 09/74 | 29/74 | 22/77 | 73/02/76 |
| Humedad relativa media | 10 | 53 | 50 | 47 | 48 | 52 | 60 | 62 | 62 | 65 | 62 | 60 | 56 | 56 |
| Num. dias con helada | 10 | 5.80 | 4.20 | .66 | .22 | .00 | .10 | .00 | .10 | .11 | 60 | 2.66 | 2.54 | 16.99 |

Appendix 8 (continued)

NORMALES CLIMATOLOGICAS
1951-1980

Latitud 20-41 | Irapuato, Irapuato, Gto | EST. CLIMATOLGICA
Longitud 101-21 | Altitud 1724 MSNM | ORG. SMRD-SARH

| PARAMETROS | ANOS | ENE | FEB | MAR | ABR | MAY | JUN | JUL | AGO | SEP | OCT | NOV | DIC | ANUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ---Temperaturas--- | | | | | | | | | | | | | | |
| Maxima extrema | 27 | 35.5 | 34.6 | 38.8 | 39.9 | 36.8 | 38.0 | 35.0 | 33.0 | 39.1 | 33.0 | 34.0 | 39.6 | 39.6 |
| Promedio de maxima | 27 | 26.1 | 27.8 | 30.2 | 31.4 | 32.0 | 30.3 | 28.2 | 28.0 | 27.7 | 27.8 | 27.3 | 25.7 | 28.5 |
| Media | 27 | 16.9 | 18.3 | 20.8 | 22.7 | 24.0 | 23.5 | 21.9 | 21.8 | 21.5 | 20.4 | 18.8 | 17.2 | 20.7 |
| Promedio de minima | 27 | 7.7 | 8.8 | 11.4 | 14.1 | 16.0 | 16.8 | 15.7 | 15.7 | 15.4 | 13.1 | 10.4 | 8.7 | 12.8 |
| Minima extrema | 27 | -.6 | -2.5 | 1.1 | 6.1 | 10.0 | 10.8 | 6.0 | 7.5 | 4.8 | 1.0 | -.5 | -1.5 | -2.5 |
| Fecha (dia/ano) | | 24/55 | 24/76 | VS/72 | 05/60 | 06/74 | 19/65 | 25/69 | 20/70 | 26/75 | 19/73 | 26/74 | 22/54 | 24/02/76 |
| Humedad relativa media | | | | | | | | | | | | | | |
| Num. dias con helada | 27 | 4.62 | 1.57 | .29 | .00 | .00 | .00 | .00 | .00 | .00 | .59 | 1.14 | 3.29 | 11.50 |

Appendix 8 (continued)

NORMALES CLIMATOLOGICAS
1951-1980

Latitud 19-36 | Zitacuaro, Zitacuaro, Mich. | EST. CLIMATOLGICA
Longitud 100-22 | Altitud 1981 MSNM | ORG. SGAD-SUN

| PARAMETROS | ANOS | ENE | FEB | MAR | ABR | MAY | JUN | JUL | AGO | SEP | OCT | NOV | DIC | ANUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ---Temperaturas--- | | | | | | | | | | | | | | |
| Maxima extrema | 20 | 27.2 | 30.6 | 31.6 | 32.2 | 32.7 | 30.9 | 26.0 | 26.2 | 25.8 | 30.0 | 30.0 | 28.0 | 32.7 |
| Promedio de maxima | 20 | 21.3 | 23.1 | 25.5 | 27.7 | 27.8 | 24.1 | 22.0 | 22.2 | 21.9 | 22.4 | 22.4 | 21.5 | 23.5 |
| Media | 20 | 15.0 | 16.1 | 18.2 | 20.2 | 20.8 | 19.1 | 17.6 | 17.6 | 17.3 | 17.0 | 16.3 | 15.3 | 17.5 |
| Promedio de minima | 20 | 8.7 | 9.1 | 10.9 | 12.7 | 13.9 | 14.1 | 13.2 | 13.0 | 12.8 | 11.6 | 10.3 | 9.1 | 11.6 |
| Minima extrema | 20 | 2.0 | 3.2 | 6.0 | 7.8 | 9.2 | 10.6 | 10.2 | 11.0 | 3.0 | 3.0 | 3.4 | 3.0 | 2.0 |
| Fecha (dia/ano) | | 12/56 | 08/68 | VS/68 | 01/51 | 21/51 | 02/56 | 22/56 | VS/VS | VS/79 | 02/79 | 14/63 | 29/79 | 12/01/56 |
| Humedad relativa media | | | | | | | | | | | | | | |
| Num. dias con helada | 20 | 4.10 | 2.10 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .52 | 1.47 | 2.00 | 10.19 |

Appendix 8 (continued)

N O R M A L E S   C L I M A T O L O G I C A S
1951-1980

Latitud 19-25 | Uruapan, Uruapan, Mich. | EST. CLIMATOLGICA
Longitud 102-04 | Altitud 1634 MSNM | ORG. SGAD-SMN

| PARAMETROS | AROS | ENE | FEB | MAR | ABR | MAY | JUN | JUL | AGO | SEP | OCT | NOV | DIC | ANUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ---Temperaturas--- | | | | | | | | | | | | | | |
| Maxima extrema | 8 | 28.5 | 28.5 | 31.0 | 31.0 | 31.5 | 31.0 | 29.0 | 28.0 | 28.5 | 28.5 | 34.5 | 34.0 | 34.5 |
| Promedio de maxima | 8 | 24.0 | 25.3 | 27.3 | 28.7 | 28.8 | 26.1 | 24.5 | 24.9 | 24.5 | 24.7 | 24.7 | 23.6 | 25.6 |
| Media | 8 | 15.2 | 16.1 | 17.5 | 19.2 | 20.1 | 20.0 | 19.2 | 19.2 | 18.7 | 18.2 | 17.1 | 15.6 | 18.0 |
| Promedio de minima | 8 | 6.5 | 7.0 | 7.8 | 9.8 | 11.5 | 14.0 | 14.0 | 13.5 | 13.0 | 11.7 | 9.6 | 7.7 | 10.5 |
| Minima extrema | 8 | 1.0 | 2.0 | 2.5 | 3.5 | 7.0 | 9.5 | 9.0 | 9.0 | 7.5 | 4.0 | 3.0 | -.5 | -.5 |
| Fecha (dia/ano) | | VS/VS | 23/55 | 03/57 | 04/57 | VS/60 | 30/59 | VS/VS | 23/53 | 23/53 | 22/52 | VS/53 | 06/60 | 06/12/60 |
| Humedad relativa media | | | | | | | | | | | | | | |
| Num. dias con helada | 26 | 1.38 | 1.03 | .19 | .03 | .00 | .00 | .00 | .00 | .00 | .00 | .14 | .87 | 3.64 |

Appendix 8 (continued)

N O R M A L E S   C L I M A T O L O G I C A S

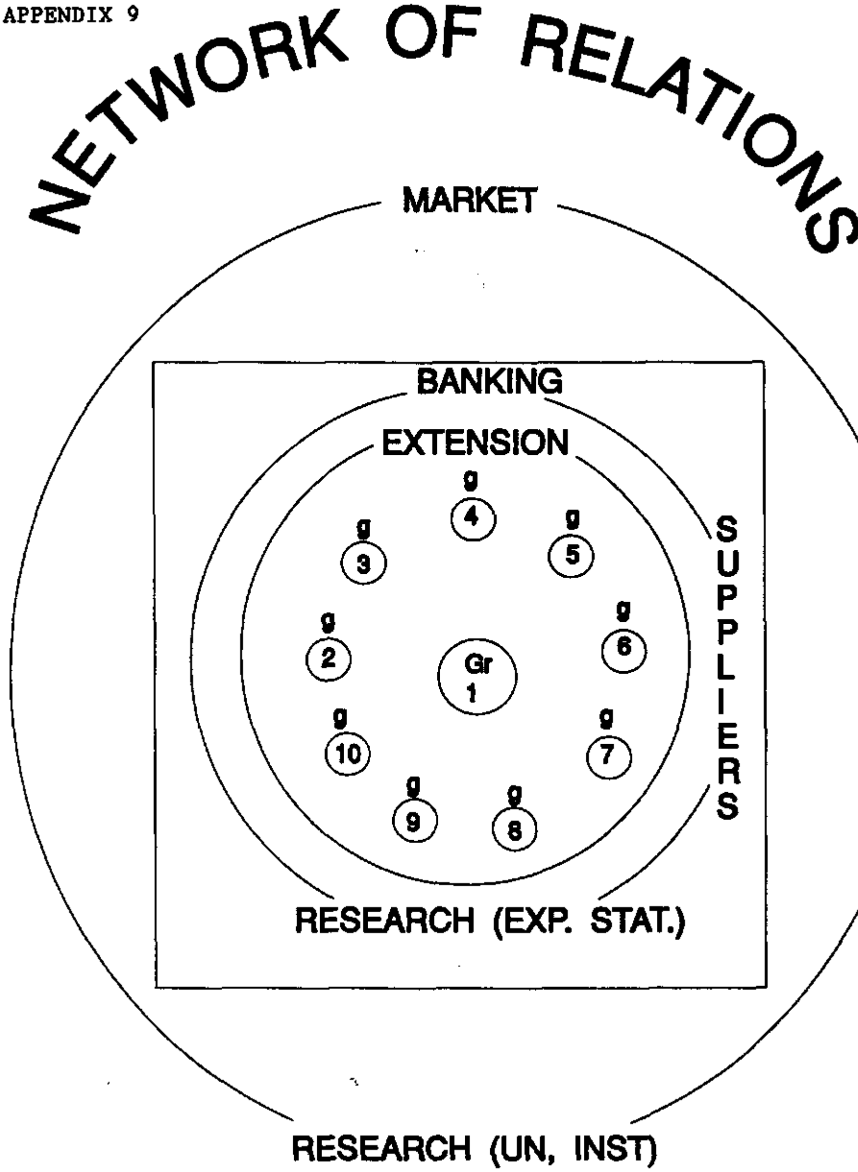
1951-1980

Latitud 24-48 | Culiacan, Sin. | OBS. SINOPTICO

Longitud 107-24 | Altitud 84 MSNM | ORG. DGEIES-SMN

| PARAMETROS | AROS | ENE | FEB | MAR | ABR | MAY | JUN | JUL | AGO | SEP | OCT | NOV | DIC | ANUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ---Temperaturas--- | | | | | | | | | | | | | | |
| Maxima extrema | 28 | 35.1 | 37.1 | 37.9 | 40.4 | 41.4 | 43.0 | 41.7 | 43.0 | 40.7 | 39.4 | 39.2 | 35.1 | 43.0 |
| Promedio de maxima | 28 | 27.7 | 29.3 | 31.1 | 33.5 | 35.3 | 36.1 | 35.9 | 35.3 | 35.0 | 34.4 | 31.8 | 28.6 | 32.8 |
| Media | 28 | 19.9 | 20.6 | 21.9 | 24.6 | 27.3 | 29.6 | 29.7 | 29.1 | 29.0 | 27.7 | 24.0 | 20.7 | 25.3 |
| Promedio de minima | 28 | 12.4 | 12.2 | 13.3 | 15.8 | 18.8 | 23.6 | 24.2 | 23.7 | 23.8 | 21.3 | 16.3 | 13.4 | 18.2 |
| Minima extrema | 28 | 3.8 | 1.6 | 5.4 | 10.0 | 12.5 | 15.8 | 20.0 | 19.0 | 19.0 | 14.1 | 6.6 | 3.8 | 1.6 |
| Fecha (dia/aro) | | 23/55 | 04/56 | 03/71 | 08/75 | 01/75 | 05/53 | VS/VS | 13/65 | 29/63 | 31/69 | 23/57 | 24/53 | 04/02/56 |
| Humedad relativa media | 28 | 68 | 63 | 59 | 56 | 57 | 62 | 70 | 74 | 74 | 70 | 66 | 68 | 66 |
| Num. dias con helada | 28 | .10 | .06 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .07 | .23 |

APPENDIX 9




Gr1=grower number one

Appendix 10 The productivity of labour, fuel and durable production means by tomatoes from heavy heated glasshouses in The Netherlands

| | 1954 | 1958 | 1963 | 1969 | 1975 | 1982 |
|---|---|---|---|---|---|---|
| Yields per 1000 m2 greenhouse | | | | | | |
| - Kg harvest before June | 1850 | 3500 | 5300 | 6100 | 7500 | 8500 |
| - Kg harvested after June | 5850 | 6000 | 5000 | 6900 | 7500 | 20500 |
| | ----- | ----- | ----- | ----- | ----- | ----- |
| - Kilogramme total | 7700 | 9500 | 10300 | 13000 | 15000 | 29000 |
| Used production means per 1000 m2 greenhouse | | | | | | |
| - Oil 3,500 sec in ton's | 35 | 44 | 57 | 63 | 65 | 38 |
| - Capital (dpm 2)) in *f* 1000,- | 28 | 34 | 38 | 42 | 50 | 66 |
| - Labour in hours | 1170 | 1030 | 800 | 650 | 650 | 720 |
| Productivity per: | | | | | | |
| - Ton oil | 220 1) | 216 | 181 | 206 | 231 | 763 |
| - *f* 1000,- capital | 275 | 280 | 271 | 310 | 300 | 439 |
| - One houe labour | 6.6 | 9.2 | 12.6 | 20.0 | 23.1 | 40.3 |
| Costs per kg tomatoes in Dutch cents | | | | | | |
| - Fuel costs | 0.44 | 0.35 | 0.36 | 0.39 | 0.24 | 0.54 |
| - DPM costs | 0.37 | 0.36 | 0.36 | 0.32 | 0.33 | 0.44 |
| - Labour costs | 0.21 | 0.20 | 0.21 | 0.28 | 0.38 | 0.53 |
| | ----- | ----- | ----- | ----- | ----- | ----- |
| - Totaal fuel, dpm and labour | 1.02 | 0.91 | 0.93 | 0.89 | 0.95 | 1.51 |

1) 7700 : 35 = 220.
2) dpm = durabele production means (capital invested in fixed resources).
Source: LEI (The Hague).