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INFLUENCE OF ENVIRONMENTAL FACTORS – TEMPERATURE AND PRECIPITATIONS – UPON THE TOMATOES CROPS

ANCUȚA MARIN¹

Summary: The diversified way of consumption of tomatoes and versatility of the species that can be grown with good results in different environmental conditions and climate have determined a particular interest for the vegetable producers. Current conceptions about balanced nutrition, grant tomato consumption a priority position, primarily because tomatoes ensures to human body a wide range of vitamins, minerals and water, so necessary for normal physiological activity of the human body. In the present paper I will present a comparative analysis of the temperature and precipitations in the period 2009-2015, during the growing period (March-September) for field tomato crops, and their influence on production. The purpose of the paper is to make some recommendations that could be useful to our vegetable growers who choose to cultivate tomatoes in field.

Keywords: culture, temperatures, precipitation, production, tomatoes.

INTRODUCTION

Tomatoes originated on the American continent, specifically in Mexico, Peru, Ecuador and Central America, were discovered and used in human nutrition since the year 200 BC. The name "tomatoes" comes from the Aztec word "*tomatel*". In the first half of the sixteenth century tomatoes are spreading in Asia (China and Japan). After WWI, tomatoes get spread across the globe, nowadays are ranked first in the world among vegetable crops.

Columbus is the one who brings the tomatoes on the European continent, first in Spain and Portugal. At the beginning of the twentieth century tomato crop for commercialization began in France (1880), then in Belgium (1904) and Germany (1914). The emergence greenhouses and solariums lead to a larger areal of growing to high latitudes in the northern and southern extremes of the temperate zones.

In Romania, tomatoes culture is signalled in the nineteenth century, when practiced on small areas. Extension of tomatoes grown in Romania is mentioned at the beginning of the twentieth century, while increasing urban population and population growth.

The way diversified of consumption of tomatoes (fresh juice, pulp, dried, etc.) as well as the versatility of the species that can be grown with good results in different environmental conditions and climate have determined particular interest for vegetable producers.

There are many varieties and hybrids in grown. In our country more than 40 varieties are approved, and worldwide there are known over 500 varieties. All these varieties are classified in various ways by:

- a) Geographical conditions: South American group and West European group,
- b) Type of spaces of production: culture in the field and in protected spaces: greenhouses, solariums, tunnels, seedbeds,
- c) Vegetation period: early varieties (95-120 days), medium late varieties (120-130 days), late varieties (over 130 days) - most commonly used in our country,
- d) Type of consumption: of fresh or processed condition.

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The purpose of the paper is to make some recommendations that could be useful to our vegetable growers who choose to cultivate tomatoes in field.

MATERIAL AND METHOD

The importance of tomato as food is given by the varied ways of their consumption - fresh juice, pulp, dehydrated - for those who reach physiological maturity and pickles - for those consumed before maturation. In addition to the high demand of the population for current consumption, tomatoes are very much requested in canning industry of vegetables, meat and fish, and is also an important export product.

They are requested at the export especially greenhouse tomatoes, the early and industrialized products. The provisions of the World Food and Agriculture Organization (F.A.O), recommends consumption of vegetables in varying amounts according to the age of consumers. Current conceptions about balanced nutrition, gives to tomato consumption a priority position primarily because they provide human organism a wide range of vitamins, minerals and water vital, so necessary for normal physiological activity of the human body.

In this paper I will present a comparative analysis of the temperature and precipitation in the period 2009-2015, during the growing season (March-September) for field tomato crops and their influence on the production.

RESULTS AND DISCUSSIONS

According to data published by FAOSTAT, the area cultivated with vegetables in the EU registered slight declines in 2009-2013 (with 8.36%), being small variations from year to year, both in Romania and in the European Union (Table No. 1 and Chart 1).

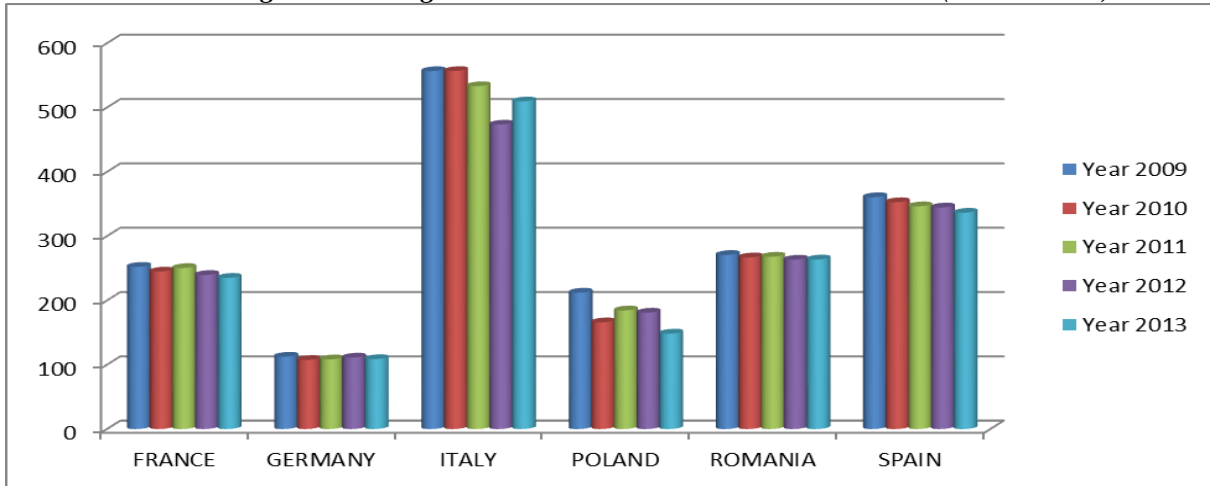
Table 1

| THE SITUATION OF AREAS CULTIVATED WITH VEGETABLES IN ROMANIA AND MAIN EU COUNTRIES | | | | | |
|---|------------------|------------------|------------------|------------------|------------------|
| -thousand hectares- | | | | | |
| | Year 2009 | Year 2010 | Year 2011 | Year 2012 | Year 2013 |
| FRANCE | 252,30 | 245,03 | 250,49 | 239,65 | 235,21 |
| GERMANY | 112,55 | 107,51 | 108,34 | 111,18 | 108,78 |
| ITALY | 556,66 | 556,80 | 533,27 | 473,53 | 509,56 |
| POLAND | 212,13 | 165,97 | 184,48 | 181,07 | 148,47 |
| ROMANIA | 270,78 | 266,94 | 268,01 | 263,44 | 263,75 |
| SPAIN | 360,59 | 352,79 | 346,39 | 344,59 | 336,41 |
| TOTAL EU | 2515,40 | 2409,1 | 2415,00 | 2313,20 | 2305,10 |
| % ROMANIA/EU | 10,76 | 11,08 | 11,10 | 11,39 | 11,44 |

Source: FAOSTAT

As reflected in Table 1 and Chart 1, the country with largest surface area of vegetable growing is Italy, with a maximum of 556 800 ha in 2010 and 509 600 ha in 2013. Romania represents from 10.76 to 11.44% of the area cultivated with vegetables in the EU, being 270 780 ha in 2009 and reaching 263 440 ha in 2012. The latest data from the Ministry of Agriculture and Rural Development, the year with the small vegetable growing area in Romania was 2014, when it was only 239.0 thousand hectares with a decrease of 12% compared to 2009.

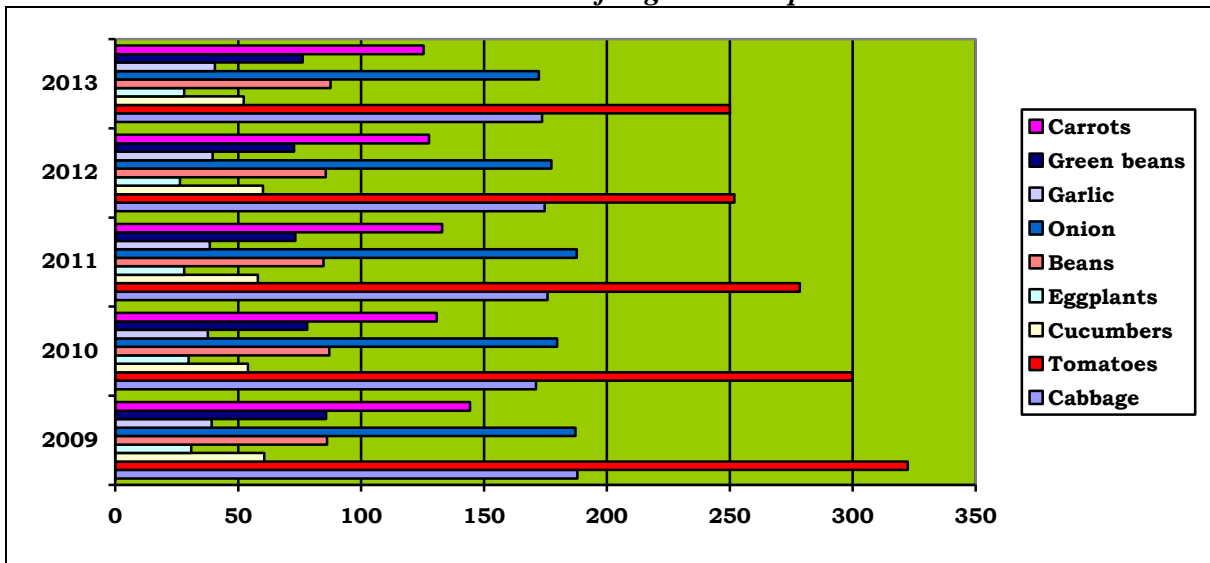
Chart 1 – Vegetable acreage situation in Romania and EU countries (thousand ha)



Source: FAOSTAT

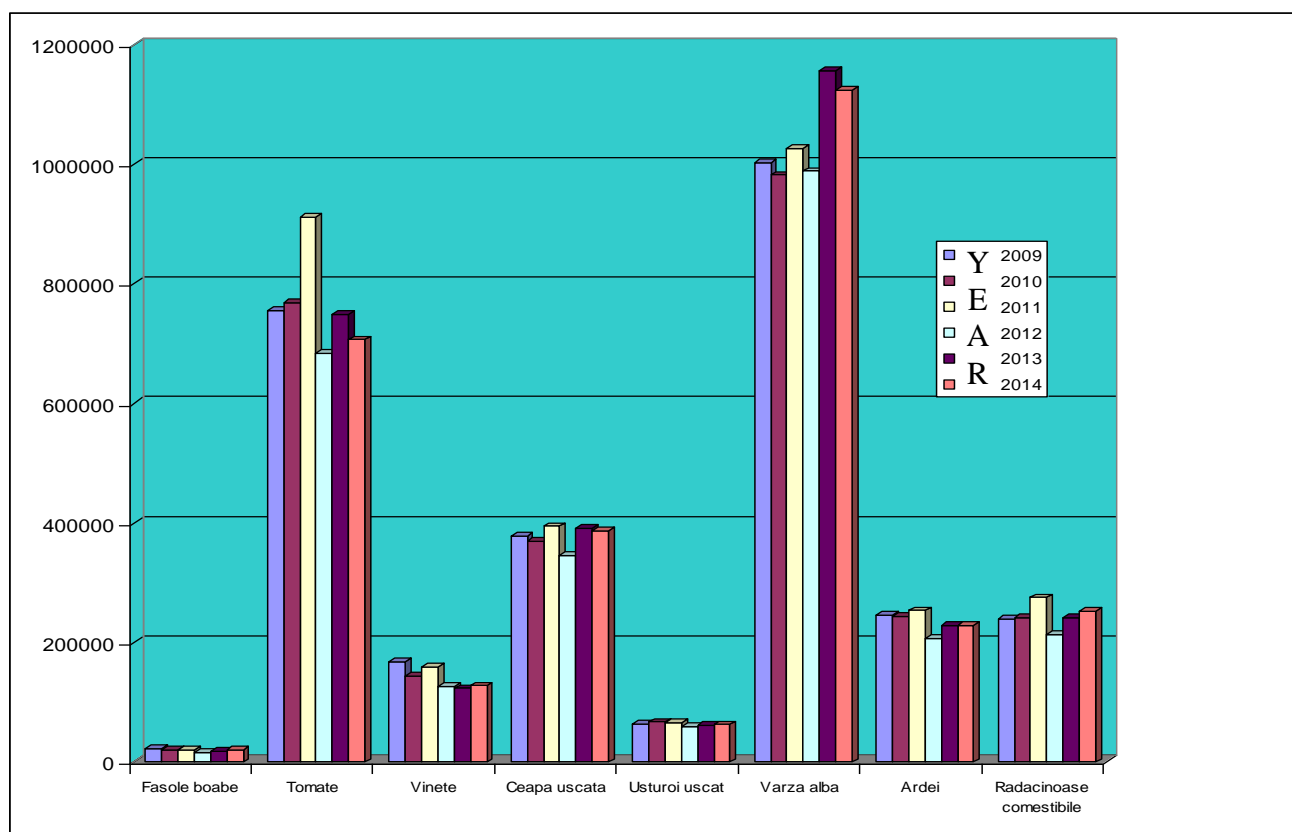
As concerning the areas occupied by different types of vegetables in the EU, as illustrated by Chart 2, these have been in relative decline, the decrease is more pronounced at the areas occupied by tomatoes, 22.4% (322.300 ha in 2009, 250 thousand ha in 2013) and potatoes, 16.3% (2096.2 thousand hectares in 2009, 1753.6 thousand ha in 2013), which are the most expanded.

Chart 2 – The structure of vegetable crops in the EU



Source: FAOSTAT

In Romania, according to data from the National Statistics Institute, the structure of vegetable crops is shown in Chart 3. We note that tomatoes ranks 2 after white cabbage, followed by onions, peppers and root vegetables.

Chart 3 – The structure of vegetable crops in ROMANIA

Source: National Institute of Statistics

Analysis of vegetable production in Romania and major EU countries reveals that they declined within 2009 to 2013. Thus the total vegetable production in 2009 was 69080.2 thousand tons, reaching in 2013 at the 64658.0 therefore a decrease of approximately 7%.

Table 2

| SITUATION OF VEGETABLES PRODUCTION IN ROMANIA AND MAIN EU COUNTRIES | | | | | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| - thousands tones - | | | | | |
| | Year 2009 | Year 2010 | Year 2011 | Year 2012 | Year 2013 |
| FRANCE | 5.685,1 | 5.593,0 | 5.494,5 | 5.283,5 | 5.235,3 |
| GERMANY | 3.662,0 | 3.350,7 | 3.593,6 | 3.820,7 | 3.416,1 |
| ITALY | 15.481,8 | 14.565,0 | 14.242,3 | 12.960,9 | 13.049,2 |
| POLAND | 5.804,8 | 5.113,4 | 5.801,7 | 5.656,0 | 5.210,7 |
| ROMANIA | 3.912,8 | 3.876,8 | 4.191,5 | 3.550,6 | 3.976,6 |
| SPAIN | 13.342,9 | 12.728,8 | 12.714,1 | 12.962,8 | 12.701,3 |
| TOTAL | 69.080,2 | 65.497,2 | 67.466,5 | 64.421,5 | 64.658,0 |
| % ROMANIA/UE | 5,66 | 5,92 | 6,21 | 5,51 | 6,15 |

Source: FAOSTAT

The highest production of vegetables is registered in Italy (20% of EU total), followed by Spain (19.6% of EU total), while Germany is the last among the leading EU countries (5.3% of total EU). Romania produced in 2013, 6.15% of EU totals (Table 2). In 2014 total production of vegetables in Romania was 3807.0 thousand tons, 4.26% less than in 2013 and

9.17% less than the maximum range of 4191.5 thousand tons. There could be many explanations. Most vegetable producers prefer to sell at a loss than to join or form a group of producers to negotiate a better price.

The data provided by the Ministry of Agriculture and Rural Development have synthesized information concerning the areas and production of tomatoes in the period under review (Table 3, Chart 4 and Chart 5).

Table 3

| SITUATION OF AREAS CULTIVATED WITH TOMATOES AND TOMATOES PRODUCTION IN ROMANIA BETWEEN 2009 AND 2014 | | | | | | | |
|--|--------------|-------|-------|------|-------|------|------|
| SPECIFICATION | UM | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| Surface | thousands ha | 49,1 | 19,8 | 51,8 | 49,7 | 48,4 | 44 |
| TOTAL Production | thousands to | 755,6 | 768,5 | 911 | 683,3 | 749 | 711 |

Chart 4- Tomatoes crops surface

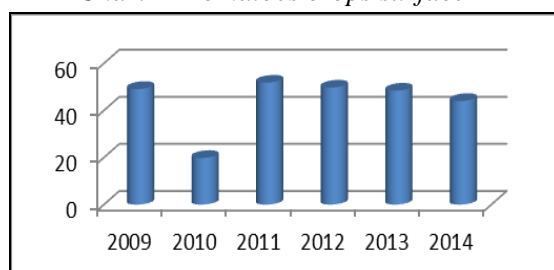
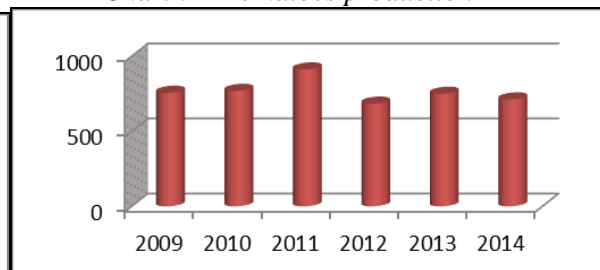


Chart 5 – Tomatoes production



Thereby, 2010 was the year with the smallest surface it represents only 38% of the area that was cultivated with tomatoes in 2011, for example, that is the year with the maximum surface cultivated in the range of years studied. However production recorded in 2010 was ranked second in the interval 2009-2014. The average production of 763 thousand tons interval, only in 2010 and 2011 were recorded above average production of 5.5 thousand tons, 148 thousand tons respectively.

We can draw two conclusions: either was used better performing varieties either temperature-rainfall weather conditions were more favourable to plant development. Following further graphs of temperature and precipitation in the period 2009-2015 we appreciate that the second conclusion is more plausible.

Pedoclimatic conditions allow Romania's annual crop of tomatoes, although the regions of origin, they are perennials. According to data recorded by weather stations in the country in the period 2009-2015 (chart 6), temperatures ranged as follows:

- Between 0°C in March 2012 and 8°C in March 2014,
- Between 12°C and 14°C the two exceptions were in April 2009 and April 2012,
- Between 17,4°C in May 2014 and 19,4°C in May 2015,
- Between 21,2°C in June 2014 and 24,6°C in June 2012,
- Between 22,1°C in July 2014 and 28,9°C in July 2015,
- Between 24,5°C in August 2009 and 27,8°C in August 2015,
- Between 18,6°C in September 2013 and 22,5°C in September 2011.

It follows that the wettest year was 2014, the driest being in 2009.

The tomatoes are thermophilic plants (heat love). Minimum seed germination temperature is 10°C (depending on variety), and the optimum temperature is 24°C. The soil temperature is an important factor in root growth. At temperatures below 10°C and 37°C over plant growth stops. The optimum temperatures for normal growth of the root system of tomato plants are between 15 and

35°C. That is why we will further analyze the influences that have had exceptions temperature and precipitation on the essential moments of the tomato crop - germination and pollination.

Chart 6 - Monthly average temperatures in the period 2009-2015

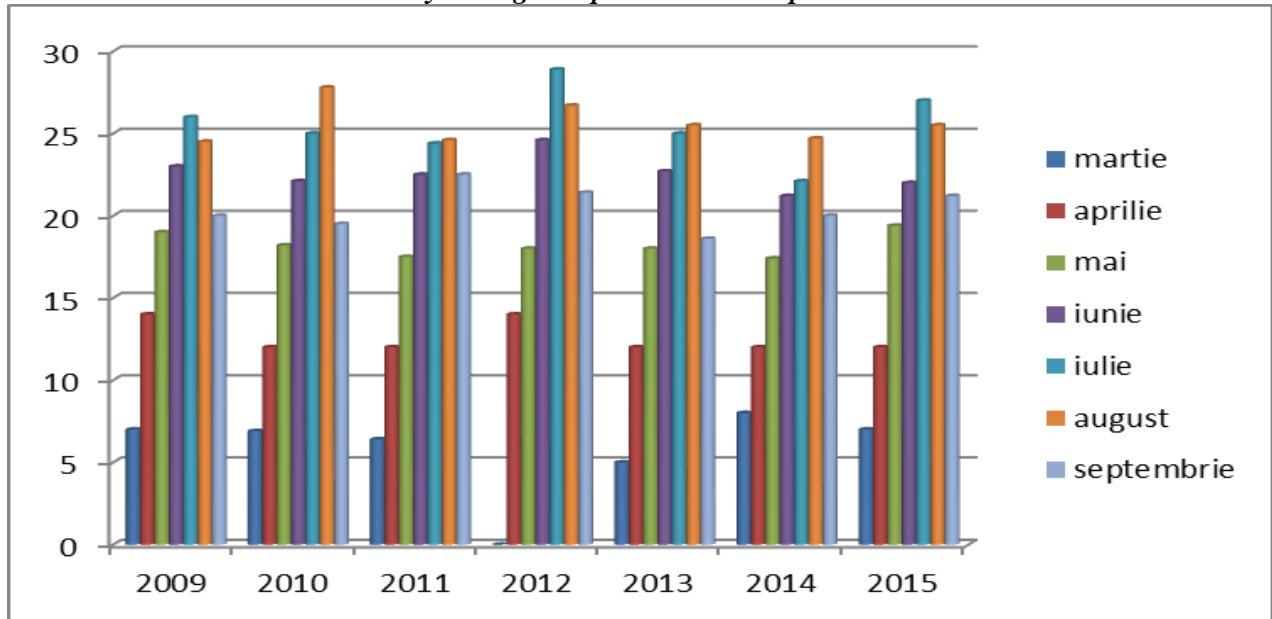
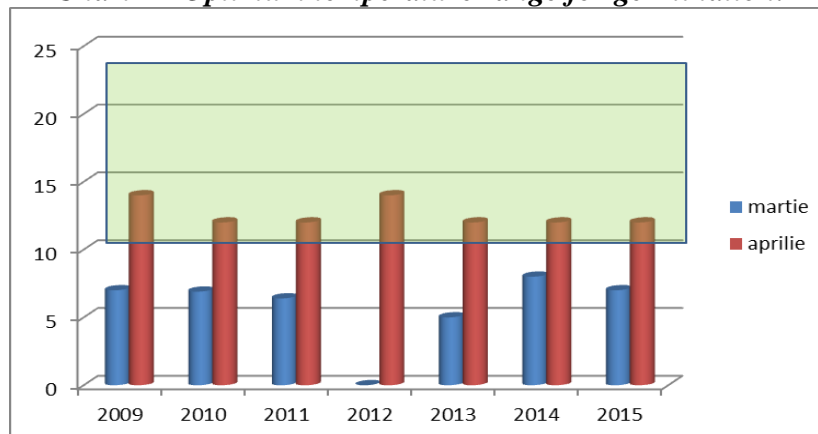


Chart 7 shows that the germination of the seed field tomato is practically impossible in March and has minimal chances in April. That is why it is recommended germination in protected spaces and replanting seedlings in field when the temperature is optimal.

Tomatoes are self-pollinating plants, meaning that each flower has both female organs (pistil) and male (stamens). The stamens are located at the top of the flower and the pestle is located at the bottom. Fertilization occurs by gravity, pollen from the stamens "gliding" over pestle. Where this "slip" does not occur or is insufficient quantitative, fertilization does not occur and flowers falls without fruition (bind).

As gravity is a phenomenon that acts permanently, I can think of two main causes that prevent fertilization. Primarily "sliding" does not occur when pollen is too glued to the stamens and cannot break away from them. Secondly, even if the "slippage" occurs, the pollen that falls is too dry to stick to the pistil and fertilize it.

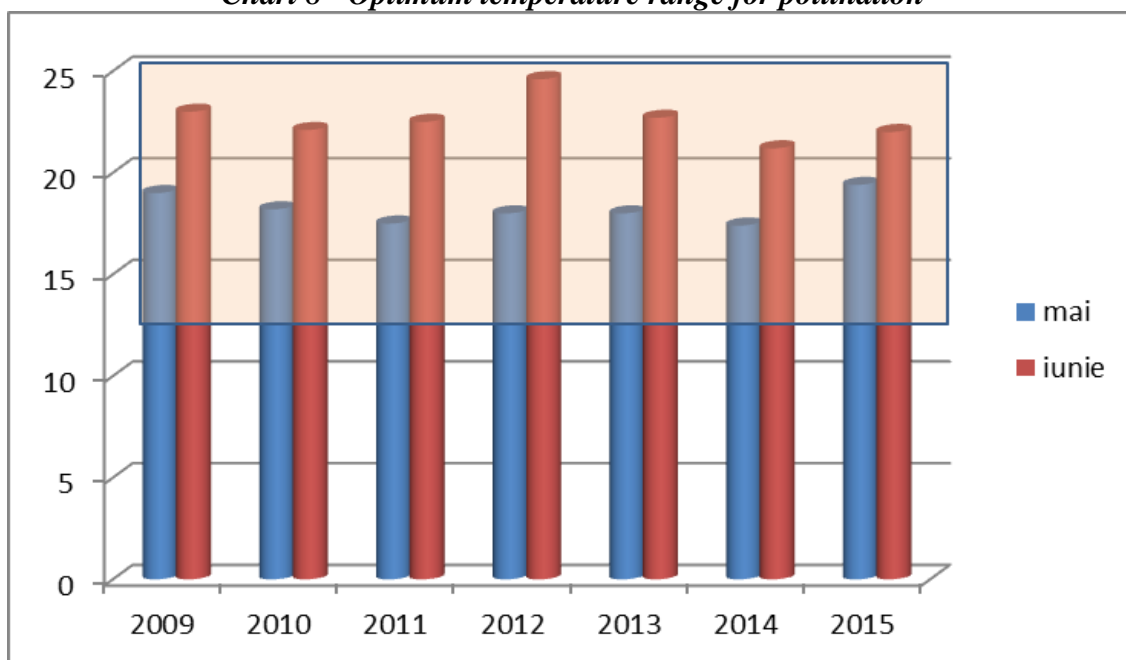
Chart 7 - Optimum temperature range for germination.



The optimum temperature of occurrence of pollination is between 13°C and 25°C. Tomatoes are plants that can tolerate temperatures outside this range, only that, especially if

the situation lasts for several days in a row, they lose their "interest" for pollination and "focus" more on the problems of survival. At temperatures above 35°C, the pollen becomes sterile.

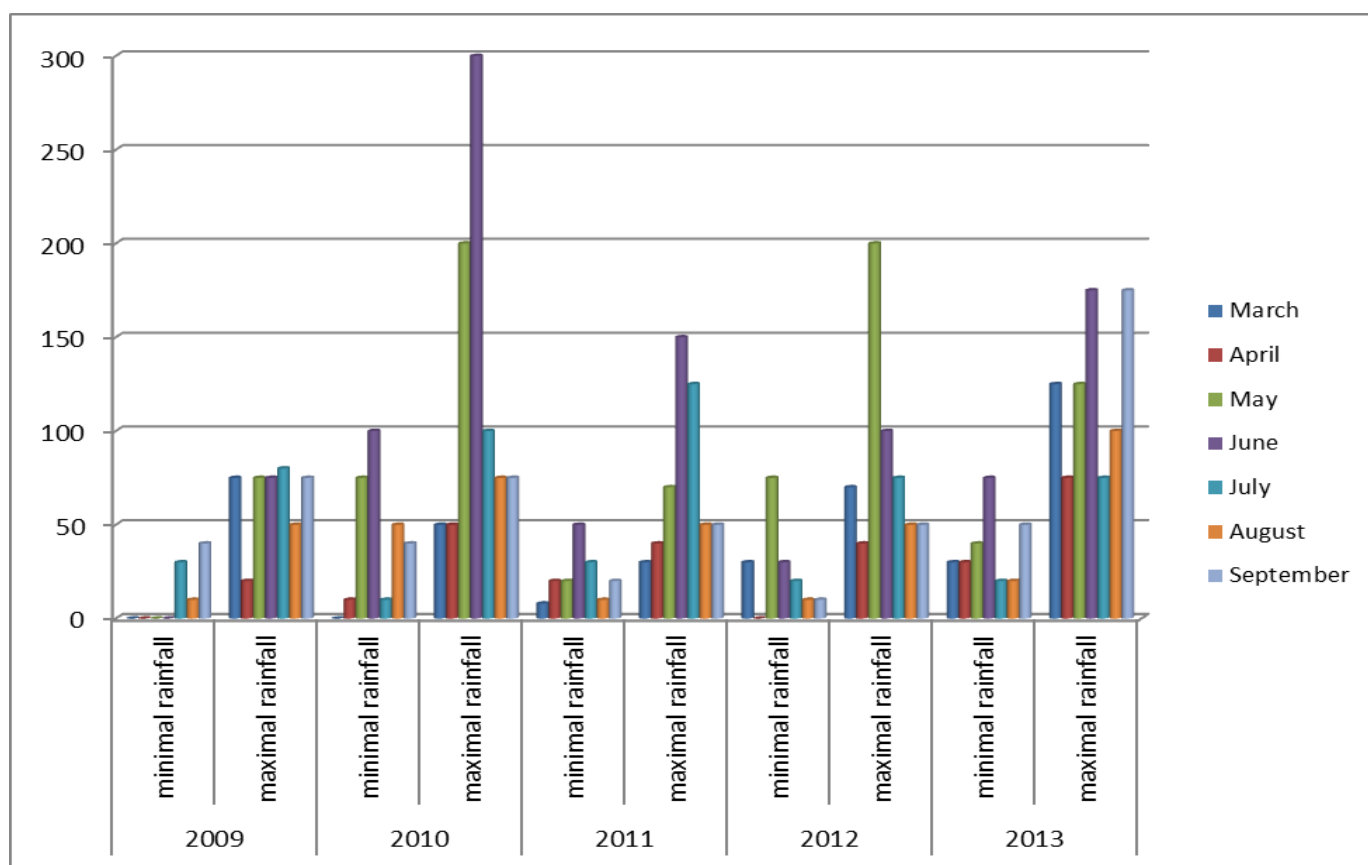
Chart 8 - Optimum temperature range for pollination



From INMH records we obtain the data about annual rainfall values. Minimum and maximum temperatures recorded during the growing season between March and September is shown in Graph 8, for all the studied period 2009-2015. These varied between:

- 0 mm in March 2009 and 2010 and 125 mm in March 2013,
- 0 mm in April 2009 and 150 mm in April 2014,
- 0 mm in May 2009 and 200 mm in May 2010 and 2012,
- 0 mm in June 2009 and 300 mm in June 2010,
- 10 mm in July 2010 and 175 mm in July 2014,
- 10 mm in August 2009 and 2011 and 125 mm in August 2014,
- 10 mm in September 2012-2014 and 175 mm in September 2015.

Another important component in influencing the development of tomato (tomato productions) is humidity. If it's too low, the pollen is dry. If it is too high the pollen grains stick together pollination is insufficient. In both cases there are recorded low productions of tomatoes. Regarding the precipitations, it follows that 2010 has seen the largest amount of water in May-June, cumulating an average of 500 mm.

Chart 7 - Annual rainfall in the period 2009-2015

CONCLUSIONS

In the present work is demonstrated that the best productions were achieved when they were used varieties less demanding regarding the temperature and humidity; also the best productions were recorded when they were met cropping technologies. The use of indigenous varieties would be a plus for Romanian producers, primarily because consumers find our products, even if they are smaller, tastier and secondly because they are already adapted to the environment and climate from our country.

For a better capitalization of obtained productions, the producers of vegetables should form groups of producers or associations to ensure their quality seedlings, fertilizers and technologies. Also through associations could purchase specific equipment (accessing European funds or bank loans), they can use them in common for the elimination of manual work and thus reducing production costs.

For a better capitalization of production, considering that there is a decreased degree of capitalization for fresh tomatoes of only 67%, the difference being self-consumption and losses, it could create short chains of capitalization, associations / groups of producers being able to build halls with mini tomato processing lines that do not meet the quality requirements for selling fresh.

Not in the least, expanding the range of cultivation by building protected spaces could lead to higher productions.

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