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Study of the impact of plant's support and fertilisation systems upon the productive and quality potential manifestation of some tomato hybrids cultivated in solariums

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Abstract Due to continued growth of fuel prices and heating and electricity mainly, it was impossible the vegetable cultivation in greenhouses heated by private growers. But generally, to increase the profitability in vegetable crop in case of tomatoes removing the heating costs is not enough , but also improving those technology links to offset the influence of heating lack , which led to a decrease in almost all early production, but also it's quality during the first part of the harvest period.
This paper presents results regarding the influence of the interplay between experimental factors, correspondents of major technological links of production and its quality and hence on economic efficiency of the culture.

Key words

solarium, culture, vegetables, fertilizers, hybrid, production, tomato

Price increase of fuel and of any kind of energy in general, led to the impossibility of growing vegetables in greenhouses heated by the vast majority of private farmers.[2] There have been and continue to be affected small producers, especially those who ventured to cultivate vegetables as starters in the profession and not always have enough financial capital to ensure their start.

For this reason many farmers have shifted to growing vegetables in unheated rooms, solariums is most handy. But to increase the profitability of vegetable crop in case of tomatoes removing the heating costs is not enough, but also improving those technology links that offset the influence of lack of heating, which led to a big decrease in early production, but also of its quality of the first part of the harvest period.

Hybrid, by its characteristics, nearby with the vegetation management system by changing or not axial system architecture of the plant and improving irrigation system and fertilization applied, can help achieve the goal of this profitable crop of tomatoes in the new conditions.[1] These conditions manifest by deprivation of the application of growing technology and increasingly fierce competition on the market with similar products imported and beyond.

The contribution of the factors listed above that are competing to elucidating the problem taken in the survey in interpreting the complex relationships created between them, was studied in terms of influence on reducing energy costs, the cost of seeds and planting and increasing revenues as a result of improving production quality and favourable harvesting dynamics.

Material and Method

The study regarding the profitability of tomato culture was performed in a family of the commune Santana, basin of Arad, where tradition is in cultivating vegetables on large areas, especially the tomato growers private. Family Association has approx. 0.5 ha of unheated greenhouses. The experiment consisted of two hybrids of tomato crop in November note to say Magnus Platus F1 and F1 of the Dutch company De Ruiter Seedes.

Culture was established in the period April 5 to 10, 2008 and 2009 in unheated greenhouses. Seedling age was 65 days and variations in the density of 4 plants/m^2 management and support of the plant on the trellis and string trellising.

There was made a polifactorial experience in which the experimental factors were:

Factor A - leadership and support system of the plants growing

a_1 - system management and support on the trellising rope;

a_2 - system management and support on the trellis

Factor B - The fertilization

b_1 - Classic fertilization system (indigenous fertilizers)

b_2 - Kemira modern fertilization system (Cropcare in basic fertilisation, Ferticare fertilization in vegetation).

Factor C - Hybrid:

c_1 - F1 Magnus 5 F_1;

c_2 - Platus F_1.

The applied technology was distinguished by the use of:

- Irrigation system with drip irrigation type Netafim (Israel);
- The plant nutrient system of drip irrigation (fertigation) using fertilizer company Kemira (complex fertilizers based treatments, starter and micro irrigation phasial with foliar fertilizers and irrigation).

Present study aimed to establish profitable opportunities in greenhouses unheated tomato culture in the new competitive market conditions, using biological material to study the newest fixed-growing hybrids that have appeared in recent years. Also, their mode of expression was monitored in terms of productive capacity and product quality using both systems management and support plant growth and phasial fertilizer.

Results and Discussions

Table 1 and figure 1 include data regarding the yields achieved under the aspect of manifestation of the productive potential of both hybrids, but also of quality potential , manifested by range of first class quality extra and I under the impact of a_1 and a_2 factor - leadership and support for trellising plants by the strings and trellis.

There is variation in the average number of fruit per plant and average weight of a fruit in both fertilization systems (classical and Kemira).

In both management and support systems to both plants and hybrids, the average number of fruit per plant is higher in case of applying Kemira fertilizer system and also the average weight of fruit, even if in case of the F_1 hybrid Platus this is only with 1.02% higher, compared with 9.8% in F_1 Magnus obvious then the average production per plant based on the proportional relationship between the average number of fruit and average weight of these as aspects of the productive potential of the event, follow the same orders of magnitude for both hybrids, the response was more pronounced at Platus F_1 (1.6%) when driving on the trellis, and opposite when driving and supporting the strings.

Table 1

Experimental results of determined growth tomato hybrids in cold solariums in cycle I, 2008-2009

Factor A (leading and support system of plants)	Factor B (fertilisation system)	Factor C (the hybrid)	Average no. of fruits/ plant	Average weight/ fruit (g/piece)	Average production			Extra and I quality	
					Kg/ plant	t/ha	% than c_1	t/ha	%
a_1- leading and support of plants by trellising on ropes	b_1-classic	c_1 - Magnus F_1	24,4	135,4	3,303	132,1	100,0	104,1	78,8
		c_2 -Platus F_1	26,1	133,8	3,493	139,7	105,8	114,9	82,3
		Average c for a_1xb_1	*25,3*	*134,3*	*3,398*	*135,9*	*	*109,5*	*80,6*
	b_2- Kemira	c_1 - Magnus 5 F_1	29,6	150,1	4,443	177,7	100,0	150,9	84,9
		c_2 -Platus F_1	29,1	148,4	4,320	172,8	97,2	147,9	85,6
		Average c for a_1xb_2	*29,4*	*140,0*	*4,382*	*175,3*	*	*149,4*	*85,2*
	Factor B average for a_1		***27,3***	***142,5***	***3,890***	***155,6***	*****	***129,5***	***83,2***
a_2- leading and support of plants on trellis	b_1 –classic	c_1 - Magnus 5 F_1	24,0	133,9	3,213	128,5	100,0	95,3	74,2
		c_2 -Platus F_1	24,1	141,7	3,415	136,6	106,3	105,3	77,1
		Average c for a_2xb_1	*24,1*	*137,8*	*3,314*	*132,6*	*	*100,3*	*75,6*
	b_2- Kemira	c_1 - Magnus F_1	27,2	145,4	3,955	158,2	100,0	127,2	80,4
		c_2 -Platus F_1	27,9	144,0	4,018	160,7	101,6	134,7	83,8
		Average c for a_2xb_2	*27,6*	*144,7*	*3,987*	*159,5*	*	*130,9*	*82,1*
	Factor B average for a_2		***25,8***	***141,3***	***3,650***	***146,0***	*****	***115,6***	***79,2***

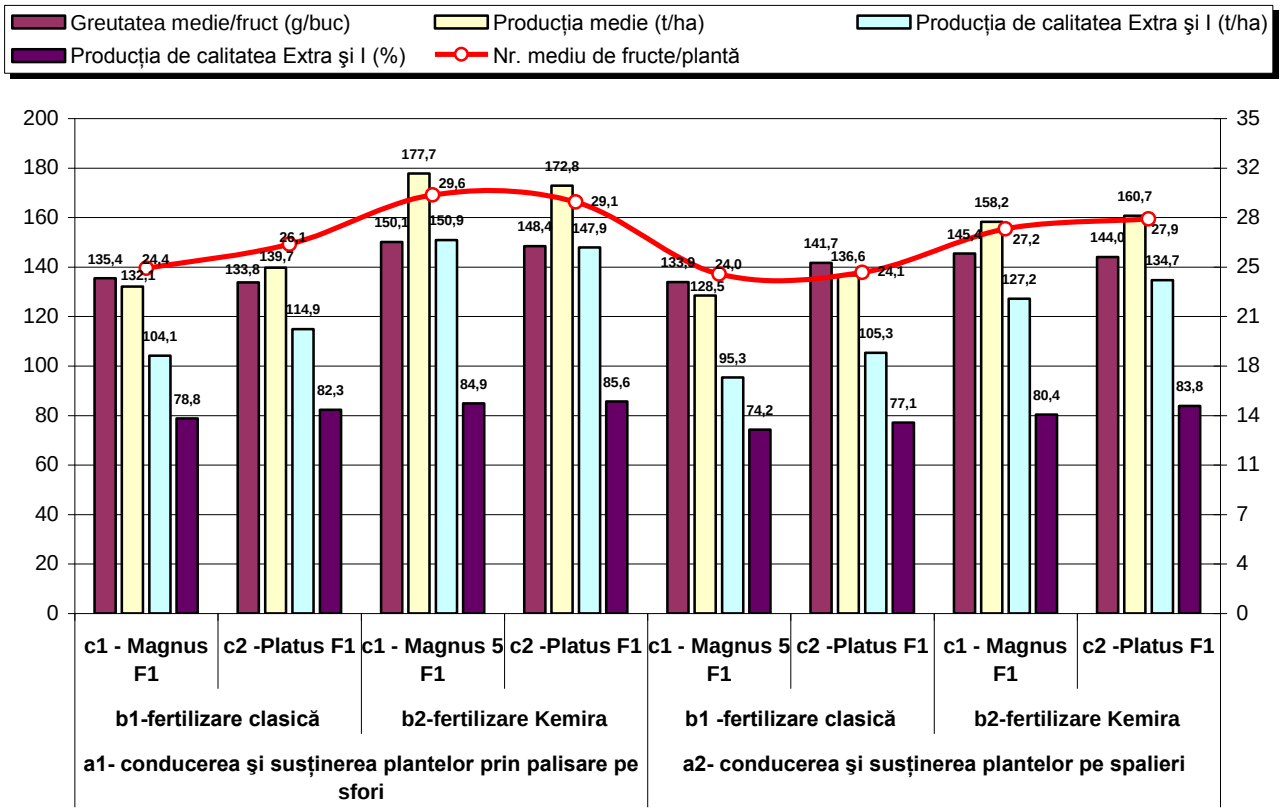

Fig.1. Experimental results of tomato hybrids cultivated by using the leading and support system by trellising

In terms of production quality stands that extra shares of first quality and extra quality inh in both management and support systems to both plants and hybrids, which lies in the range of 74.2% ($a_2b_1c_1$) and 84.9% ($a_1b_2c_1$) - for Magnus F_1, respectively 77.1% ($a_2b_1c_2$) and 85.6% ($a_1b_2c_2$) - for Platus F_1 (Table 2).

The highest yields were recorded under the influence of $a_1$factor (back on the strings), averaging 155.6 t / ha, with 83.2% quality production extra and I, in comparison with average production of 146.0 t / ha and 79.2% quality production extra and I under the influence of a_2 (supporting the trellis). In terms of influence on fertility production system there is a production of 167.4 t / ha in case of applying fertilization with Kemira fertilizer type (b_2), with increasing the production by 24.7% production growth compared to the domestic fertilizer(b2) fertilization. It also highlighted an increase of 5.6% (83.8% vs. 78.2% in B_2).

Also from table 2 results in the synthesis media productions made under the influence of sequential interdependence of the two factors (A and B) and the average experience for each hybrid. At Platus F1 the average achieved is 152.5 t / ha, 2.2% higher than in F_1 Magnus (149.2 t / ha - 100.0%), and at the production of quality E + I had an additional 2.4% (82.4% vs. 80.0%).

Table 2

Synthesis of the experimental results of determined growth hybrids cultivated in cold solariums in cycle I 2008- 2009 by using trellising on ropes

Factor:			Average production for:											
			Factor C				Factor B				Factor A			
A	B	C	t/ha	% than a_{1-3}	Of which Extra + I		t/ha	% than b_1	of which Extra + I		t/ha	% than a_1 and a_3	Of which Extra + I	
					t/ha	%			t/ha	%			t/ha	%
a_1	b_1	c_1 - Magnus F_1	132,1	100,0	104,1	78,8	135,9	100,0	109,5	80,6	155,6	100,0 103,2	129,5	83,2
		c_2 -Platus F_1	139,7	105,8	114,9	82,3								
		Average c for a_1xb_1	*135,9*	*	*109,5*	*80,6*								
	b_2	c_1 - Magnus 5 F_1	177,7	100,0	150,9	84,9	175,3	129,0	149,4	85,2				
		c_2 -Platus F_1	172,8	97,2	147,9	85,6								
		Average c for a_1xb_2	*175,3*	*	*149,4*	*85,2*								
	Average of factor B for a_1		***155,6***	*****	***129,5***	***83,2***								
a_2	b_1	c_1 - Magnus 5 F_1	128,5	100,0	95,3	74,2	132,6	100,0	100,3	75,6	146,0	93,8 96,8	115,6	79,2
		c_2 -Platus F_1	136,6	106,3	105,3	77,1								
		Average c for a_2xb_1	*132,6*	*	*100,3*	*75,6*								
	b_2	c_1 - Magnus F_1	158,2	100,0	127,2	80,4	159,5	120,3	130,9	82,1				
		c_2 -Platus F_1	160,7	101,6	134,7	83,8								
		Average c for a_2xb_2	*159,5*	*	*130,9*	*82,1*								
	Average of factor B for a_2		***146,0***	*****	***115,6***	***79,2***								
a_3	b_1	c_1 - Magnus 5 F_1	130,3	86,4	99,7	76,5	134,2	100,0	104,9	78,2	150,8	96,9 100,0	122,6	81,3
		c_2 -Platus F_1	138,2	91,6	110,1	79,7								
		Average c for a_2xb_1	*134,2*	*89,0*	*104,9*	*78,2*								
	b_2	c_1 - Magnus F_1	168,0	111,4	139,1	82,8	167,4	124,7	140,2	83,8				
		c_2 -Platus F_1	166,8	110,4	141,3	84,7								
		Average c for a_2xb_2	*167,4*	*111,0*	*140,2*	*83,8*								
	Average of factor B for a_3		*150,8*	*100,0*	*122,6*	*81,3*	*150,8*	*	*122,6*	*81,3*	*150,8*	*100,0*	*122,6*	*81,3*
		c_1 - Magnus F_1	*149,2*	*100,0*	*119,4*	*80,0*	*	*	*	*	*	*	*	*
		c_2 -Platus F_1	*152,5*	*102,2*	*125,7*	*82,4*								
		Average of factor C	*150,8*	*	*122,6*	*81,3*								

Table 3 shows the results of statistical calculations performed in terms of significance of differences due to the interaction of the factors taken into the study.

Production achieved in case of application management and support system of trellising plants by the string (a_1) is statistically assured as very significant positive compared to the leadership and support system of the plants on the trellis (a_2) (Section 1). In Kemira fertilizer system (b2) application the production achieved is 24.7% higher than the classical (b_1), which provides a statistical significance of the difference very significant positive (point 2), the superiority of these fertilizers are evident in both hybrids taken into the study.

The hybrid Platus F1 (c_2) stands out with a production increase of 2.2%, the difference meaning is very significant positive (Section 3). In both management and support systems by applying the Kemira fertilizer (b2) we obtain very significant production increases (29.0% and respectively 20.3%).

Making a detailed analysis of the effects of experimental factors on production interactions shows the following aspects:

- Production made under the influence of plant management and support system on the string (a1) has assured statistical significance of the difference between a1 and a2 production (management and support of the trellis plants) is very significant positive (1 point);

- Under the influence of Kemira fertilizer (b2) is achieved a production that insured statistical significance of the production difference between B_2 and B_1 (clasic fertilizer) being very significant positive (point 2;

- The influence of the same system of fertilization (b_1 and / or b_2) in interaction with different production management systems to determine the statistical coverage, production of which differences are meaningful and very significant positive and negative (item 4);

- The influence of fertilization b_2 (Kemira) in combination with a_1 (management and support on the strings), it means a_1b_2, determined to achieve higher production from the combination of statistical insurance a_2b_2 (management and support on the trellis) significance of differences between them are production very significantly negative (item 4);

- The influence of fertilizer Kemira (b_2) in connection with the same management system and support plant growth conducive to higher production in the combinations of a_1b_2 and a_2b_2 to a_1b_1 and a_2b_1 significance of differences in production is very significantly negative (item 4);

Table 3

Unilateral impact and interactions of the experimental factors upon tomato production by using determined growth hybrids in cold solariums

Variant	Production (t/ha)		Relative production (%)	Difference (±t/ha)	Significance
1. Impact of the plants' leading and support system upon tomato production					
a_1-a_2	155,58	146,00	106,6	-9,58	***
DL 5%=1,78		DL 1%= 2,70		DL0,l%= 4,34	
2. Impact of the fertilisation system upon tomato production					
b_2-b_1	167,35	134,23	124,68	33,13	***
DL 5% = 1,49		DL l% = 2,05		DL 0,l% = 2,82	
3. Impact of the hybrid upon the production					
c_2-c_1	152,45	149,13	102,23	3,33	***
DL5% = 1,60		DL 1% = 2,17		DL 0,l% = 2,90	
4. Impact of different leading and support systems and the same or different fertilisation systems upon tomato production					
a_2b_1-a_1b_1	132,55	135,90	97,53	-3,35	0
a_2b_2-a_1b_2	159,45	175,25	90,98	-15,80	000
a_2b_2-a_1b_1	159,45	135,90	117,33	23,55	***
DL 5%= 2,32		DL 1%=3,37		DL 0,l%= 5,08	
5. Impact of the same fertilization systems and different hybrids upon tomato production					
b1c2- b1c1	138,15	130,30	106,02	7,85	***
b2c2- b2c1	166,75	167,95	99,29	-1,20	-
DL 5% = 2,27		DL l %= 3,07		DL 0,l% = 4,10	
6. Impact of different fertilisation systems and the same or different hybrids upon the production					
b2c1- b1c1	167,95	130,30	128,89	37,65	***
b2c2- b1c2	166,75	138,15	120,70	28,60	***
b2c2- b1c1	166,75	130,30	127,97	36,45	***
DL 5% = 2,19		DL l %= 2,98		DL 0,l% = 4,04	
7. Impact of different leading and support systems and the same or different hybrids upon tomato production					
a2c1- a1c1	143,35	154,90	92,54	-11,55	000
a2c2- a1c2	148,65	156,25	95,14	-7,60	000
a2c2- a1c1	148,65	154,90	95,97	-6,25	000
DL 5% = 2,39		DL 1% = 3,43		DL 0,1% = 5,09	

Variant	Production (t/ha)		Relative production (%)	Difference (±t/ha)	Significance
8. Impact of the same leading and support system and the same fertilisation systems upon different hybrids					
a1b1c2- a1b1c1	139,70	132,10	105,75	7,60	***
a2b2c2- a2b2c1	160,70	158,20	101,58	2,50	-
DL 5% = 3,20			DL 1 % = 4,34	DL 0,1% = 5,80	
9. Impact of the same leading and support system and different fertilisation systems upon the same hybrid					
a1b2c1- a1b1c1	177,70	132,10	134,52	45,60	***
a2b2c2- a2b1c2	160,70	136,60	117,64	24,10	***
DL 5% = 3,09			DL 1% = 4,22	DL 0,1% = 5,72	
10. Impact of different leading and support systems and the same fertilisation system upon the same hybrid					
a2b1c1- a1b1c1	128,50	132,10	97,27	-3,60	0
a2b1c2- a1b1c2	136,60	139,70	97,78	-3,10	-
a2b2c1- a1b2c1	158,20	177,70	89,03	-19,50	000
a2b2c2- a1b2c2	160,70	172,80	93,00	-12,10	000
DL 5% = 3,24			DL 1 % = 4,54	DL 0,1% = 6,46	

- For points 7, 8, 9 and 10 depending on the binomial and trinomial combinations which is performed and compared with each other, meaning production differences ranging from no significance to the distinct and highly significant positive or negative, that stands out all combinations and all comparisons between them very beneficial influence on both the production of hybrid fertilization system Kemira (b_2) compared with the traditional fertilization (b1).

Table 4 and the graph of figure 2 present the economic efficiency with details for the three experimental factors. From the analysis of this table results the influence of b_2 factor (Kemira fertilizer type) on the level of profit achieved in both hybrids (Platus F_1 and Magnus F_1) in both systems management and support plant growth (on strings and trellis).

Table 4

Economical efficiency of tomato culture in cold solariums in cycle I spring-summer, 2008 - 2009

Specification	Factor A – Plants' leading and support systems							
	a_1- leading and support of plants by trellising on ropes				a_2- leading and support of plants on trellis			
	Factor B – fertilisation system							
	b_1- classic		b_2- Kemira		b_1- classic		b_2-Kemira	
	Factorul C - Hibridul							
	c_1 - Magnus F_1	c_2 -Platus F_1	c_1 - Magnus F_1	c_2 - Platus F_1	c_1 - Magnus F_1	c_2 -Platus F_1	c_1 - Magnus F_1	c_2 - Platus F_1
Average production t/ha of which	132,1	139,7	177,7	172,8	128,5	136,6	158,2	160,7
- Extra and I quality (t/ha)	104,1	114,9	150,9	147,9	95,3	105,3	127,2	134,7
- Quality II (t/ha)	28,0	24,8	26,8	24,9	33,2	31,3	31,6	26,0
Income (lei/ha)	367238	392557	511776	505752	350805	377016	443052	463174
Costs (lei/ha)	327608	342265	376724	369792	310970	321010	327128	335863
Profit (lei/ha)	39630	50292	135052	135960	39835	56006	115924	117311
Profitableness rate (%)	12,1	14,7	35,8	36,8	12,8	17,4	35,4	34,9

The profit in the combinations and $a_1b_2c_2$ $a_1b_2c_1$ and also $a_2b_2c_1$ and $a_2b_2c_2$ has the highest values with no significant difference the profit rate was among 34.9 and 36.8%.

In conclusion both experimental hybrids (Platus F_1 and Magnus F_1) exhibits a very high production potential from Kemira fertilizer system application, production is very significant increased in both systems of vegetation management. Applying the classical system of fertilization on Platus F1 hybrid he achieved distinctly significant production increases (5.8% and 6.2%) versus Magnus F_1 in both systems management and support plants, because if the system Kemira fertilizer (b_2) production increases to no longer have any significance (-2.8% and 1.6%).

Maximum profit is achieved when applying Kemira fertilization in management and support system the strings in both plant hybrids, closely followed in the management system and support the plant trellis.

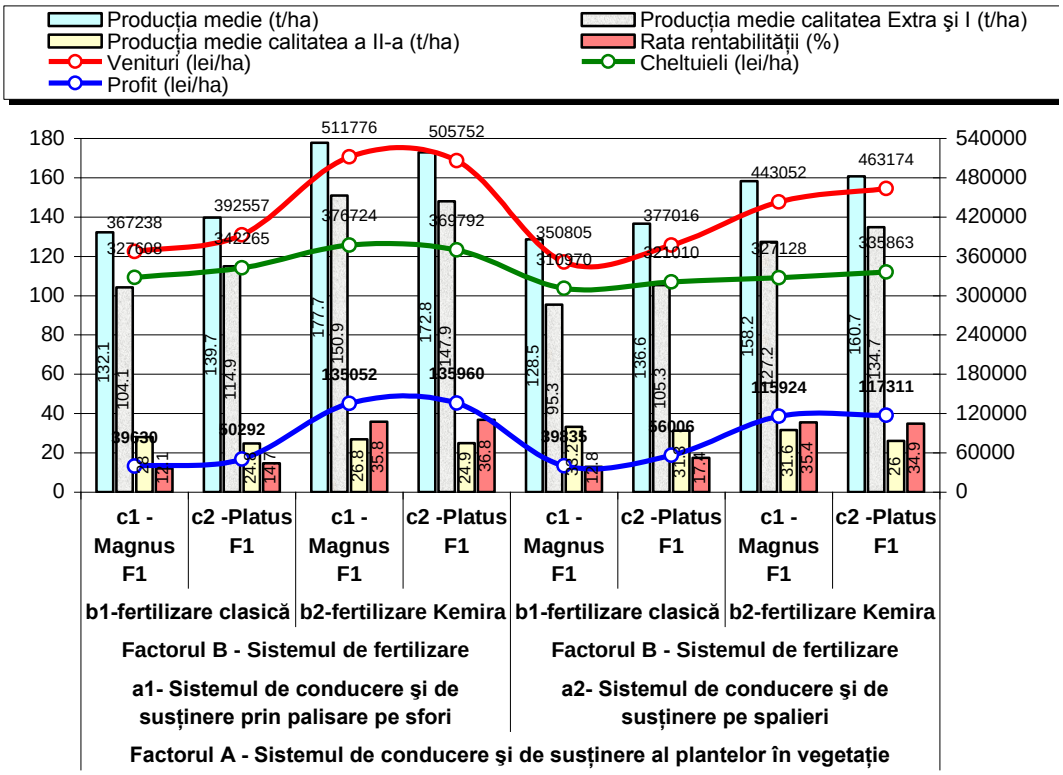

Fig. 2. Economical efficiency of tomato culture in cold solariums in cycle I spring-summer, 2008 - 2009

Conclusions and Recommendations

1. Growing tomato plants by conducting and supporting the trellis (a_2) in unheated greenhouses is not justified in terms of yields achieved in either system of fertilization applied to any of hybrids. Basically in both hybrids and in both fertilization systems yields achieved are lower under the influence of a_2 than a_1.

2. In both management systems in vegetation stands out Kemira fertilization system, both in terms of higher production levels achieved and in the production quality.

3. Both hybrids Platus F_1 and Magnus F_1 are proving to be valuable hybrids both in terms of production quantity levels achieved and the quality weight as extra and I quality of the average production.

4. Kemira fertilizer system helps to maximize the full capacity of the productive potential of hybrid expression cultivated by comparison with a classical system for greater system management and application support trellising plants by the strings.

5. The advantage of application the management and support system of trellising plants by the string is one of reduction of expenses with obtaining the necessary materials for the purchase of labour trellis, the idea of accepting a slightly reduced profit in the final activity production, depending on the interaction of different factors studied.

6. The incomes obtained from the revaluation of the production from unheated solariums are greatly reduced compared with those obtained from the heated solariums and greenhouses especially those covered with polyethylene film, or even heated or half heated.

7. It recommends further research to strengthen the conclusions of the experiment performed.

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