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Research Article

Type of Protection in Hybrid Tomato Plant Conducted in Protected Environment, With and Without Application of Insecticides

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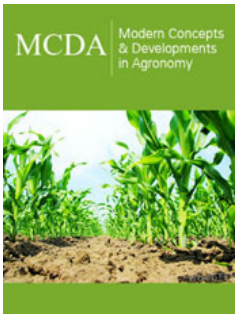

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Abstract

The crop protection with colorful knits and Nonwoven Textile has been much used, for improvement of the efficiency of cultivation and minimizing pesticide application. Thus, this study aimed to verify the effect of the type of protection of plants or fruits of two tomato hybrids, conducted in a protected environment, with and without application of insecticides in the experimental area of UNESP - Campus of Ilha Solteira. The following parameters were evaluated: height; average diameter of the stem; average rates of absolute growth and productivity of total commercial and bored fruits. The experimental design was a Randomized Block Design (RBD), with treatments arranged in a split plot in a 4x2x2 factorial scheme, with four types of protection, two types of application of insecticides and two hybrids. The results were subjected to analysis of variance (F test) and the effects of treatments were compared by Tukey test at 5% probability, leading to the following conclusions: the application of insecticides did not affect the growth of plants; the greenhouse protected with Blue Chromatinet 30% gave higher plant height; hybrid Saladete had better adaptation to growing conditions; greenhouses having no side protection showed greater total productivity, however with higher losses due to the disposal of unmarketable fruits; the greenhouse protected by Nonwowen Textile gave the lowest productivity of bored fruit in the treatments with and without application of insecticides; the hybrid Saladete proved to be better adapted to growing conditions showing greater business productivity and lower yields of bored fruit.

Keywords: *Lycopersicon esculentum* mill; Chromatinet; Nonwoven textile; Bagging; Hybrids

Introduction

The growing demand for high quality vegetables and offered throughout the year has contributed to the investment in new cropping systems that allow production adapted to different regions and adverse environmental conditions. In Brazil, the cultivation of vegetables under protected cultivation has increased among producers, due mainly to the relative ease in handling the growing conditions compared to the conventional system in the open field.

Vegetables, in different regions of the world have been benefited from growing in greenhouses. From the arid desert to humid rainforests, from the northern cold to warm equator, from the sea level to the top of the ridges, from America to Asia, from small to large farmers, whether in winter or in summer, being present in the lives of various farmers around the world. It is an irrefutable and irreversible fact at the present time [1].

The cultivation of tomato under protected cultivation in the 1990s became fashionable, the area under protected cultivation grew 40% and 53% the production [2], making it a production system widespread in the Southeast, especially in the state of São Paulo, the largest vegetable producing center of Brazil. This cultivation technique comes from the need

to provide the consumer products "in natura" with good quality throughout the year [3].

The perspective for protected cultivation is good as long as associated with other technologies that contemplate the quality and productivity. The numbers are impressive and help explain why so much is invested in both technology in horticulture, with the adoption of different production systems. Some horticulturists want to produce more; others want to harvest in the winter when prices are higher; still others pursue higher prices with differentiated products by their quality.

The tomato plant is the target of several diseases that can cause irreversible damage, leading to indiscriminate use of chemicals causing damage to the environment and to man. In pursuit of rationalization use of these inputs, it is necessary to the implementation of new technologies to reduce large investments in its application, being defended by producers who are seeking for an increase in profit.

Producers increasingly seek new options for cultivation, either for higher profits or by improving the quality of food, taking into consideration consumers need to get better quality food, not caring about its price. Thus, there is the need to increase better quality food in the market, as well as the reduction of environmental contamination due to the accumulation of pesticides.

One of the technologies that has been used is the protection with colorful knits and Nonwoven Textile in vegetables and ornamental plants which can minimize the use of pesticides on agricultural crops in order to reduce the number of pesticide applications in the crop cycle, contributing to the preservation of natural resources and providing products with best quality and with low levels of chemical residues.

According to Shahak et al. [4], the use of colored meshes constitute a new element in protected cultivation, causing specific morphological and physiological responses, improving the efficiency of cultivation and with satisfactory quality and economic outcomes, which according to Orem-Shamir et al. [5] it will depend on the type of crop and the stage of crop development.

Thus, this study aimed to verify the effect from the type of protection of plants or fruits of two tomato hybrids conducted in a protected environment, with and without application of insecticides.

Materials and Methods

The experiment was conducted on the Experimental Farm for Teaching, Research and Extension of UNESP - Campus of Ilha Solteira, located in the city of Ilha Solteira, with a Latitude of 20º22' South, Longitude 51º22' West and altitude 330m.

The climate of the region is characterized as sub-humid, with hydraulic power insufficiency and with heat well distributed throughout the year, with drought in the winter, annual average temperature around 24.1 °C and annual rainfall of 1400mm [6]. The soil of the experimental area was classified as Argissolo Vermelho, Eutrophication according to the classification of the Brazilian System of Soil Classification [7]. The experimental area was sampled and the results of chemical analysis of the soil are shown in Table 1.

Table 1: Results of the analysis of soil fertility in the area of greenhouse cultivation, in the layer 0 to 0.20m. Ilha Solteira (SP).

Greenhouse by	Protection Type Chemical Analysis Results										
Types of protection	P resina	M.O.	pH $CaCl_2$	K	Ca	Mg	H+Al	Al	SB	CTC	V%
	mg dm^{-3}	g dm^{-3}	mmolc dm^{-3}								%
Chromatinet	74	32	6,1	4,6	96	21	16	0	121,2	137,2	88
Nonwovwn Textile	82	32	5,6	4,5	78	18	21	0	101,1	122,1	83
Normal / bagged	85	32	5,8	3,8	96	18	18	0	117,4	135,4	87

Analysis performed by the Laboratory of Soil Fertility, Faculty of Engineering, UNESP, Campus of Ilha Solteira.

The development of two tomato hybrids, Saladete DRW3410-F1 and Débora Plus-F1, grown in three greenhouses with roof arc-shaped, with transparent plastic cover of 75mm thickness, with east-west orientation were assessed with two greenhouses with dimensions of 5.4 x 15.0m, and a greenhouse with dimensions of 5.4 x 15.0m, headroom height of 2.5m and rooftop height of 4.0.

The effects of the type of insulation in the development and production of two tomato hybrids were studied with and without the application of insecticides in protected environment. Plants and fruits were submitted to the following types of protection:

1. Chromatinet - protected cultivation laterally to screen for managing spectrum Blue Chromatinet 30%.
2. Nonwoven Textile - protected cultivation laterally with white Nonwoven Textile 15gm^{-2}.
3. Normal - cultivation without any type of side protection.
4. Bagging - crop protection with the fruits Nonwowen Textile white 15gm^{-2}, and the plants without any side protection (Figure 1).

The hybrids used have indeterminate growth and the following characteristics:

a) Hybrid- Saladete DRW3410 F1 is from Italian-type, highly productive, early indeterminate growth, uniform bunches along the crop. It stands out for its great taste, with resistance

to tomato mosaic (ToMV) virus, Verticillium wilt (*Verticillium dahliae* race 1), Fusarium wilt (*Fusarium oxysporum f.sp. lycopersici* races 1 & 2) and the species of root-knot nematodes.

b) Hybrid Débora Plus-F1, is the holy cross type, long structural life cycle of 110-115 days, with resistance to Verticillium wilt race 1 (*Verticillium dahliae*) and fusarium wilt races 1 and 2 (*Fusarium oxsyporum f.sp.lycopersici*) and nematode (*Meloidogyne incognita*, *M.javanica*)

Figure 1: Overview of the types of protection and development of the plants at 10 days after transplanting, in protected environments. Ilha Solteira (SP).

Seeds were sown in polystyrene trays with 128 pyramidal cells, and commercial organic- substrate with a seed per cell. The transplant was done on spacing of 1.2 x 0.5m, using as cover nonwoven black soil 25gm-^{2} (mulching) in plots fertilized with 4gm^{-2} of N, 30gm^{-2} of P_2O_5, 10gm^{2} of K_2O e 2,0 Lm^{-2} of organic compound. A topdressing fertigation was held of 12g plant-1 of N and 7.2g plant-1 of K_2O, divided into six applications.

The driving system adopted was one plant per hole, with one rod staking with individual stakes upright system. All plants were showed after the latest assessment of height at 60 days. For irrigation of crop, drip tapes with nominal flow rate of 3,8 Lh^{-1}m^{-1} at 70 kPa were placed, operating pressure and with emitters every 0.30m, installed below the ground cover with black Nonwowen Textile. The crop was irrigated throughout the cycle, initially two daily shifts of 15 minutes, which went to three shifts of 15 minutes from the startup of the fruit production.

During the experimental period for weed control, hand weeding was required only among the streets. In disease control all necessary applications were made and pest control applications were made only in plots consisting of treatment factor "with insecticide application", leaving portions of the treatment "without application of insecticides."

The harvest was done twice a week, starting 69 Days After Transplanting (DAT) and extended until turning to 133 DAT, all the ripe fruit was harvested and those which were at the beginning of physiological maturity when the fruit begins to change color.

Regarding to phytotechnical features the following parameters were evaluated:

a) average of plants at 15, 30, 45 and 60 days after transplanting height.

b) average diameter of the rod, making measurements at the time of the stem of each plant at 15, 30, 45 and 60 days after transplanting.

c) mean absolute plant growth rates: rates of absolute growth for height and stem diameter of plants were obtained [8].

d) total productivity of fruit, commercial and bored in kgm^{-2}.

The experimental design was a Randomized Block Design (RBD), with treatments arranged in a split plot factorial 4x2x2, where four types of protection were studied (Chromatinet on the lateral, white Nonwowen Textile on the lateral, normal greenhouse with lateral isolation and normal greenhouse without lateral isolation with bagging fruit) two types of spraying insecticides (with and without the application of insecticides) and two tomato hybrids with indeterminate growth (Saladete DRW3410-F1 e Débora Plus-F1). The experimental plot consisted of 14 plants per subplot and 7 plants in 4 recurrences.

The results observed for each variable were subjected to analysis of variance (F test) setting the type of protective factor and when answered the ratio 7:1 for the residual mean square as recommended by Banzatto & Kronka [9], was conducted to analyze groups of experiments in order to verify the effect of type of protection in the development and production of culture. Treatment effects were compared by Tukey test at 5% probability.

Results and Discussion

Height and stem diameter of plants

For the characteristics height and diameter of the stem of plants there was no significant treatment effects with and without application of pesticides in plants. However, in plants grown under side protection with Chromatinet significant differences in mean of height of the two hybrids analyzed were found, observing a better development of plants subjected to this treatment at all time intervals except at 60 DAT where a stabilization occurred in plant growth (Table 2). This fact is directly related to the characteristic of Blue Chromatinet 30%, which acts as a light filter. The meshes break direct light converting it into diffused light, and the quality of light that reaches the cultivation is higher stimulate photosynthesis, since this affects the biosynthesis of chlorophyll and other pigments by regulating the expression of certain genes [10]. This may explain the higher plant height found for the two hybrids studied in protected with mesh Blue Chromatinet greenhouse. Regarding the studied hybrids, we observe better development of the hybrid Saladete DRW3410 in all periods analyzed, thus finding a better-adapted to the conditions of this hybrid undergone management. Cuquel et al. [11] studied the effect of colored meshes (blue and red), placed under transparent plastic greenhouses or even in individual cages on the development of ornamental plants, found that the best results were obtained under blue mesh. The authors alerted that although detected effect of the transmission spectrum on different plants, one must also determine the optimal level of shading, which does not result in damage to the development of culture, due to the reduction in the availability of radiation.

Table 2: Mean values of height and diameter of the stems of plants (cm) measured at 15, 30, 45 and 60 days after transplanting (DAT), obtained for hybrid tomato Saladete DRW3410-F1 and-Débora Plus F1 produced in the type of protection, protected environment. Ilha solteira (SP).

Height of Plants (cm)								
Type of Protection	15 DAT		30 DAT		45 DAT		60 DAT	
	Saladete	Débora	Saladete	Débora	Saladete	Débora	Saladete	Débora
Chromatinet	43,75 aA	37,79 aB	109,62 aA	91,62 aB	173,38 aA	147,92 aB	205,29 aA	199,04 aA
Nonwoven textile	33,54 bA	32,29 bA	90,21 bA	78,13 bB	150,21 bA	130,17 bB	189,04 aA	181,86 aA
Normal	33,33 bA	28,46 cB	64,13 bA	70,83 cB	137,96 cA	122,42 bB	173,66 aA	171,75 aA
Bagging	32,37 bA	32,46 bA	84,58 bA	81,13 bA	136,33 cA	130,63 bA	174,21 aA	173,71 aA
General average	35,71 A	32,75 B	92,14 A	80,43 B	149,47 A	132,78 B	185,55 A	181,59 B
C.V. (%)	34,57		54,28		47,30		8,62	
Rod Diameter of Plants (cm)								
Chromatinet	5,83 aA	6,74 aA	8,51 aA	9,31 aA	10,59 aA	11,55 aA	11,46 a	12,45 a
Nonwoven textile	4,64 aA	6,31 aA	8,22 aA	9,49 aA	11,81 aA	13,36 aA	13,13 a	15,29 a
Normal	5,12 aA	6,47 aA	8,96 aA	10,81 aA	12,41 aA	13,59 aA	13,23 a	14,67 a
Bagging	5,60 aA	6,54 aA	9,67 aA	10,86 aA	13,20 aA	13,64 aA	13,97 a	14,44 a
General average	5,30 B	6,51 A	8,84 B	10,11 A	12,01 B	13,03 A	12,95 B	14,21 A
C.V. (%)	8,74		10,01		19,05		4,10	

Average followed by the same small letter in the column and capital letter on the line, within each evaluation period, do not differ at 5% probability by the Tukey test.

To the diameter of the rods no significant differences between the types of protection used were observed, there has been significant differences only for the diameter of the rods Débora Plus which showed the highest mean values when compared to the hybrid Saladete DRW3410. According to Silva [6] plants with larger diameters are less likely to stem breakage of rods, either by the pressure exerted by the fruit or high loads resulting from wind or combination of two factors.

Absolute growth rate of height and stem diameter of plants

Comparing the rates of absolute growth of height and stem diameter of plants, there has been no interference with the type of protection observed in the rates of growth. However, the larger size of hybrid plants Saladete DRW3410 obtained compared with Débora Plus, was due to higher rates of absolute height growth

observed in the early stage of development. In the first sampling interval of 15 - 30 and 30 - 45 DAT, the hybrid Saladete showed TCAs of 18% and 9% greater than the hybrid Débora, providing a larger growth in these intervals. However, the sampling interval of 45-60 DAT, there was better development of Débora Plus with TCA 35% higher than the hybrid Saladete DRW3410, which shows delayed development for the hybrid Débora Plus. When compared to the TCA in sampling interval of 15-60 DAT significant differences between the studied hybrids were not found, thereby experiencing a rate of growth equal to the two hybrids, however it is noteworthy early growth of hybrid Saladete DRW3410 and late growth hybrid Débora Plus (Table 3).

Table 3: Average values of absolute growth rate of height and stem diameter of plants (cm day-1), between the ranges of 15-30, 30-45, 45-60 and 15-60 (DAT), obtained for hybrids tomato Saladete DRW3410-F1 and Débora Plus -F1 produced depending on the type of protection, protected environment. Ilha Solteira (SP).

Absolute Growth of Plant Height Rate (cm day-1)								
Type of Protection	15-30 DAT		30-45 DAT		45-60 DAT		15-60 DAT	
	Saladete	Débora	Saladete	Débora	Saladete	Débora	Saladete	Débora
Chromatinet	4,39 aA	3,59 aA	4,25 aA	3,75 aA	2,13 aA	3,41 aA	3,59 aA	3,58 aA
Nonwoven textile	3,77 aA	3,06 aA	4,00 aA	3,47 aA	2,59 aA	3,45 aA	3,46 aA	3,32 aA
Normal	3,38 aA	2,83 aA	3,59 aA	3,44 aA	2,38 aA	3,29 aA	3,12 aA	3,18 aA
Bagging	3,49 aA	3,25 aA	3,45 aA	3,30 aA	2,52 aA	2,87 aA	3,16 aA	3,14 aA
General average	3,76 A	3,18 B	3,82 A	3,49 B	2,41 B	3,25 A	3,33 A	3,31 A
C.V. (%)	8,74		10,01		19,05		4,10	
Absolute Growth Rate of the Plant Stem Diameter (cm-1 day)								
Chromatinet	0,18 a	0,17 a	0,14 aA	0,15 aA	0,06 aA	0,06 aA	0,12 aA	0,13 aA
Nonwoven textile	0,24 a	0,21 a	0,24 aA	0,26 aA	0,09 aA	0,13 aA	0,19 aA	0,20 aA
Normal	0,25 a	0,29 a	0,23 aA	0,18 aA	0,05 aA	0,07 aA	0,18 aA	0,18 aA
Bagging	0,27 a	0,29 a	0,24 aA	0,18 aA	0,05 aA	0,05 aA	0,19 aA	0,16 aA
General average	0,24 A	0,24 A	0,21 A	0,19 A	0,06 A	0,08 A	0,17 A	0,17 A
C.V. (%)	21,38		29,08		66,85		11,98	

Average followed by the same small letter in the column and capital letter on the line, within each evaluation interval, do not differ at 5% probability by the Tukey test.

According to Benicasa [8], the absolute rate of growth can be used to get an idea of the average growth rate over a period of observation. Compared to rates of absolute growth of the stems of the plants, there was no significant differences among hybrids studied at all sampling intervals. However, the highest rates of absolute growth of the stems were found in the sampling intervals of 15-30 and 30-45 DAT, showing a higher rate of growth of stems in this period.

Productivity for the treatments with and without application of insecticide

Regarding to productivity, there are significant differences between the interaction of the types of protection and the application of insecticides. In overall productivity greenhouses without lateral, normal and with the bagged fruit, presented better productivity when compared to protected greenhouses with Chromatinet and Nonwoven textile. Since the greenhouse Nonwowen textile presented total productivity of the order of 8.63kgm^{-2} in plants sprayed with insecticide, while in plants without application of insecticide the total productivity was 10.89kgm^{-2}, has also been observed in plants when subjected to the bagging of fruits, as these resulted in productivity of about 11.22 and 12.36kgm^{-2} for the treatments with and without application of insecticides, respectively (Table 3). This may be related to adverse reactions triggered in plants, such as abortion of flowers found in these plots, although not measured.

According to Chandler [12], the action of some insecticides does not happen only on the pests, but also alters the physiology of plants. This fact, which may have occurred in plants grown in the greenhouse with nonwoven and in the greenhouse that the fruits were protected by this material. For the total productivity and commercial, it is observed that protected greenhouse with Blue Chromatinet 30% obtained the lowest productivity in treatments with and without application of insecticides (Table 3), which may be related to greater vegetative growth of the crop (Table 2), which interfered directly in production, so finding a possible injury in plants grown under blue mesh. CuqueL et al. [11] warn that although this type of knitted colorful promote the effect of the differential transmission spectrum on plants, one must be careful to determine the optimum level of shading, which does not result in damage to the development of culture.

Regarding to discarded productivity of fruits produced, we observe significant differences between the types of protection, predominating the insulating effect of cultivation for the type of protection Chromatinet and Nonwoven textile therefore these had lower productivity when compared with the normal type of protection. It is still observed in the application of insecticide treatments the effectiveness of using nonwoven such type of side protection, as among the environments studied this type of protection was the only one which did not show significant differences among treatments with and without the application of insecticides, thus showing the isolation occurred in this environment due to low productivity of bored fruits (Table 3).

When analyzing the effect of the type of protection in the treatment without application of insecticide, it is again evident the effect of the insulation provided by the greenhouse with white nonwoven, since it presented a productivity of bored fruit from the order of 0.26kgm^{-2} while the greenhouse without any side protection productivity of bored fruits was approximately 1.83 kgm^{-2} (Table 3).

Productivity for Saladete and Débora hybrid

The total productivity, commercial and discarded dropped significantly difference between the interaction of the types of protection with the studied hybrids. In Table 4 it is shown the total commercial and discarded hybrids Saladete and Débora depending on the type of protection productivity. It is observed that in greenhouses without side protection and protection bagging fruit, provided the highest total and marketable productivity, with no significant differences between the two hybrids within these types of protection.

In the greenhouse kept with white nonwoven, comparing the two hybrids studied, it appears that the larger total and marketable productivity were obtained for the hybrid Saladete averaging this superiority from the order of 21% (Table 4). This demonstrates the superiority of the hybrid Saladete better adaptation to growing conditions in the greenhouse nonwoven as also evidenced for vegetative growing under these conditions (Table 2, 3).

Table 4: Total productivity, commercial, discarded fruits produced with and without insecticide application depending on the type of protection, in a protected environment. Ilha Solteira (SP).

Type of Protection	Total Productivity (kgm^{-2})		Commercial Productivity (kgm^{-2})		Discarded Productivity (kgm^{-2})	
	With insecticide	Without insecticide	With insecticide	Without insecticide	With insecticide	Without insecticide
Chromatinet	9,75 bA	9,43 cA	9,71 bA	9,02 bA	0,04 bB	0,40 cA
Nonwoven Textile	8, 63 cB	10,89 bA	8,61 cB	10,63 aA	0,02 bA	0,26 cA
Normal	11,34 aA	11,24 bA	10,64 aA	9,40 aB	0,69 aB	1,83 aA
Bagging	11,22 aB	12,36 aA	10,43 abA	10,92 aA	0,79 aB	1,44 bA
General Average	10,23 B	10,98 A	9,85 A	9,99 A	0,39 B	0,98 A
C.V. (%)	5,07		5,81		34,42	

Average followed by the same small letter in the column and capital letter on the line, within each variable evaluated do not differ at 5% probability by Tukey test.

The productivity in the greenhouse with the kind of protection with Blue Chromatinet had lower productivity for both hybrids studied, however no significant differences among hybrids were observed under the growth conditions studied. With regard to hybrids, larger commercial and total productivity were found for hybrid Saladete from the order of 10.75 and 10.24kg-m^{2}, respectively. While hybrid Débora presented the total and marketable productivity were from the order of 10.46 and 9.60, respectively (Table 4).

Regarding to the productivity of bored fruit significant differences between the interaction of hybrid with protection types used were identified. The greatest productivity of bored fruits was obtained in greenhouses left without lateral protection (Normal and bagged). When a comparison among the productivity of bored fruits of hybrid Débora in the nonwoven protected greenhouse and the productivity of the normal greenhouse, it was observed that the greenhouse with nonwoven produced 0.58kgm^{-2} and the normal one 7.13kgm^{2} (Table 5), this difference presented is 12 times smaller for the nonwoven x jj greenhouse, demonstrating the efficiency of this type of protection to contain losses in fruit cultivation. Otherwise, the protection with Blue Chromatinet losses were five times lower compared to the losses from the normal greenhouse. No significant differences between the types of Nonwowen Textile protection and Chromatinet (Table 5) were found.

Regarding to the productivity of bored fruit to the hybrid, the greater discarded productivity was obtained for the type of hybrid Débora normal protection with 7.13kgm^{-2} and bagged with 5.58kgm^{-2} for the greenhouses protected by Nonwoven Textile and Chromatinet, no significant differences among hybrids (Table 5) were observed.

In general, comparing the productivity of bored fruit [of hybrids, the hybrid Saladete presented bored fruit productivity from the order of 2.11kgm^{-2} and the hybrid Débora bored fruit productivity was of 3.65kgm^{2}, the difference presented is 72% higher for the hybrid Débora, which shows a greater susceptibility of this hybrid to the attack from pests (Table 5). It was not found in the literature studies using tomato as the type of protection and colored nonwoven mesh, however, in studies with pepper conducted by Rumpel & Grudzien [13], and Gent [14], these interferences found in using these types of materials (not known as fabric or Nonwoven Textile), in production and average of pepper.

Table 5: Total Productivity, commercial, discarded and number of fruits produced for commercial tomato hybrids Saladete DRW3410-F1 and Débora Plus-F1 produced depending on the type of protection, in a protected environment. Ilha Solteira (SP).

Type of Protection	Total Productivity (kgm^{-2})		Commercial Productivity (kgm^{-2})		Discarded Productivity (kgm^{2})	
	Saladete	Débora	Saladete	Débora	Saladete	Débora
Chromatinet	9,51 bA	9,67 bA	9,37 bA	9,36 bA	0,57 bA	1,29 bA
Nonwoven Textile	10,68 abA	8,84 bB	10,54 abA	8,70 bB	0,59 bA	0,58 bA
Normal	11,26 aA	11,31 aA	10,43 abA	9,62 abA	3,46 aB	7,13 aA
Bagging	11,54 aA	12,04 aA	10,64 aA	10,71 aA	3,80 aB	5,58 aA
General Average	10,75 A	10,46 A	10,24 A	9,60 B	2,11 B	3,65 A
C.V. (%)	9,74		9,49		54,22	

Average followed by the same small letter in the column and capital letter on the line, within each variable measured, do not differ at 5% probability by Tukey test.

Regarding to business productivity independently of the type of insecticide application, productivity was between 8.61 and 10.92kgm^{-2}, above the average productivity in tomato in the state of São Paulo, which was in 2006, according to the Instituto de Economia Agrícola, de 6,0kgm^{-2} [15]. Next results were found in the study of Gualberto et al. [16] evaluated different tomato genotypes of indeterminate growth found average productivity ranging from 9.63 to 11.43kgm^{-2}. And it is also consistent with the yield found in the region, according to a study of Bogiani [17] it was obtained equivalent yields to 7.14 and 9.59kgm^{-2} for cultivation in protected environment [18,19].

Conclusion

After analyzing the results, it was found that:

A. Treatments for insecticide application did not affect the vegetative growth of plants in all types of protection.

B. The protected Blue Chromatinet 30% provided the greenhouse tomato plant height.

C. The hybrid Saladete DRW3410 on the conditions of cultivation placed, had better adaptation, reflecting the greater height and exchange absolute height growth of plants.

D. Sideways unprotected greenhouses have higher total productivity, however having major losses due to the disposal of unmarketable fruits, reflecting directly on business productivity.

E. Protected Nonwowen Textile greenhouse produced lower bored fruits, both in treatments with and without application of insecticides.

F. The hybrid Saladete DRW3410 proved to be better adapted to growing conditions showing greater business productivity and lower yields of bored fruit.

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