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Fungicides and Forms of Application in Controlling the Colletotrichum Lindemuthianum in the Culture of Common Beans

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Abstract

Anthracnose is one of the major diseases of the bean culture and causing major losses to the culture. The bad handling held by producers, not to acquire periodic seeds, lack of knowledge of technologies and control techniques further aggravate these losses. The objective was to evaluate the effect of fungicides used to control anthracnose in beans, relying on fungicides application stage and in mixtures used.The experiment conducted with the cultivar ANFC 9 in experimental field at União de Ensino do Sudoeste do Paraná (UNISEP), DoisVizinhos, PR in 2016. The experimental desing was a randomized block desing with 5 treatments and 4 replicates.The treatments used T1: none application; T2: V4: Oranis; V5: Oranis + Mertin; R8: Oranis + Mertin; T3: V4: Comet; V5: Comet + Chlorothalonil; R8: Comet + Chlorothalonil; T4: Oranis in V4, V5 and R8 stages;T5: V4: Oranis; V5: Oranis + Chlorothalonil; R8: Oranis + Chlorothalonil. The variables analyzed were incidence and severity of disease, plant height in the commercial maturation,insertion height of first pod, number of pods per plant, number of seeds per pod, thousand grain weight and productivity.There was not anthracnose severity due to climate conditions. It was observed that the application of fungicides has positive results in grain weight and, therefore, in productivity.

Key words: *colletrotichum lindemuthianun. Phaseolus vulgaries. Severity. Productivity.*

INTRODUCTION

The common bean is a vegetable which belongs to the family of Fabaceae, holding a 90 to 100 days cycle. The culture presents a superficial root system, whose seeds possess a high percentage of protein in its composition which may hit 30% (AMBROZIM et al., 2015).

Originating in southern Mexico, the common bean arrived in the Brazilian's diet through the African descendants and native Indians, right after the discovery of Brazil, from then on it has become an indispensable food to the population (FERNANDES, 2010).

The national production between the years of 2014 and 2015 was of 3,33 million tons, with a harvesting area of 3.19 million hectares, its productivity hit 1,044 kg ha-1 (AMBROZIM et al., 2015). According to Costa et al. (2015), common bean cultivation may present serious specific phytopathogenic problems, mainly due to the fact of that the producers storing and cultivating their own seeds.

Due to this non acquisition of seeds, Brazil suffers with a high index of diseases, yet the one that highlights the most is anthracnose, which causing agent is called Colletotrichum lindemthianum. This disease can cause up to 100% damage if not controlled and with favorable conditions (RAVA et al., 2013).

Symptoms of this disease can be observed mainly in the aerial part of the plant, which injuries are necrotic dark-brown colored on the ribs and in the interior face of the leaf. The disease can also cause injuries on the stalk and petiole, being long and dark and at times low, on the string beans the disease presents itself in a circular low form (HENNING, 1997).

The production of grains same as every other activity presents its obstacles, thus, it is the rural producer's duty to overcome them and in order for that to happen the producer must gather information, aiming producing with more efficiency, quality and quantity. In order to achieve this goal, the management of the culture must be accomplished in the best form possible. The control of this disease can be done through cultural practice (culture rotation in plantation period), yet when these practices are not sufficient it is necessary the utilization of chemical control, using fungicides, which can be used as treatment of seeds, having a better result thus with leaf application (HENNING, 1997). In this context, this work has as its goal to evaluate the use of different fungicides and mixtures of tanks in the control of anthracnose in the common bean culture.

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MATERIAL AND METHODS

The experiment has been conducted in UNISEP's experimental field located in the city of Dois Vizinhos – Paraná, which is situated in latitude 25º46'18,8'' South, longitude 53º02'52,2'' West and altitude of 650 meters.

Figure 1. Map of the location of the city of Dois Vizinhos – PR. Source: Dois Vizinhos City Hall – PR, 2016.

According to Koppen the climate of the region is type Cfa that presents temperate climate, in which the air temperature in the coldest months varies between -3ºC and 18ºC, whereas the average temperature of the hottest month is higher than 10ºC, thus having definite summer and winter seasons. In accordance with the author previously mentioned, the region presents a humid climate, with precipitation in all the months of the year, thus not having a specific dry season, with warm summers possessing an average temperature of 22ºC.

The soil in which the experiment has been conducted belongs to the latosol group that are composed of mineral material, presenting a B horizon latosol preceded by an A horizon. These are profound soils and with good drainage, present throughout the majority of Brazilian territory, when of a 24 clayey texture they are very used to grain production (NUNES, 2007).

To the implantation of the experiment, the collection of soil samples in various sites, which were then homogenized and taken only a single sample to analyze, in order to obtain the nutrients content available in it, that are available in the attachment A. The experimental design that has been used was the random blocks one, concerning five treatments and four repetitions of each treatment, the parcels being constituted by 20,16m2 each and its dimensions in accordance to Figure 2.

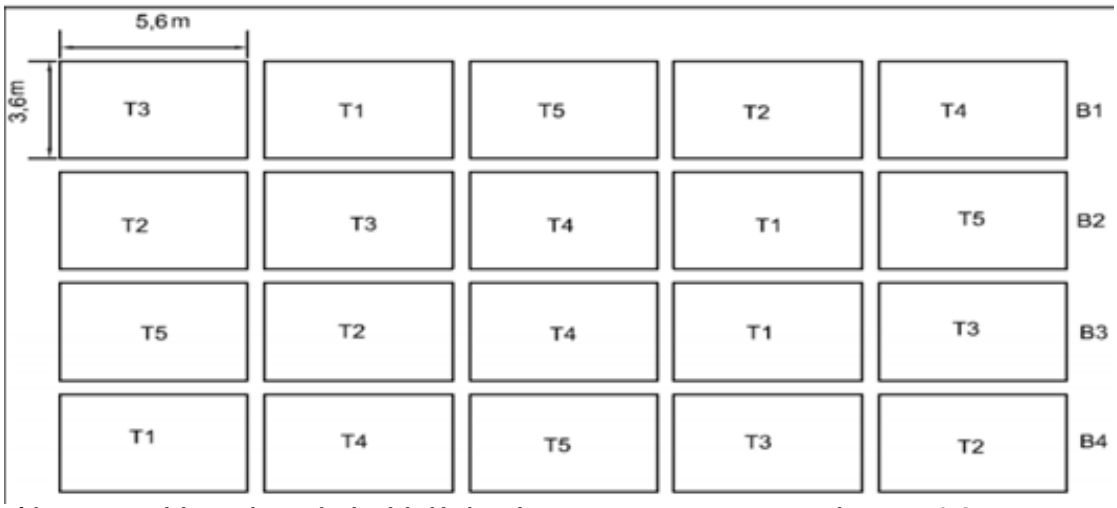

Figure 2. Sketch of the experimental design, showing by detail the blocks and its respective treatments. Dois Vizinhos – PR, 2016

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The treatments used and its respective seasons of applications are disposed in Chart 1.

Treatment	Product	Chemical Group	Dose ml ha $^{-1}$	Season of application
T1	Witness – with no application			
T2	Oranis	Strobirulin	200 ml	V4
	Oranis	Strobirulin	200 ml	Pre Bloomed V5
	Mertin	Organoestanico	800 ml	
	Oranis	Strobirulin	200 ml	Grain filling – V8
	Merlin	Organoestanico	800 ml	
T3	Comet	Strobirulin	400 ml	V4
	Comet	Strobirulin	400 ml	Pre Bloomed V5
	Clorotalonil	Isophthalonitrine	2000 ml	
	Comet	Strobirulin	400 ml	Grain fillin – V8
	Cloratalonil	Isophthalonitrine	800 ml	
T4	Oranis	Strobirulin	200 ml	V4
	Oranis		200 ml	Pre blooming V5
	Oranis		200 ml	Grain filling – V8
T5	Oranis	Strobirulin	200 ml	V4
	Oranis	Strobirulin	200 ml	Pre blooming V5
	Cloratalonil	Isophthalonitrine	2000 ml	
	Oranis	Strobirulin	200 ml	Grain filling – V8
	Cloratalonil	Isophthalonitrine	2000 ml	

The culture that has been utilized was the pinto beans ANFC 9 one, registered by Agro Norte. This culture presents as its main characteristics white flower and yellow string bean when in physiologic maturation, its seeds present a light beige color and yellowed integument having a cycle of 94 days. The culture's sowing took place on 12 February 2016, utilizing a directs system of plantation and a population of 12 plants per meter and a spacing of 0,45 m.

The applications were effectuated with a costal sprayer pressurized with CO_2 and an output of 165,2 L ha^{-1}, a yellow simple fan type beak, MAG. 110002 AD model and speed of application 1 ms^{-1}. Basic fertilizing was utilized with formulation 5-20-15, applying 309,9 Kg ha^{-1}. The management of weeds has been accomplished in two phases, one in pre-planting and the other post-emergency of the culture.

The management of plagues in the culture was accomplished according to the Integrated Pest Management (IPM), being monitored and applying insecticide when the control of plague level was achieved, doing so that the plague control would not result in loss of productivity. The evaluations of anthracnose consisted in verifying the severity and disease incidence, with the assistance of the diagrammatic scale developed by EMBRAPA, 2005, which bases on the percentage of the leaf area infected by the disease. The first trefoil of the plant was verified after evaluating 10 plants per parcel in each evaluation.

The incidence of the disease on the string beans of the plant that belong to the third medium were also evaluated, being verified 20 plants per parcel, using the Schoonhoven described scale (1991). The interlude between the evaluations was of 7 days until the end of the culture's cycle, whereas in the string beans there was an evaluation in R9 (physiological maturation). The productive aspects were evaluated considering yield components, having as response a variable height of the plant (cm), when the culture achieved the commercial maturation point, insertion height of the firs string bean (cm), number of string beans per plant, number of grains per string beans and weight of a thousand grains (kg), corrected to 13% of humidity.

The results of the yield components were obtained from an average of a sample of 10 plants per parcel, being the productivity obtained by the harvest of an area of 4,05 m^2 in the center of each parcel, where these samples were cleansed, weighted and corrected to 13% of humidity. The climate data were obtained from the agroclimatic bulletin of UTFPR Campus (Universidade Tecnológica Federal do Paraná), in Dois Vizinhos. The data of the severity evaluations and productivity aspects of the culture were submitted to analysis of variance (ANOVA) using the Assistat program. When significant results were obtained, the test of average comparison has been accomplished by the Tukey method to the level of 5% of significance.

RESULTS AND DISCUSSION

The anthracnose on the common bean presented low incidence when the leaf evaluations were accomplished, yet on the string beans evaluations it has not been found disease incidence, making the treatments similar concerning the anthracnose control, which were proven by the statistical analysis (Chart 1).

Chart 1. Analysis of severity of Colletrotrichum lindemuthianum in common beans culture, treated with different fungicides. Dois Vizinhos – PR, 2016.

Treatments	**Evaluation 1 20 March**	**Evaluation 2 3rd April**	**Evaluation 3 24 April**	**Anthracnose evaluation on the string beans (R9)**
T1	0 a	0,5 a	1 a	0 a
T2	0 a	0,3 a	0,6 a	0 a
T3	0 a	0,5 a	0,5 a	0 a
T4	0 a	0,4 a	0,7 a	0 a
T5	0 a	0,5 a	0,7 a	0 a

The low incidence of anthracnose was due to the fact that some climatic conditions were not favorable to the disease's appearing (Chart 2), mainly in relation to the relative humidity of the air, which kept between 83 and 74%, being considered low to the development of anthracnose. Another relevant factor that may be associated to the low incidence of anthracnose is the sanitary quality of the seeds, thus the contaminated seeds are the biggest cause of this disease transmission.

Chart 2. Climate data of the relative months of the experiment's period, average temperature and accumulated precipitation in the year of 2016. (GEBIOMET, 2006).

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Month	RH (%)	Temperature °C
February	83	24,4
March	83	21,9
April	78	22,6
May	74	16,3
June	82	13,6

According to Izabel (2006), the occurrence of anthracnose (Collectrotrichum lindemutianum), is favorable when the temperature is within 13 and 27ºC, however the best temperature for its development occurs when the temperature hits 21ºC, and the relative humidity an average of 91%. Another factor that may be taken into consideration to the non-development of the disease is the use of healthy and good quality seeds.

The area in which the experiment was accomplished may not be favorable to the disease's dissemination, thus it presents a low rate of motion of animals and machinery. In a study conducted by Krieger (2006) where he evaluated the criteria for applying fungicides, the results evaluated were similar, not being detected anthracnose in different seasons of evaluations.

The described fact by the author is directly linked to the use of inspected seeds and with no rain precipitations during cultivation. The same happened in a study conducted by Filho et al. (2008), after evaluating the control of anthracnose in the common bean using the fungicides, he obtained a similar result, in which the plant did not present symptoms of disease, nor in the leafs nor in the string beans.

However, Lima (2010), in his experiment aiming the control of anthracnose in the white mold in the common bean, obtained a better result applying the fungicide Piraclostrobin in a mixture with Metiram or Meticonanzebe, these provided low levels of severity of the disease, presenting a control of 60% when compared with the witness.

When comparing the height of the plants results of each treatment, as it can be observed according to Figure 3, that T2 presented a bigger size of plants, followed by T5 and T4, being the treatment with T3 the one that resulted in less developed plants also with smaller size.

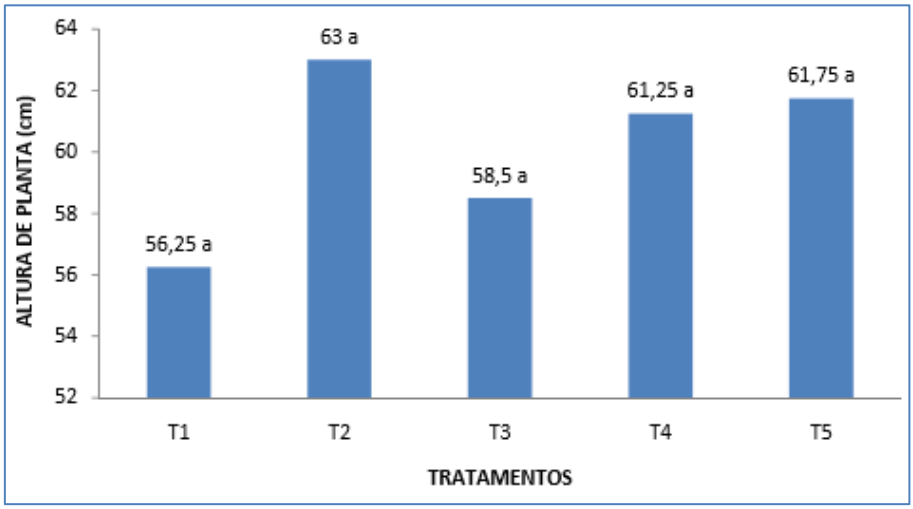

Figure 3. Average of treatments, in reference to the height of plants submitted to fungicide applications and evaluated at the moment of harvest, Dois Vizinhos – PR, 2016.

In a study conducted by Abadia (2014), aiming to evaluate the use of piraclostronbin in the beans' agronomic characters, the author observed an interaction between the season of Comet and Opera's application, in which a positive effect occurred on Comet's, resulting in a greater height of the plants.

According to saisshoji et al. (1998), after using triazole based fungicides, also known as tebuconazone he has obtained a decrease on the plant's size, this event happens because the fungicide is also a growth regulator.

In the string beans insertion height evaluation with 21,5 cm, one can notice on Figure 4 that the treatment 5 presented a bigger height number in the insertion of the string beans with 21,5 cm, being statistically equal to treatment 2 with 19,25 cm. The lower number was found in the witness being 16 cm, statistically equal to treatments 2 and 3.

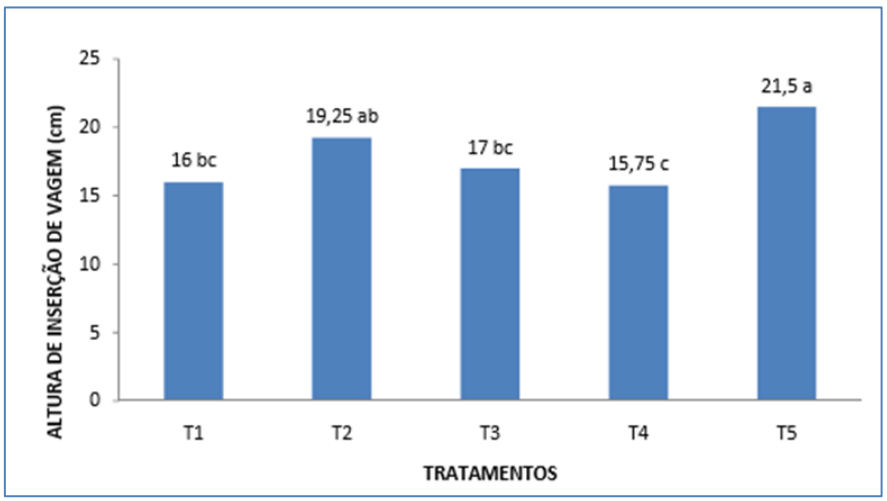

Figure 4. Average of treatments, in reference to the height of string bean insertion, submitted to applications of fungicides and evaluated at the moment of harvest, Dois Vizinhos – PR, 2016.

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According to a study conducted by Abadia (2014), after using piraclostrobin to the observation of agronomic common beans characters, the author observed that there was no significant difference to the height of insertion of the first string bean after applying the Comet. In accordance with Figure 5, one can notice the homogeneity within the number of string beans per plant in the different treatments applied.

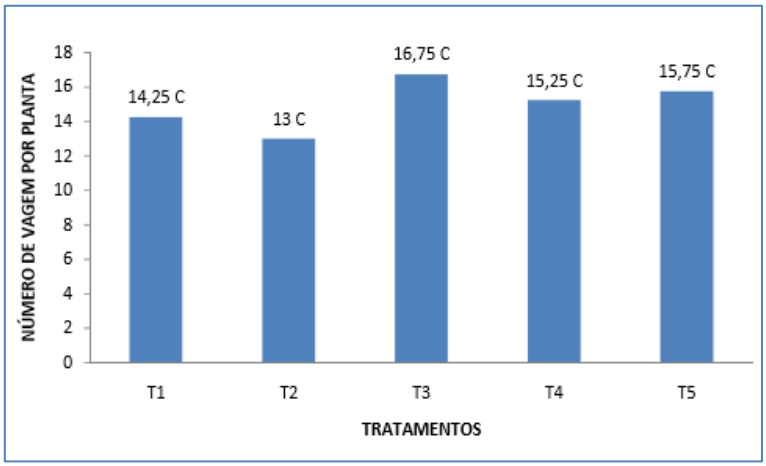

Figure 5. Average of treatments, in reference to the number of string beans per plant submitted to fungicide application and evaluated at the moment of harvest, Dois Vizinhos – PR, 2016.

In a study conducted by Veiga (2009) which sought to discover the secondary effects originated by fungicide application in the culture of beans, it has been observed that none of the treatments provided difference, between string beans' dry material and not even the same number of string beans per plant.

Demant (2012) after a study about angular spots control in the common bean, obtained the same result stating that the application of different fungicides did not present statistical differences in the number of string beans per plant. In Figure 6 one can notice the results of number of grains per string beans, considering that even statistically equal, treatment 2 was the one that presented a bigger result.

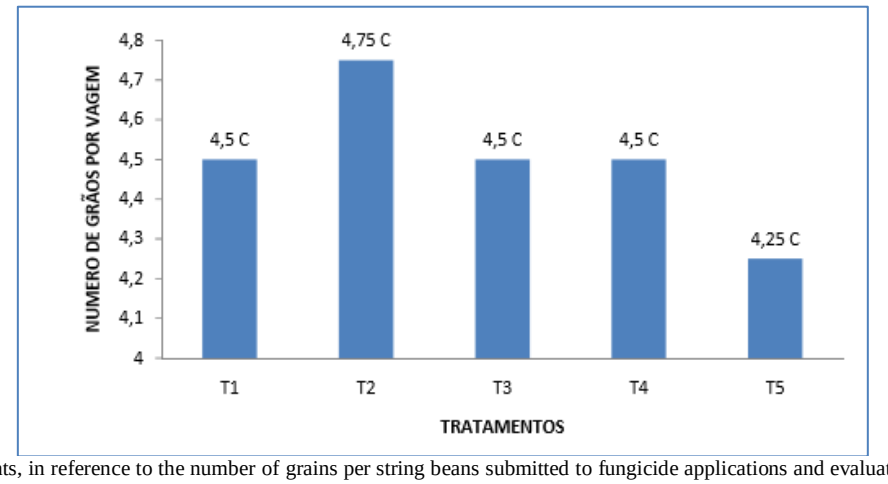

Figure 6. Average of treatments, in reference to the number of grains per string beans submitted to fungicide applications and evaluated at the moment of harvest, Dois Vizinhos – PR, 2016.

Kozlowski et al. (2009) after evaluating the effect of strobilurin based fungicides in the growth of plants, verified that it does not present significant differences in the number of grains per string beans. In figure 7, one can observe that treatment 5 presented bigger yield of grains, with an average of 867,76 Kg ha-1, following treatment 4 and treatment 2, being the lowest number found the one in the witness, with an average of 663,22 Kg ha-1, not differing from treatments 3 and 4.

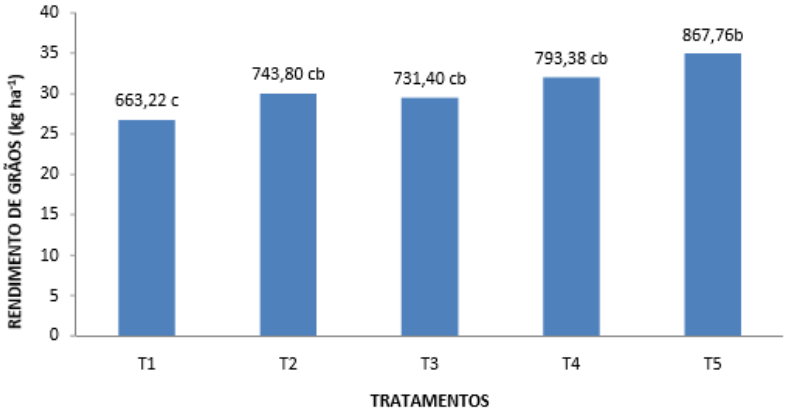

Figure 7. Average of treatments, in reference to the yield of grains submitted to fungicide applications and evaluated at the moment of harvest, Dois Vizinhos – PR, 2016

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Sartolato (2003) affirms that fungicides mixture have been very much used in the last few years as a method of control for diseases of the common bean, presenting excellent results. According to the author the fungicides mixtures make it able to amplify its action aspect, allowing one to have simultaneous control of other diseases in the common bean culture, not only anthracnose, lowering the possibility of selection of fungicide resistant pathogen biotypes.

Seeking to evaluate the efficiency of fungicides mixtures concerning the control of anthracnose on beans, Sartorato (2013) obtained similar results to the present work, in which he when evaluating the productivity, observed that all the treatments presented significant difference in relation to the testimony, proving thereby the high efficiency of the fungicides used.

In a study conducted by Oliveira et al (2008) seeking to evaluate the effect of strobilurin in the productivity of the common bean, the authors found different results in comparison to this work, in that work he applied Azoxystrobin in isolation, this separately presented a raise in its productivity up until 21%, when compared to the witness. However, when mixing the mixture with the active principle Difenoconazole the productivity has shown itself inferior, not differing from the witness.

Treatment 5 presented the highest weight of a thousand grains, with an average of 250,25 g, and did not differ from treatment 2. The lowest result was found on witness (T1), with an average of 212,4 grams, and did not differ from treatment 3 and 4 (Figure 8).

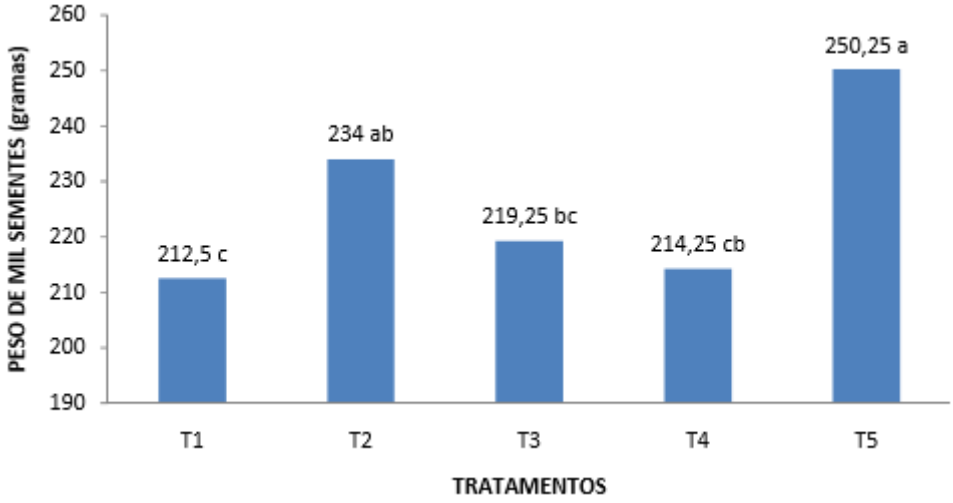

Figure 8. Average of treatments, in reference to the weight of a thousand grains submitted to the fungicides applications and evaluated in the moment of harvest, Dois Vizinhos – PR, 2016.

Minuzzi et al. (2011) in his experiment sought to test the efficiency of fungicides and different active ingredients in the control of anthracnose, and also obtained a significant difference, when applying azoxistrobin / difenoconazole he obtained a higher weight gain, with a raise of 11,6% when compared to the witness.

According to Sartorato e Rava (2003), after evaluating the efficiency of fungicides with different mixtures and doeses in the control of the angular spot in the common bean, they observed that among all the production aspects it has only occurred a significant difference in the mass of a thousand grains, in which it differed within the treatments and the witness.

CONCLUSIONS

After analyzing the results, we come to the conclusion that even without favorable conditions of humidity to the development of anthracnose, it is of fundamental importance to apply fungicides. Due to the fact that the plant is then protected since the initial development stages, in case of a disease focus, it will have lower effect in the culture.

When analyzing the results obtained by the experiment, and through the analysis of statistics one can affirm that treatment 5, with mixtures of the fungicide of the chemical group of strolubilurin and isophthanonitrin has also presented a higher result, thus the same presente a yield in the weight of a thousand grains bigger than the others up to 250 grams and a productivity of 867,76 kgha-1.

When analyzing the height of insertion of the first string bean, treatment 5, with mixtures of the fungicide of the chemical group of Strolubilurin and Isophthanonitrin presented a bigger height of insertion of the string bean and also on the yield of grains. When analyzing the others production aspects, such as: Height of Plants, Number of String Beans per Plants, and Number of Grains per String Beans, one can observe there has not been any significant difference between the treatments.

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