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# The cherry tomato under an organic system inoculated with *Trichoderma asperellum* and intercropped with vegetables of family fabaceae[1]

## Minitomateiro em sistema orgânico inoculado com Trichoderma asperellum e consorciado com hortaliças da família fabaceae

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**ABSTRACT -** The use of growth-promoting microorganisms and the intercropping of agricultural crops can be an advantageous alternative in family farming and organic production systems. The aim of this study was to evaluate the productivity and quality of the cherry tomato inoculated with *T. asperellum* (GEBio R) and intercropped with fabaceous vegetables. The experimental design was of randomised blocks, with and without the application of *T. asperellum* in cultivars of the cherry tomato under single cultivation (control), and intercropped with chickpea (*Cicer arietinum L.*) 'BRS Aleppo', the common white lupin (L.), and/or the snow pea (*Pisum sativum* L. var. *saccharatum*), with four replications. The following were evaluated: dry-weight production in the fabaceae, and leaf chlorophyll content, productivity, fruit quality and sensory analysis in the cherry tomato, in addition to the land equivalent ratio (LER). The white lupin had greater dry biomass and showed competition with the cherry tomato, reducing productivity; however, due to grain production, the LER was higher compared to the monocrop. The snow pea and the chickpea produced less biomass compared to the white lupin, and increased the relative leaf chlorophyll index in the cherry tomato. The intercrops showed similar production to the monocrop. The sensory analysis did not differentiate the cherry tomatoes by treatment. Inoculating with *T. asperellum* increased productivity in the cherry tomato by 38% over time, regardless of the intercrop.

**Key words:** *Solanum lycopersicum*. Agricultural microbiology. Polyculture. Sensory analysis.

**RESUMO -** O uso de microrganismos promotores de crescimento e o cultivo consorciado de culturas agrícolas pode ser uma alternativa vantajosa na agricultura familiar e sistemas orgânicos de produção. Assim, objetivou-se avaliar a produtividade e a qualidade do minitomateiro inoculado com *T. asperellum* (GEBio R) e consorciado com as hortaliças fabáceas. O delineamento experimental foi em blocos casualizados, com e sem a aplicação de *T. asperellum* nos consórcios de minitomateiros cultivados com grão-de-bico (*Cicer arietinum* L.) cultivar BRS Aleppo, tremoço-branco (*Lupinus albus* L.) cultivar comum e ou ervilha-torta (*Pisum sativum* L. var. *saccharatum*), e cultivo solteiro (testemunha), com quatro repetições. Foram avaliados a produção de massa seca das fabáceas, teor de clorofila das folhas do minitomateiro, produtividade, qualidade dos frutos e análise sensorial dos minitomates, além do índice de uso eficiente da terra (UET). O tremoço-branco apresentou maior fitomassa seca e competição com o minitomateiro, reduzindo sua produtividade. No entanto, em função da produção de grãos, apresentou maior UET quando comparado com o cultivo solteiro. As espécies ervilha-torta e grão-de-bico produziram menor fitomassa em relação ao tremoço-branco, incrementaram o índice relativo de clorofila das folhas do minitomateiro e os consórcios produziram semelhante ao cultivo solteiro. A análise sensorial não diferenciou os minitomates entre os tratamentos. A inoculação de *T. asperellum* aumentou em 38% a produtividade do minitomateiro ao longo do tempo, independentemente do consórcio.

**Palavras-chave:** *Solanum lycopersicum*. Microbiologia agrícola. Policultivo. Análise sensorial.

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## INTRODUCTION

The tomato (*Solanum lycopersicum* L.) is the most commercialised and consumed vegetable in Brazil today, equivalent to 28 thousand tons per month (AGRIANUAL, 2018). In 2017, the area under domestic production reached 61.1 thousand ha, producing 4.37 million tons and placing Brazil amongst the ten largest world producers (COMPANHIA NACIONAL DE ABASTECIMENTO, 2019; IBGE, 2018).

Among the types of tomato on the market, the cherry tomato (Solanum lycopersicum L. var. *cerasiforme*) has high added value and is increasingly consumed *in natura*, behind only long-life and Italian salad tomatoes (COMPANHIA NACIONAL DE ABASTECIMENTO, 2019).

Due to the growing demand for alternatives that contribute to more-sustainable agricultural production with fewer risks for producers, consumers and natural resources, biological technology is important, including beneficial microorganisms, such as the fungi of genus *Trichoderma*. These are biocontrol agents that are known worldwide (KUZMANOVSKA *et al*., 2018) and can be used as phosphate solubilizers (FRANÇA *et al*., 2017) and to induce plant resistance to pests and diseases (COPPOLA *et al*., 2017; VITTI *et al*., 2016).

*Trichoderma* spp. are growth promoters (SALAS-MARINA *et al*., 2015; ZIN; BADALUDDIN, 2020) and mitigate the effects of temperature (GHORBANPOUR *et al*., 2018), with the potential to influence the yield and nutrient content of the tomato fruit (NZANZA; MARAIS; SOUNDY, 2012) and to economise on fertiliser (SANI *et al*., 2020).

Another important factor is intercropping, which affords a greater land equivalent ratio with higher yield and increases income diversification over space and time while contributing to family farming, including the nutritional needs of the family (SILVA *et al*., 2020). Under this system, fabaceous species (the jack bean, white lupin, *crotalaria juncea*, cowpea and mung bean) can transfer the nitrogen fixed by symbiosis to the intercropped plant (AMBROSANO *et al*., 2018; SALGADO *et al*., 2020). According to Wutke, Calegari and Wildner (2014), fabaceous species, such as the chickpea (*Cicer arietinum* L.) 'BRS Aleppo', the common white lupin (*Lupinus albus* L.) and/or snow pea (*Pisum sativum* L. var *saccharatum*), are recommended for cultivation during the autumn/winter.

In view of the need for sustainable technological strategies to collaborate with family and organic farming, the aim of this study was to evaluate the productivity and quality of the cherry tomato inoculated with *Trichoderma asperellum* and intercropped with fabaceous vegetables.

## MATERIAL AND METHODS

The experiment was carried out from April to December 2018 in an arched agricultural greenhouse of 210 m² covered in 150-micron transparent polyethylene plastic and protected along the sides by a sombrite screen. The greenhouse is located in Pirassununga, São Paulo (21°59' S, 47°25' W, at an altitude of 627 m). According to the Köppen classification, the climate in the region is type Cwa (subtropical, with dry winters and hot summers). The maximum and minimum temperature, and relative humidity during the experimental period are shown in Figure 1.

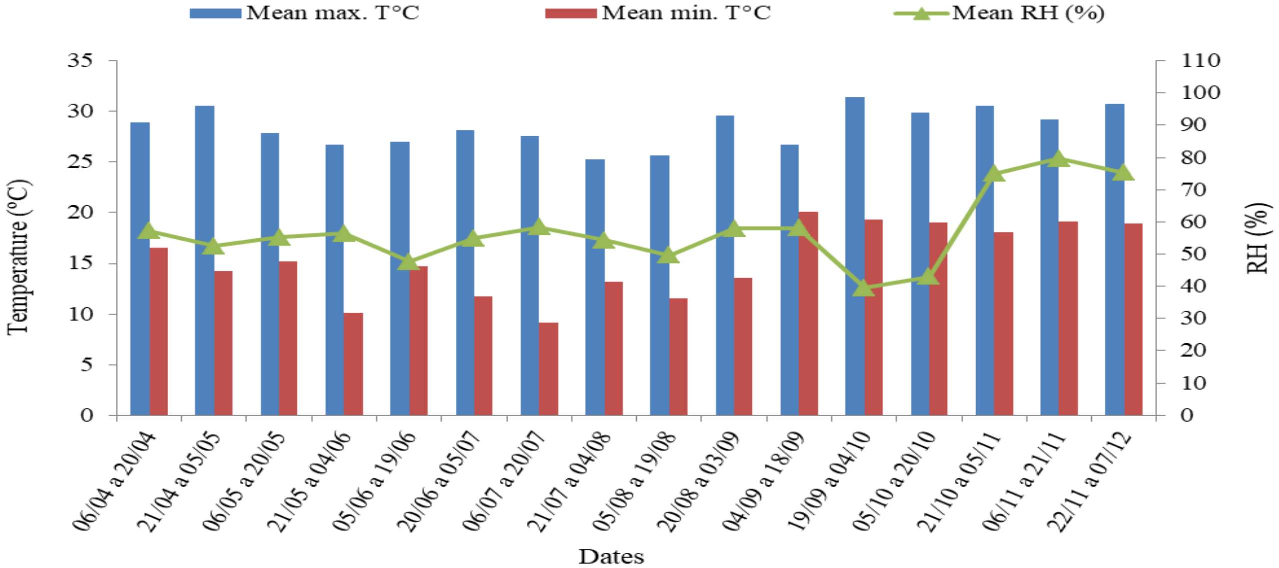
The experimental design was of randomised blocks in a 2 x 5 factorial scheme, corresponding to the application or lack of application of *Trichoderma asperellum* in the tomato under single cultivation (control) and intercropped with chickpea 'BRS Aleppo', the common white lupin and/or the snow pea, with four replications. The experimental plots consisted of fibreglass boxes with a volume of 0.5 $m^3$ and a surface area of 1 $m^2$.

The experiment began in April 2018 with the planting of 2 grams of millet seed (*Pennisetum americanum* L.) in each experimental plot; this was left for a period of 60 days and then harvested, ground and distributed evenly over the soil in the plots at a rate of 10.60 kg dry matter $m^{-2}$. At the end of May, the soil was collected from the 0-20 cm layer for chemical analysis. The soil was classified as a Eutrophic Red Latosol with a clayey texture (EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA, 2013), whose chemical analysis gave the following results: pH in $CaCl_2$ = 6.0, P = 43 mg $dm^{-3}$, S = 11 mg $dm^{-3}$, K = 1.0 $mmol_c$ $dm^{-3}$, Ca = 51 $mmol_c$ $dm^{-3}$, Mg = 17 $mmol_c$ $dm^{-3}$, H+Al = 19 $mmol_c$ $dm^{-3}$, SB = 69 $mmol_c$ $dm^{-3}$, CEC = 88 $mmol_c$ $dm^{-3}$, V = 78% and OM = 16 g $kg^{-1}$.

Before covering the soil with the millet, 4 kg CIAFERTIL® commercial organic compost were added per plot and incorporated into the 0 to 20 cm layer of the soil. An analysis of the compost showed pH = 8.5, humidity = 18.30%, total dry weight = 81.70%, organic matter = 12.40%, ash = 86.0%, total carbon = 7.2%, organic carbon = 2.4%, N = 6.7 g $Kg^{-1}$, $P_2O_5$ = 21.0 g $kg^{-1}$, $K_2O$ = 20.4 g $kg^{-1}$, S = 4.9 g $kg^{-1}$, CaO = 59.3 g $kg^{-1}$, MgO = 14.1 g $kg^{-1}$, Cu = 159.8 mg $kg^{-1}$, Fe = 8563.5 mg $kg^{-1}$, Zn = 76.2 mg $kg^{-1}$, Mn = 1341.8 mg $kg^{-1}$; C/N ratio = 11/1.

The wild cherry tomato (IAC access 21) was sown in polyethylene trays containing organic substrate for seedling production. *T. asperellum* (GEBio R) was selected by França *et al*. (2017), for the production of IAA (indoleacetic acid) and the solubilization of phosphates. Nineteen days after sowing (DAS), 50% of the cells were inoculated with 2 mL of a 1 x $10^7$ concentration of *T. asperellum* conidia $mL^{-1}$ (counted in a Neubauer chamber under an optical microscope) using a pipette. The seedlings

**Figure 1** – Maximum and minimum temperature, and relative humidity from April to December 2018




Source: http://www.agrariasusp.com.br/agrariasusp01/estacao.html

were kept in a greenhouse and irrigated daily by sprinkler until 53 DAS, when they were transplanted at a spacing of 0.8 x 0.8 m to give a total of 4 plants per plot.

Prior to transplanting, the soil was corrected with 80 g $m^{-2}$ magnesium thermophosphate (Yoorin master®), which in addition to phosphorus (16% $P_2O_5$), includes 18% calcium (Ca), 7% magnesium (Mg), 0.1% boron (B), 0.05% copper (Cu), 0.3% manganese (Mn), 10% silicon (Si) and 0.55% zinc (Zn).

Thirty days after transplanting the seedlings, the fabaceous vegetables were sown between the tomato plants in two rows spaced 30 cm apart, at the following planting densities per square metre: 12 chickpea plants, 8 snow pea plants and 16 white lupin plants.

The *T. asperellum* was reinoculated at a concentration of 1 x $10^7$ conidia $mL^{-1}$ applied to the surface of the soil in a circle close to the cherry tomato plants (3 mL $plant^{-1}$) and on the sowing rows of the fabaceae (4 mL per linear metre).

A top dressing of potassium was applied at 65 DAT, using 140 g wood ash $plant^{-1}$ (3% $K_2O$) distributed around the plants. At 73 DAT, Agrucon® mineral fertiliser as a source of micronutrients was applied via the leaves by back sprayer at a concentration of 0.2 g $L^{-1}$. Nitrogen was added at 92 DAT, using 125 g $plant^{-1}$ castor cake (5% N).

The cherry tomato plants were grown with two stems per plant with the aid of a tape, and the lateral branches were pruned twice a week. At 137 DAT, apical pruning of the plants was carried out to ensure the growth of 12 clusters per $plant^{-1}$.

The tomato moth (*Tuta absoluta*) was controlled with four applications of 0.5% neem oil; manual weeding was carried out to control spontaneous plants. Pollination was carried out manually by shaking the plants, due to the screen surrounding the greenhouse preventing the entry of pollinators and the action of the wind.

Four indirect assessments of the chlorophyll content (at 92, 108, 127 and 152 DAT) were carried out, measured on the fourth leaf from the apex of the cherry tomato plants using a ClorofiLOG - CFL1030 chlorophyll meter (FALKER), for a total of eight evaluations.

The white lupin, chickpea and snow pea were evaluated in senescence, collecting the grain and determining the shoot dry weight of the plants; the white lupin was evaluated at 127 DAS, and the chickpea and snow pea at 134 DAS.

The land equivalent ratio (LER) was determined from the equation: LER = (PIT/PST) + (PIF/PSF), where PIT corresponds to the productivity of the intercropped tomato, PST corresponds to the productivity of the tomato under single cultivation (control), PIF corresponds to the productivity of the intercropped fabaceous vegetables, and PSF corresponds to the productivity of the single fabaceous vegetables, based on the formula proposed by Willey (1979). To calculate the productivity of the fabaceous vegetables under single cultivation, data from the literature corresponding to the cultivar employed in the experiment was used, as per Santi *et al*. (2016).

A physical and chemical analysis was carried out in triplicate with fruit harvested at 112 DAT to determine the levels of total soluble solids, the pH, titratable acidity and maturation index, and to perform an instrumental colour analysis, as per the Instituto Adolfo Lutz (2008).

The maturation index was obtained from the ratio between the total soluble solids (TSS) and titratable acidity (TA) expressed as citric acid (TRESSLUE; JOSLYN, 1961).

The instrumental colour analysis of the extract was based on the luminosity parameter (L*), which varies from 0 (black) to 100 (white), and employed a MiniScan EZ 4500L portable spectrophotometer (HunterLab). The fruit was cut in half and placed in Petri dishes, which were then placed on the base of the apparatus, calibrated using a white standard. The CIELab system was used, where L* represents the luminosity index, a* the red content and b* the yellow content.

The sensory analysis was carried out and approved by the Ethics Committee under CAAE 26213419.9.0000.5504, using fruit harvested at 137 DAT. The sensory tests were performed in individual booths under white light. The ranking test (ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS, 1994) was carried out with 44 evaluators. One tomato from each treatment was simultaneously presented on coded disposable plates, and each evaluator was asked to rank them in increasing order for each attribute: size, red colour of the fruit, red colour of the pulp, characteristic tomato aroma, crispy texture, firmness, juiciness, sweetness, acid taste and preference. The order of presentation was randomised for each evaluator, and between each sample, the evaluator rinsed his/her mouth with mineral water.

For the statistical data analysis, an analysis of variance (Anova) was carried out, and when significant differences were found ($p<0.05$), the mean values were compared by Tukey's test at a level of 5% probability using the SISVAR 5.6 statistical software (FERREIRA, 2011). When there was an effect on the time factor, regression analysis was carried out. The production data for fresh and dry weight in the white lupin, chickpea and snow pea were transformed using Log10(X) in order to meet the assumptions of the mathematical model. The data obtained in the ranking test were interpreted as per the Friedman test ($p\leq0.05$) (NEWELL; MACFARLANE, 1987) considering a minimum difference ≥70 for eight samples and 44 evaluators.

## RESULT AND DISCUSSION

There was no interaction between the treatments (intercropping with fabaceous vegetables) and inoculation with *T. asperellum* evaluated over time, for any of the variables under analysis.

Dry weight in the white lupin was superior to that of the chickpea and snow pea, irrespective of inoculation with *T. asperellum* (Table 1).

**Table 1** - Dry weight in the fabaceous vegetables intercropped with the cherry tomato[1]

| Fabaceous vegetables[2] | Dry weight (kg $m^{-2}$) |
|---|---|
| White lupin | 2.12 a |
| Chickpea | 1.07 b |
| Snow pea | 0.87 b |
| CV (%) | 15.26 |

[1]Mean values followed by different letters differ by Tukey's test ($p<0.05$); [2]chickpea (*Cicer arietinum* L.) 'BRS Aleppo', common white lupin (*Lupinus albus* L.) and/or snow pea (*Pisum sativum* L. var. *saccharatum*)

White lupin can contribute between 90 to 100 kg $ha^{-1}$ nitrogen (N), affording a reduction in the cost of nitrogen fertiliser for crops grown in succession (WUTKE; CALEGARI; WILDNER, 2014). According to the same authors, by cultivating white lupin, 40 to 150 kg $ha^{-1}$ N can be fixed.

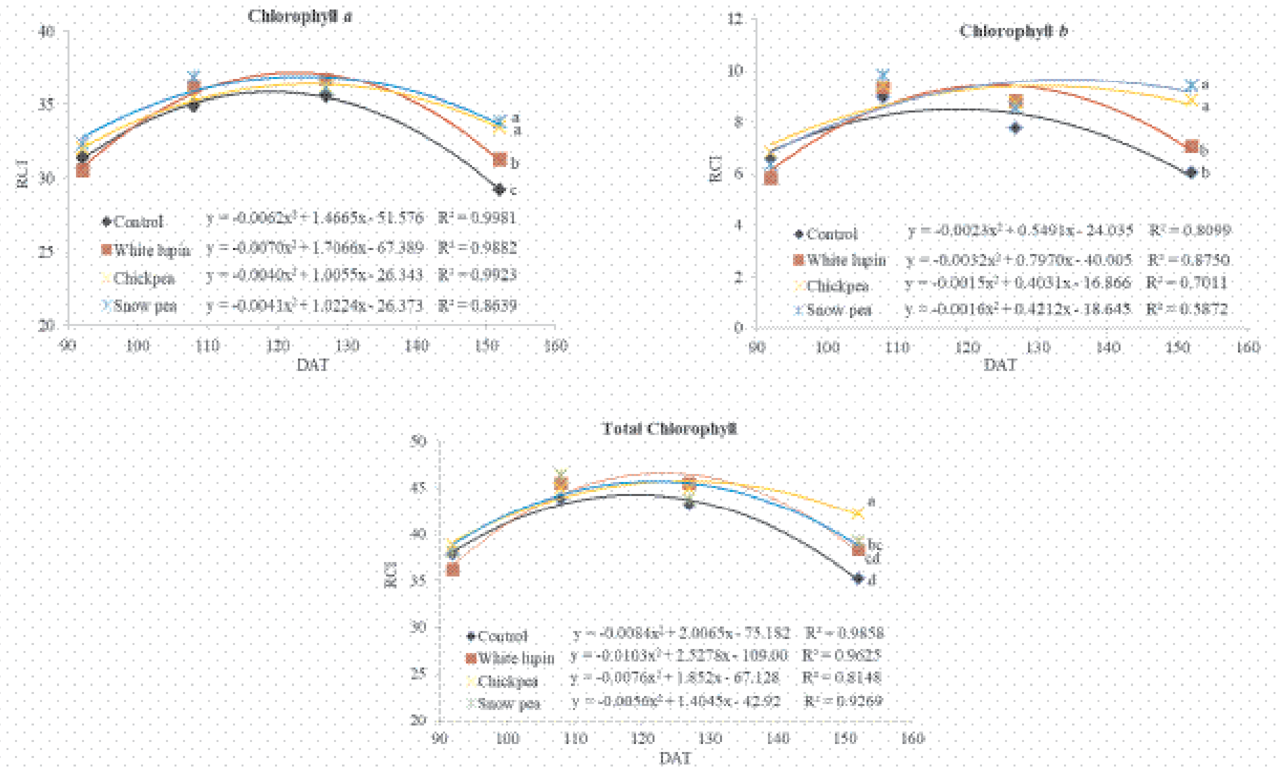
The relative chlorophyll index (*a*, *b* and total) in the intercropped cherry tomatoes showed a quadratic response as a function of time (Figure 2). At 152 DAT, a greater value for chlorophyll *a*, chlorophyll *b* and total chlorophyll was seen in the leaves of the cherry tomato plants intercropped with the peas and chickpea. The higher levels of chlorophyll *a*, chlorophyll *b* and total chlorophyll in the cherry tomato intercropped with these two plants may have been due to the release of nitrogen present in the biomass of these fabaceae, since they began the process of senescence during initial grain-filling without completing their reproductive cycle. The white lupin, despite having the characteristic of high efficiency in fixing and sharing nitrogen from biological fixation (AMBROSANO *et al*., 2018), used the N for grain-filling, since it was the only intercrop to complete each stage of the reproductive cycle. In turn, the control obtained the lowest relative indices of chlorophyll *a*, chlorophyll *b* and total chlorophyll under single cultivation, even when there was no competition for light.

The greatest nitrogen content, measured indirectly by the RCI, was found in the leaves of the cherry tomato intercropped with the snow pea and chickpea, but had no effect on the productivity of the cherry tomato.

The total number of fruit (TNF) and total fruit weight (TFW) showed a difference between the intercrops and the monocrop, and in relation to the inoculation with *T. asperellum* (Table 2). The TNF in the cherry tomato when intercropped with white lupin was 17.7% lower in relation to the monocrop (control). TFW in the cherry tomato intercropped with the snow pea and chickpea was not affected. However, when intercropped with white lupin, there was a reduction of 30% compared to the monocrop. It should be noted that the white lupin was grown until it produced grain, allowing the product to be used for food and/or commercialisation.

*T. asperellum* afforded better performance in the cherry tomato, both intercropped with fabaceae and under single cultivation, increasing TNF by 27% on average in relation to the absence of *T. asperellum*, and increasing TFW production by 38%. *T. harzianum* was able to improve growth in the tomato, and improve photosynthesis, the levels of total chlorophyll and gas exchange in the plants (VITTI *et al*., 2016). Indoleacetic acid (IAA) is a phytohormone produced by *T. asperellum* GEBio R, and is one of the most important auxins for regulating plant growth (FRANÇA *et al*., 2017).

**Figure 2** - Relative chlorophyll index (RCI) for chlorophyll *a*, chlorophyll *b* and total chlorophyll in the cherry tomato intercropped with white lupin, chickpea and snow pea[1] and under single cultivation (control)[2], over time[3]




[1]chickpea (*Cicer arietinum* L.) 'BRS Aleppo', common white lupin (*Lupinus albus* L.) and snow pea (*Pisum sativum* L. var. *saccharatum*). [2]Mean values followed by diferent letters within each time under evaluation differ by Tukey's test ($p<0.05$). [3]DAT: days after transplanting

**Table 2** - Total number of fruit (TNF) and total fruit weight (TFW) in the cherry tomato under single cultivation (control) and as an intercrop, with and without inoculation with *T. asperellum*[1]

| Treatment[2] | TNF (fruit plant$^{-1}$) | TFW (g plant$^{-1}$) |
|---|---|---|
| Control | 77.19 a | 556.62 a |
| Snow pea | 75.81 a | 538.86 a |
| Chickpea | 73.17 a | 498.91 ab |
| White lupin | 63.55 b | 389.35 b |
| With *Trichoderma asperellum* | 63.80 B | 416.87 B |
| Without *Trichoderma asperellum* | 81.01 A | 574.99 A |
| CV (%) | 13.50 | 18.50 |

[1]Mean values followed by different lowercase letters between the fabaceae and the control, and uppercase letters for *T. asperellum*, differ by Tukey's test ($p<0.05$). CV = coefficient of variation; [2]chickpea (*Cicer arietinum* L.) 'BRS Aleppo', common white lupin (*Lupinus albus* L.) and/or snow pea (*Pisum sativum* L. var. *saccharatum*)

The treatments that provided the largest TNF in the cherry tomato were the same that afforded the greatest TFW, showing for plants that produced a greater quantity of fruit, the weight of the fruit did not decrease. An increase in the total production of tomato plants in the greenhouse after inoculation with *T. harzianum* was also found by Nzanza, Marais and Soundy (2012).

As a function of time, TNF and TFW did not differ between the intercropped systems, however, both were influenced by inoculation with *T. asperellum* (Figure 3). For the collections made 127, 152 and 179 DAT, production and productivity were superior after inoculation with *T. asperellum* compared to the non-inoculated plants.

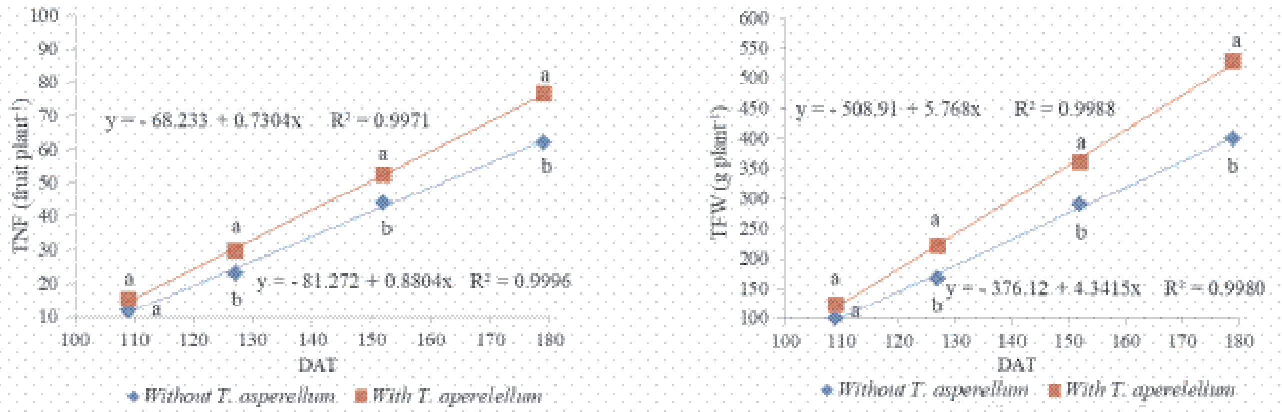
The application of *Trichoderma* can also affect the nutritional quality of the tomato and help economise on fertiliser, since it can promote root colonisation, increasing secondary roots and encouraging a larger leaf area (SANI *et al*., 2020). In addition, *Trichoderma* spp. acts as a natural decomposer of organic matter, favouring the recycling of nutrients (ZIN; BADALUDDIN, 2020).

The white lupin was considered when analysing the land equivalent ratio (LER) as it had completed its reproductive cycle, reaching the grain-filling phase. The LER was calculated from the productivity data, (Table 3). Considering a productivity of 150 g $m^{-2}$ for the white lupin under single cultivation, as per Santi *et al*. (2016), an index of 2.02 (without *T. asperellum*) and 1.98 (with *T. asperellum*) was obtained.

LER values greater than 1.0 mean that the intercrop is efficient, i.e. there is better use of the physical space. Furthermore, there are other equivalent advantages, such as the optimisation of labour, fertilisers and the use of water resources (irrigation). To grow white lupin separately under single cultivation, a 99% and 68% larger area would be needed to obtain the same results as in the intercropped plants in terms of grain and fruit productivity.

In general, crop productivity is reduced under an intercropping system; however, when it comes to land use, in many cases the intercrop is efficient. Ambrosano *et al*. (2014) studied intercrops of the cherry tomato using green manure, and found that when intercropped with white lupin, production in the cherry tomato was reduced by 21% in relation to the monocrop, but with an LER of 1.16. The highest LER found by the authors (2.54) was for the mung bean (*Vigna radiata* L.).

**Figure 3** - Total number of fruit (TNF) and total fruit weight (TFW) in the cherry tomato with and without inoculation with *Trichoderma asperellum*, as a function of time (DAT - days after transplant)[1]




[1]Mean values followed by different letters for the same date differ by Tukey's test ($p<0.05$)

**Table 3** – Land equivalent ratio (LER) for the cherry tomato intercropped with white lupin, with and without the application of *T. asperellum*[1]

| Treatment | PIT | PST | PIF | PSF* | LER |
|---|---|---|---|---|---|
| | g $m^{-2}$ | | | | |
| Without *Trichoderma asperellum* | 1346.12 | 2015.12 | 203.0 | 150.0 | 2.02 |
| With *Trichoderma asperellum* | 1768.64 | 2437.84 | 144.8 | 150.0 | 1.69 |

[1]PIT: productivity of the cherry tomato intercropped with white lupin; PST: productivity of the tomato under single cultivation (control); PIF: productivity of the fabaceous vegetable intercropped with the cherry tomato; PSF: productivity of the fabaceous vegetable under single cultivation (SANTI *et al*., 2016)

The pH varied from 4.36 in the fruit from the monocrop (control) inoculated with *T. asperellum* and intercropped with white lupin without *T. asperellum*, to 4.63 in the control with no inoculation. The values for TSS and TA in the cherry tomato were not affected by inoculation with *T. asperellum* (Figure 4). A greater TSS content (7.42 ºBrix) was seen in the cherry tomato intercropped with white lupin compared to the other fabaceae.

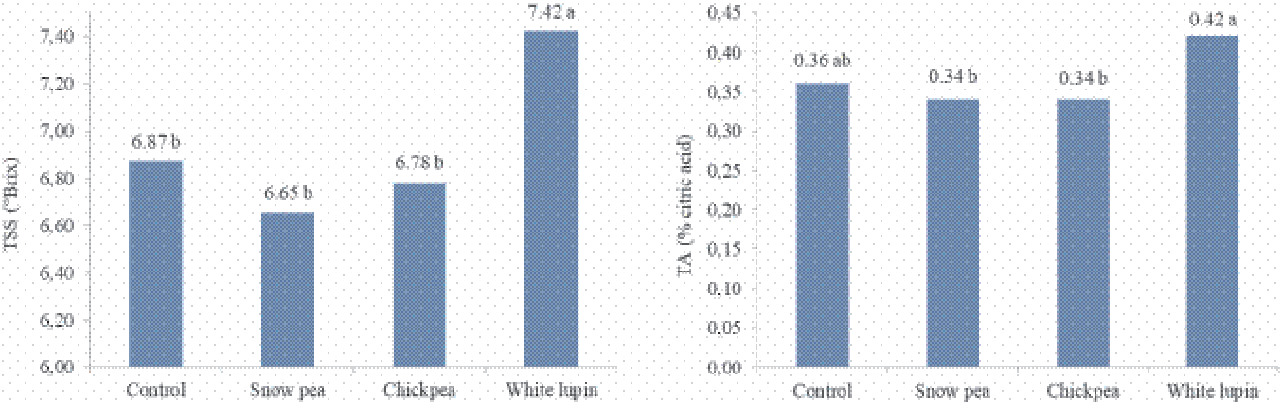
There was no difference in TA between the intercrops and the monocrop. Ambrosano *et al*. (2018), researching the same variety of tomato, found pH values of 4.35 and 6.5 ºBrix. The same authors state that the greater TSS in the fruit makes them sweeter, however, in the present experiment, this was not detected in the sensory analysis (Table 3).

There was no difference between treatments for the maturation index (MI) or colour analysis (L*, a* and b*).

The results of the sensory analysis showed that there was no difference between treatments for fruit colour, pulp colour, aroma, crispness, firmness, juiciness, sweetness, acidity or preference (Table 4).

There was a difference in size, especially for the cherry tomato intercropped with snow pea and inoculated with *T. asperellum*. The intercrop with white lupin resulted in less weight for the cherry tomato (6.1 g) in relation to the control (8.05 g), or when intercropped with chickpea (7.41 g) and snow pea (7.37 g). Despite this difference, the attribute had no influence on preference, which suggests that for consumers, the treatment would not influence decision-making when acquiring the cherry tomato.

**Figure 4** - Total soluble solids (TSS) and titratable acidity (TA) in the cherry tomato under single cultivation (control) and intercropped with fabaceous vegetables[1]




[1]Mean values followed by different letters for the same date differ by Tukey's test ($p<0.05$); $CV^{TSS} = 4.2\%$; $CV^{TA} = 9.41\%$

**Table 4** - Results of the sum of the ranking test for difference and preference in the cherry tomato intercropped with fabaceous vegetables

| Treatment | Size | Fruit colour | Pulp colour | Aroma | Crispness |
|---|---|---|---|---|---|
| Control | 214 abc | 164 a | 197 a | 208 a | 207 a |
| Control + *T. asperellum* | 205 abc | 199 a | 177 a | 222 a | 173 a |
| Snow pea | 228 ab | 216 a | 203 a | 201 a | 203 a |
| Snow pea + *T. asperellum* | 271 a | 201 a | 207 a | 206 a | 192 a |
| Chickpea | 202 abc | 193 a | 184 a | 215 a | 233 a |
| Chickpea + *T. asperellum* | 187 bcd | 173 a | 183 a | 191 a | 201 a |
| White lupin | 124 d | 211 a | 213 a | 166 a | 172 a |
| White lupin + *T. asperellum* | 145 cd | 227 a | 220 a | 175 a | 195 a |

| Treatment | Firmness | Juiciness | Sweetness | Acidity | Preference |
|---|---|---|---|---|---|
| Control | 211 a | 179 a | 175 a | 193 a | 190 a |
| Control + *T. asperellum* | 192 a | 213 a | 194 a | 205 a | 160 a |

*Continuation table 4*

| | | | | | |
|---|---|---|---|---|---|
| Snow pea | 214 a | 180 a | 197 a | 224 a | 218 a |
| Snow pea + T. asperellum | 217 a | 197 a | 181 a | 210 a | 227 a |
| Chickpea | 215 a | 174 a | 208 a | 199 a | 209 a |
| Chickpea + T. asperellum | 191 a | 198 a | 206 a | 188 a | 194 a |
| White lupin | 149 a | 213 a | 216 a | 176 a | 188 a |
| White lupin + T. asperellum | 195 a | 230 a | 207 a | 189 a | 198 a |

1Values followed by different letters on the same line differ statistically by the Friedman test ($p \leq 0.05$); Minimum difference for 8 samples e 44 evaluators = 70

## CONCLUSIONS

1. Inoculation with *T. asperellum* afforded an increase in the number and total weight of the fruit over time;
2. The snow pea and chickpea produced little biomass in relation to the white lupin, with an increase in the relative leaf chlorophyll index in the cherry tomato, and the intercrops showing similar production to the monocrop;
3. White lupin can be recommended for increasing the land equivalent ratio due to grain production; however it reduces productivity in the cherry tomato;
4. The fruit of the cherry tomato intercropped with white lupin showed a greater level of total soluble solids ($^{o}$Brix), but were not classified as being sweeter or of greater preference in the sensory analysis.

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