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An alternative to the lack of tomatoes in the rainy season in the dry tropics, growing tomatoes (Lycopersicon esculentum Mill.) Under a greenhouse

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Abstract : The production of tomatoes is constrained by many phytosanitary problems because of the proliferation of the parasites which find favorable climatic conditions to their multiplication. However, the need for its consumption continues to grow throughout the world, making it the most consumed vegetable. In Africa, fresh tomato conservation techniques are almost non-existent, forcing farmers to produce tomatoes in both the dry and rainy seasons. The production of tomato in the rainy season requires the observance of techniques limiting the loss due to pathogens. For this purpose, a test was installed according to a factorial device (2 * 4) in five rehearsals under glass. Treatments included two varieties of tomatoes (Roma and Tanya) combined with four fertilizer doses of 220 $kg.ha^{-1}$, 300 $kg.ha^{-1}$NPK (10-20-10), 30 $t.ha^{-1}$and 45 $t.ha^{-1}$of cow dung . In the greenhouse, the tomato plants were spread 50 * 50 cm on a plot of 1.2 m² taken as an experimental unit. During the experiment, phenological and yield parameters were observed. The result obtained after analyzing the two-factor variance, shows that the phenological parameters were not influenced by the types of varieties, the applied fertilizer doses and their interaction. However, a difference in fruit weight was observed between the two varieties, the Roma variety giving a better weight of more than 23 g and the Tanya having 16 g per fruit. Static analyzes on yield parameters showed significant difference between the different combinations. It was then that the yields were different according to the inputs, it is clear that the productive potential of the tomato was weakly expressed.

Thus this study presents itself as an opening open to tomato cultivation in the off-season and proposes the integration of phytosanitary control for a better optimization of the potential of the tomato.

Keywords: Tomato (*Lycopersicum esculentum* L.), fertilizers, varieties, productivity, yield and dose

Introduction

Urban and peri-urban agriculture has flourished since the onset of the economic crisis, and has become a significant source of income for many households in sub-Saharan Africa. Thus, gardens of very small areas, located in lowlands and swampy valleys, appear in or around urban areas (Nchoutnji et al., 2009). Tomato (Lycopersicon esculentum Mill.) Is a consumer product with a wide variety of uses: culinary, nutritional and even medical. By its intervention as a spice in several daily dishes, the tomato is the main market gardening favored by many farmers (Dossou et al., 2006). In fact, this vegetable of the Solanaceae family is rich in vitamins A and C, and in mineral salts, hence its importance in the household, making it the most produced vegetable in the world. Sufficient consumption of this valuable fruit would reduce the incidence of heart disease, stroke and gastrointestinal cancers, according to the World Health Organization. Not only is the tomato nutritionally interesting, it also provides farmers with a huge gain from its potential crop potential of 27.3 tonnes per hectare (Chougouro et al., 2012). Unfortunately, this production potential is not valued in developing countries, due to the lack of techniques to preserve the harvest in the off-season and the attacks of pathogens. This phenomenon leads to a loosening of the sector by low-income farmers due to the lack of phytosanitary products.

The current report indicates a rise in prices of fresh tomatoes in the rainy season due to lack of supplies. The solution to keep the price on the market, given the advanced technology and the growing need of households would be the practice of tomatoes in any season. This practice, although salvating for the stabilization of the market, would be hampered by a biotic constraint (attack of pathogens) which would lead to the mortality and / or the rot of roots, stems and fruits (Soro et al., 2008). This situation leads to yield reduction, resulting in losses that can be estimated at 50% of potential output in sub-Saharan Africa (Dossou et al., 2006). The use of pesticides has become more than a rule for market gardeners to fight against pathogens that find the climatic conditions favorable to their proliferation in hot weather (Kayum et al., 2008). However, the success of this use has always been accompanied by alarming consequences, such as air, water and soil pollution

(Kibblewhite et al., 2008, Tilman et al., 2002). In fact, the excessive application of chemicals leads to an imbalance of ecosystems, impeding the health of both farmers and consumers of market gardening products (Tsafack, 2014). The other setback in the use of plant protection products is the appearance of pesticide resistance genes in pests due to routine application. The optimal solution to the problem of lack of tomato in the off-season (rainy season), while maintaining the biological balance would be a use of responsible ecological practice. Thus, this study aims to evaluate the productivity of two varieties of tomatoes under the influence of organo-mineral fertilizers practiced under tropical greenhouse.

Material and method

This research was conducted in Lubumbashi (capital of the province of Upper Katanga), in the experimental field of the Faculty of Agricultural Sciences of the University of Lubumbashi in DR Congo. Located at 1278 m altitude, 12 ° 36'51 " South latitude and 27 ° 28'51 " East longitude (Mukalay et al., 2008), characterized by a tropical climate type CW6 after Koppen . The average annual temperature is 20 ° C, while the average annual rainfall is 1240 mm with a normal growth period of 182 days and a wet period of about 150 days (FAO, 2005). The growing season begins in the second half of October to stop around mid-April while the wet period goes from the first half of November until the first dekad of April (Kasongo et al., 2013) .

2.1.1 Plant material

In recent years the multiplicity of support organizations for farmers and seed-producing companies has been fueling unfair competition on seed quality among users. Thus, this study was set up with the aim of comparing two varieties of tomatoes, one from an international organization and the other from the market, to evaluate the performance of each of them. The main characteristics of these two varieties as presented in the data sheets are detailed in the table below.

Table 1: Characteristic of the varieties of tomatoes used

Variety	Germation	Purity	Moiture	Fruit	Sensivity	Productivity
Roma	85%	95%	8%	Long	Medium	High
Tanya	90%	98%	5%	Full	Average	High

2.1.2 Amendments

2.1.2.1 Minerals

Mineral fertilizers have the advantage of directly improving soil chemical properties (Nyembo et al, 2012). These fertilizers have the capacity to be easily bio available to the crops after the contributions allowing a maintenance of physiological functions of the plants (Ho et al., 2012). Nitrogen input is considered a stimulator of biomass production (Xuehui et al., 2014).

Cow dung

In addition to improved chemical properties, organic amendments improve the physical and biological properties of soils (Kasongo et al., 2013). Cow dung in particular contains an acceptable content of nutrients and trace elements for better market gardening (Chuimika et al., 2015).

2.2 Methodology

To complete this research, a test in a factorial device (2 * 4) in five repetitions was installed. The treatments included two tomato varieties (Roma and Tanya) as the main combined factor at 220 $kg.ha^{-1}$NPK (10-20-10), 300 $kg.ha^{-1}$NPK (10-20-10), 30 $t.ha^{-1}$and 45 $t.ha^{-1}$of cow dung as a secondary factor. For this purpose, an area of 1.2 m² (1 m * 1.2 m) was considered as an experimental unit. The experiment included a total of 40 parcels randomly placed in five blocks of eight parcels each. After placement of plots and fertilizers according to treatments, direct seeding was carried out at 50 * 50 cm spacings with three seeds that were removed from one seedling per pouch after emergence. Place under tropical greenhouse, a daily and regular watering of 6 mm of water, ie 720 mm of water for 120 days of experimentation was realized. Daily and as a function of the emergence of weeds, the formation of the crust of beating and the attacks intervened respectively the weeding, the hoeing and the mechanical struggle. Stakes composed of stems of Tithonia diversifolia were mounted as soon as the first fruits appeared to keep them above the ground. A staggered manual harvest occurred as the fruit matured and was practiced as quickly as possible to control pests, theft and rotting fruit. After harvest, the number, weight and diameter of the fruit were taken by hand counting, thanks to a kitchen scale (electronic) and a vernier caliper. While during the experiment, the rate of emergence, the survival rate and the number of flowers / plants were taken. The dataset collected during the trial was subjected to the two-factor analysis followed by the had hoc test using the R software.

Result

The table below presents the average values obtained after analysis of the two-factor variance of various parameters taken in our study.

Table 2: Influence of varieties, fertilizer doses and their interaction on growth and productivity of tomato

Sources of variation/ parameters		Re (%)	Sr (%)	Anf	AnF	WF (g)	LF (%)	Y (t/ha)
Increasing dose effect of fertilizers								
D1		91,8±9,1	72,5±2,5	14,1±6,2	19,6±1,3	19,6±6,8	45,5±1,3	1,8±1,5b
D2		91,3±13,4	90,6±2,5	13,9±4,3	48,5±1,3	26,4±5,8	40,5±1,2	6,9±5,6a
D3		82,0±10,9	84,6±1,4	13,5±4,9	50,1±1,5	18,0±9,2	33,7±9,8	7,3±4,8a
D4		85,9±10,8	81,0±1,8	13,5±7,1	34,1±1,7	18,7±7,2	37,2±2,1	5,5±3,8a
P		**0,23**	**0,52**	**0,91**	**0,06**	**0,26**	**0,73**	**0,01**
Effect varieties								
V1		85,4±1,1	84,2±1,8	11,7±0,4	43,1±1,9	16,6±3,29b	39,3±1,6	5,2±0,3
V2		90,9±1,1	79,6±2,2	15,8±0,6	33,1±1,6	24,7±3,74a	39,2±1,2	5,5±0,9
P		**0,15**	**0,66**	**0,13**	**0,47**	**0,02**	**0,85**	**0,88**
Interaction								
V1	**D1**	89,6±9,2	77,3±2,2	13,3±5,7	29,3±1,1ab	12,9±1,9b	43,6±1,6ab	3,0±0,1ab
	D2	82,6±1,5	100,0±0,0	14,5±7,7	49,0±2,2a	22,7±4,2a	43,8±1,7ab	5,9±5,4ab
	D3	78,6±5,6	81,0±1,7	9,3±2,5	61,0±2,0a	16,9±1,3b	34,2±7,7b	8,4±6,4a
	D4	90,6±9,0	81,0±2,3	9,6±1,5	33,0±2,2ab	14,1±2,9b	35,6±2,8b	3,7±2,2ab
V2	**D1**	94,0±1,0	67,7±0,0	15,0±0,0	10,0±0,0b	26,3±00a	47,36±2,1a	0,7±1,2b
	D2	100,0±0,0	81,3±3,2	13,3±2,5	48,0±5,6a	30,1±5,4a	37,36±1,0ab	7,9±6,9a
	D3	85,3±1,2	88,3±1,1	17,6±1,5	39,3±1,6ab	19,1±5,74a	33,38±1,3b	6,2±3,6a
	D4	84,3±1,3	81,0±1,7	17,3±1,1	35,3±1,5ab	23,3±7,6a	38,9±1,7ab	7,3±4,6a
P		**0,15**	**0,06**	**0,062**	**0,01**	**0,033**	**0,024**	**0,003**

Legend: Re: Rate of emergence, Sr: Survival rate of plants after emergence, Anf: Average daily number of flowers per plant, AnF: Average number of fruits per plant, WF: Average fruit weight, LF: Percentage of fruit lost on 100% of production, Y: Yield in tons per hectare of healthy tomato fruits, D : doses, V : variety.

Discussion

After statistical analysis on the emergence rate, no significant difference was observed between treatments under the influence of varieties, fertilizer doses or their combination. The likely explanation for this finding is that germination is essentially a function of the intrinsic quality of the seed, the physical properties of the soil and climatic conditions. Indeed, at the stage of germination, the seedling still lives at the expense of the nutritive reserves contained in the cotyledons of the seed not those in the soil, until the appearance of first leaves. Thus, soil nutrients are still unavailable to seed and therefore, seeds placed on soils with organic fertilizers would behave similarly to those installed on unfertilized soils (Useni et al. 2013). After analysis of the variance, no significant difference was observed on different parameters depending on the input of fertilizers. This observance could be justified by the fact that the quantities brought were already optimal, from where the plant is only used according to its need leaving the surpluses. Although being two types of applied fertilizers Nzuki et al. (2011), explain that inputs of organic fertilizers contribute in the same way as those of mineral fertilizers to crop growth. Thus, during nutrition the plant uses the elements only in mineralized form, it is then that a contribution of fertilizer is worth the organic fertilization for the plant. The yield of the tomato as a function of fertilizers showed a significant difference between the different inputs. The dose with 220 kg of NPK gave a low yield unlike the others that had higher value. This good intake gave a growth equal to the other treatments, it turned out that the nutritive stock could be exhausted before the formation of fruits. For Fandi et al. (2010) the productivity of a crop is dependent on the mineral reserve contained in the soil. Thus for our study, it can be said that the dose with 220 kg of NPK failed to provide nutrients necessary for good production. A significant difference has been observed between varieties based on fruit weight, indeed this parameter is more dependent on the genetic heritage, so the variety is known as fleshier fruit carrier. This statement can be justified by the result obtained by Nyembo et al. (2013) on the weight of corn kernels that was pending in the varietal choice. Although having a significant difference between the different combinations, it was obtained a low yield of the tomato compared to its potential. The main reasons would be the parasitic attacks observed during the experiment, but also the high temperatures. This last constraint was also noted by Daouda (2013) as being one of the cause of loss of tomato productivity.

Conclusion

The aim of this study was to observe the behavior of tomato varieties under organo-mineral fertilizers in dry tropical agro-climatic conditions. For this purpose, a factorial device (2 * 4) was set up at the Faculty of Agricultural Sciences of the University of Lubumbashi. During the experiment, the phrenological and yield parameters, and the crop losses due to the attacks were observed. It appears from the results after statistical analyzes that generally the yield obtained is low compared to the productive potential of the tomato. It is then that this research opens a way towards the practice of the tomato against the season in order to fight against the seasonal fluctuation of the price on the local market.

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