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Effect of the Variety and Fertilizers on the Resumption and the Growth in Seedbed of the Rejections of *Xanthosoma sagittifolia* (L.) Schott: A Case Study under Goma Conditions

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Abstract. Evaluating the effect of the variety and the fertilizers (compost and mineral manure DAP) on the rate of recovery and the growth in seedbed of the rejections based on two varieties of *Xanthosoma sagittifolia* (L.) Schott, produced by the PIF method, a case study was carried out in Goma town by using four types of treatments: T_0 (witnesses); T_1 (compost); T_2 (DAP), and T_3 (compost + DAP) for each variety.

The test was carried out using an experimental device of the complete randomized blocks covering four blocks, to four treatments each one for every variety. The rejections were planted on the spacing of 30 x 30 cm. The total of 640 rejections were planted, on the plot respecting 20 rejections under the spacing of 2,4 m^2.

The insurance realised during this investigation focused on the rate undertaken to the planted rejections, the diameter on the collet of seedlings, the number of formed leaves and the leaf area of the seedlings. Four seedlings per elementary plot were picked up by taking into account the fence effect in measuring these parameters. This study covered a period between March 24 and September 24, 2020. The effects of compost and mineral manure DAP on the growth parameters were appreciated by a variance analysis to a criterion classified with SPSS 20 software (IBM SPSS Statistic, 2015). The threshold of significance was fixed to 0,05%.

The achieved results on this case study are summarised in the following way:

1. The rate of resumption of the planted rejections was 100% for the whole experimented treatments for two varieties;

2. The seedlings of the green variety were more vigorous than the violet variety (F = 12,975; *P* = 0,000). These results show that the strength of the seedlings obtained depends on the experimented variety. Nevertheless, the different types of fertilizers tested did not influence the strength of the seedlings installed (F = 0,851; *P* = 0,468);

3. Neither the varieties, nor the treatments tested affected the increase in deployment of formed leaves (F = 1,325; *P* = 0,251 and F = 0,326; *P* = 0,806);

4. The green variety produced many seedlings with great leaves area compared to the violet variety (F = 21,989; *P* = 0,000). On the other hand, the different types of tested fertilisers did not affect the increase in dimension of formed leaves (F = 2,130; *P* = 0,099).

Although comparing the averages of the different treatments tested within the varieties, there is no slight difference, it is some up from the whole of the total obtained results that the green variety answers the organomineral fertilization well and it is adapted to the pedoclimatic conditions of the experimental site.

Key words: Variety, Fertilizer, Rate of recovery, Growth, Seedbed, *Xanthosoma sagittifolia*

Introduction

Xanthosoma sagittifolia (L.) Schott is ranged among the 6 plants having roots and tubers cultivated in the world (FAO, 2012). It feeds more than 400 millions of people in the world (Onokpise, 1999; Vaneker & Slaats, 2013). The corms are richer in proteins than sweet potato, the cassava, Irish potato and the yam. They measure 2 to 4% of proteins and their glucides are one of a good digestibility due to its low dimension of starch seeds (Agueguia *et al.,* 2007). Furthermore, *X. sagittifolia* is easily adapted to the agro-ecological conditions of the wet tropics, where it can yield well even in the poor soil to other cultures (Vandenput, 1981; Messiaen, 1989; Janssens, 2001; Carburet *et al.*, 2007). The tubers are rich in vitamins (A, B, C, etc.) and rock salt, including calcium and others, important to maintain good health (Amagloh & Nyarko, 2012; Traoré, 2016).

In spite of these virtues and socio-economic importance of *X. sagittifolia*, its culture on large scale hits on a problem of missing a propagation material in terms of quality and quantity of good enough extension. This is understood by mode of growth, on which dominance is most boosted the development of the side buds (Vandenput, 1981; Okungo, 2008). Foremost the multiplication range is weak, because one seedling harvested produces generally only one cutting. Thus each year, we have the same number of cuttings and the cultivated area remains generally the same, at each farming season (Messiaen, 1989; Okungo, 2008).

Concerning the agronomic potentialities that presents *X. sagittifolia* (L.) Schott (Birame, 2016), the promoting of this farming would contribute to the safety and the variety of the food resources in DRC. This promotion must fast pass by reviewing the methods of multiplication that improve the rate of accessibility to all which is general weak. The carried out studies with the PIF method showed that this technique improves the rate of multiplication of this plant. After getting spreading tools, it is a must to evaluate its performance (growth and output). Thus, the general objective of this case study is to evaluate the effect of the variety and the fertilizers (compost and mineral manure DAP) on redoing the rate and the growth in seedbed about the rejections of *X. sagittifolia* produced by the PIF method. For specific sake, it is to measure the growth parameters of vegetative development of the rejections of two varieties of *Xanthosoma spp,* under various fertilizers. The investigation hypothesis undertaken found that restating rate and growth in seedbed of the rejection. From PIF method varies according to variety and from fertilizers that determine the nutritive element quantity brought to soil influencing the restarting of the seedbed growth.

Material and Methods

Study Environment

This case study was carried out in Goma town, on the grounds of the Catholic University La Sapientia. The geographical coordinates of the experimental site taken with the GPS are as follows: 74 ° 11' 16" S; 98 ° 17' 28,1" E; 1474 m altitude (Figure 1).

The town of Goma enjoys a tropical high altitude climate of the type Cf of the Köppen classification. The annual rainfall is 1250 mm and the average monthly temperatures vary between 20°C and 25°C. The soil is of the andosol type resulting from volcanic eruptions (Kulimushi, 2011).

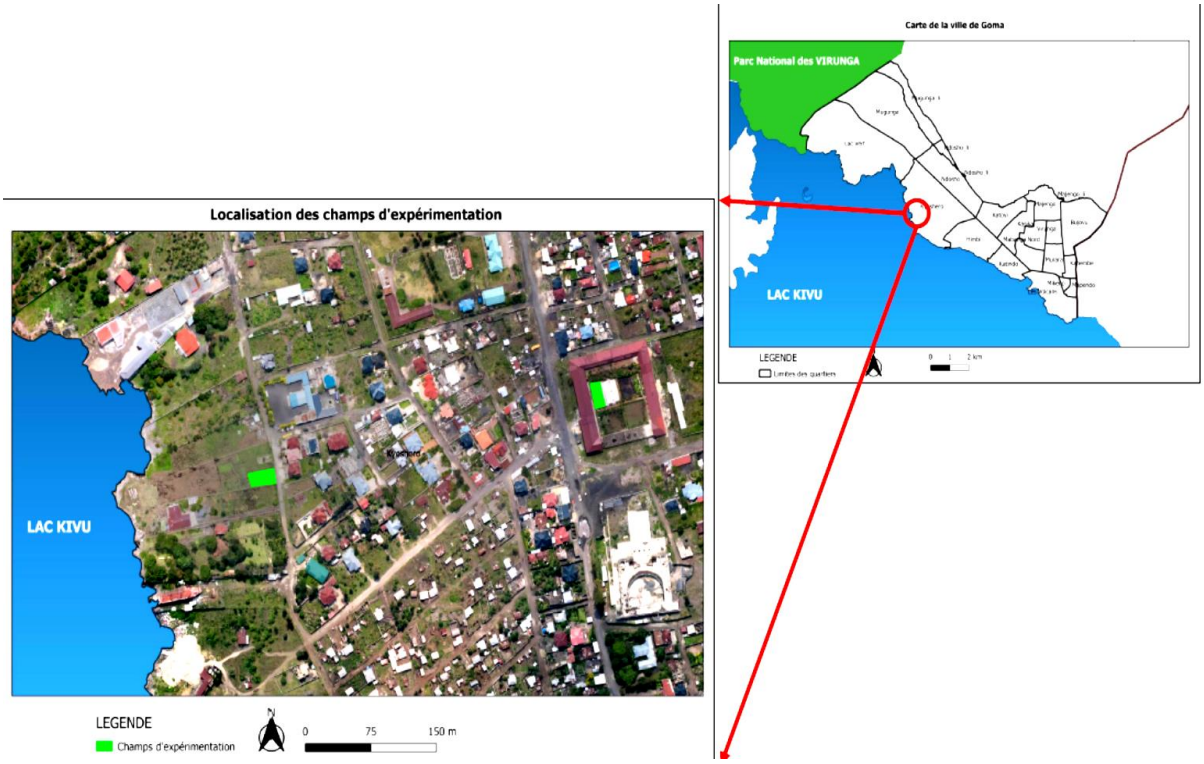

Figure 1. Location of the study site

Materials

The biological material used during the realization of this investigation was consisted of the rejections of *X. sagittifolia* produces in the propagator by the PIF method starting from the bulbs collected near the farmers of the agro-ecological zone of Mahanga in Masisi territory and Minova, a territory of Kalehe. The morphological characteristics identifying the varieties tested arise as follows: green leaves, green petioles and white tubers for the green variety and green leaves, purplished petioles and tubers purplished for the violet variety. In addition to the two varieties, two types of fertilizer were used, in particular the compost at base of the household refuse and mineral manure DAP.

Methods

The experimental preparation of the field consisted of delimiting the ground, the clearing, the digging, levelling and the trouaison in order to provide the rejections a good bed of plantation.

The preparation was done by using four arranged blocks randomized, of which each one consisted of four pieces, corresponding to the four following treatments: T_0 (witnesses), T_1 (compost), T_2 (DAP) and T_3 (compost + DAP). This device was used separately for the two varieties.

The blocks like plots were separated by paths from 1 m to facilitate the movement of the people and work weeding. A fence of 1 m was arranged around the experimental field. Each plot measured 2 m length and 1,20 m width, on the surface of 2,4 m^2 and the rejections were planted the same way for the whole test under the spacing of 30 cm x 30 cm. The total of 640 rejections were planted, respecting 20 rejections per plot.

The insurance realised during this investigation focused on the rate undertaken to the planted rejections, the diameter on the collet of seedlings, the number of formed leaves and the leaf area of the seedlings. Four seedlings per elementary plot were picked up by taking into account of the fence effect in measuring these parameters. This study covered a period

between March 24 and September 24, 2020. The effects of compost and mineral manure DAP on the growth parameters were appreciated by a variance analysis to a criterion classified with SPSS 20 software (IBM SPSS Statistic, 2015). The threshold of significance was fixed to 0,05%.

Results

Recovery Rate of Planted Rejections

The results obtained relating to the rate of resumption of planted rejections showed that all the rejections installed began again for all the treatments tested in general.

Diameter with the Collet of the Seedlings

Figure 2 gives the profile of the response of the two varieties to tested fertilizers**.**

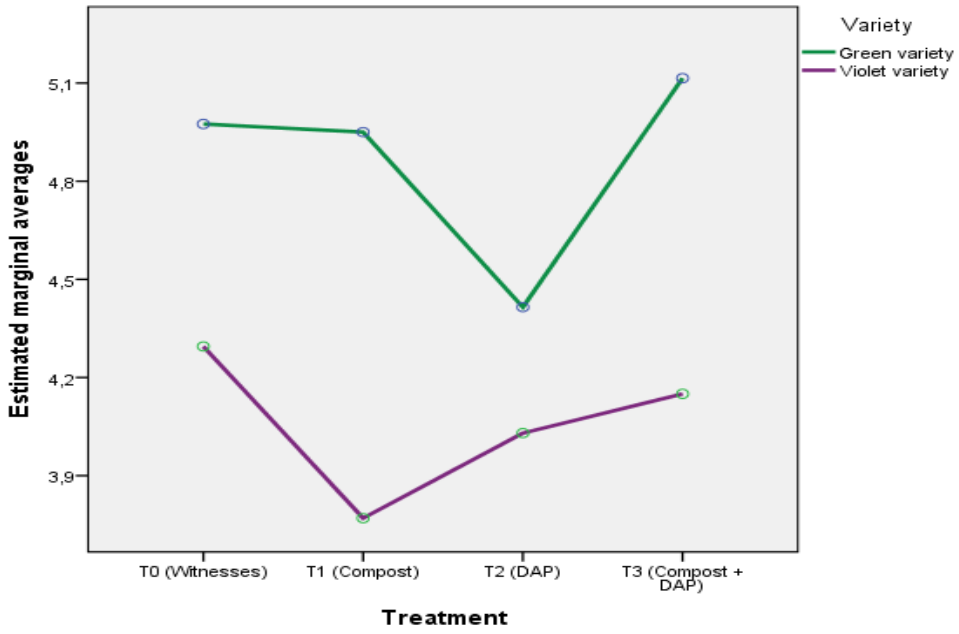

Figure 2. Profile of the response of the two varieties of *X. sagittifolia* to the fertilization

This figure reveals that the answer depends on the variety and the type of fertilizer tested. This profile of response of the varieties to the various types of fertilizer indicates that the green variety overall produced more vigorous seedlings compared to those of the violet variety (Figure 2). However, the combination of two fertilizers was better by synergism.

The results relating to the analysis of the variance of the strength of the seedlings according to the varieties tested of which the raw data are in appendix are presented in Table 1.

Table 1. Strength of the seedlings according to the varieties tested

Source	Summon squares	ddl	Average squares	F	*P*
Variety	25,760	1	25,760	12,975	0,000
Treatment	5,070	3	1,690	0,851	0,468
Variety * Treatment	3,582	3	1,194	0,601	0,615
Error	301,782	152	1,985		
Total	**3522,420**	**160**			

The results of this table show that there exists a significant difference between the varieties tested (F = 12,975; *P* = 0,000) referring to the strength of the seedlings. On the other hand, there is no significant difference between the two types of fertilizer used, including the interaction between the variety and the type of fertilizer.

A Number of Leaves Formed

Figure 3 shows the profile of the response of the two varieties to fertilizers relating to the number of leaves.

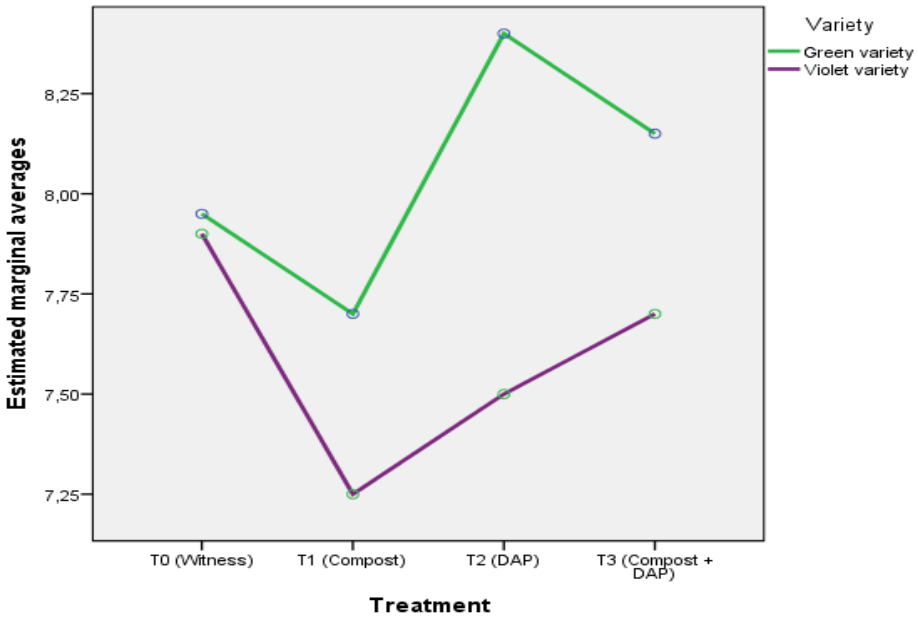

Figure 3. Profile of the response of the two varieties of *X. sagittifolia* to the fertilization

According to Figure 3, on average, there is a slight increase in the number of leaves formed at the green variety compared to the violet variety.

The relative results to the statistical analysis shows the number of leaves formed according to the tested varieties of which the raw data are in appendix, consigned in Table 2.

Table 2. A number of leaves formed according to the varieties tested

Source	Summon squares	ddl	Average squares	F	*P*
Variety	8,556	1	8,556	1,325	0,251
Treatment	6,319	3	2,106	0,326	0,806
Variety * Treatment	3,619	3	1,206	0,187	0,905
Error	981,250	152	6,456		
Total	**10781,000**	**160**			

The results of this table reveal that there are significant differences neither between the varieties nor between the treatments tested of the point of considering a number of formed leaves (F = 1,325 ; *P* = 0,251 and F = 0,326 ; *P* = 0,806), including the interaction enters the variety and the type of tested fertilizer.

Leaf Area

Figure 4 gives the profile of the response of the two varieties to fertilizers tested with regard to the size of leaves.

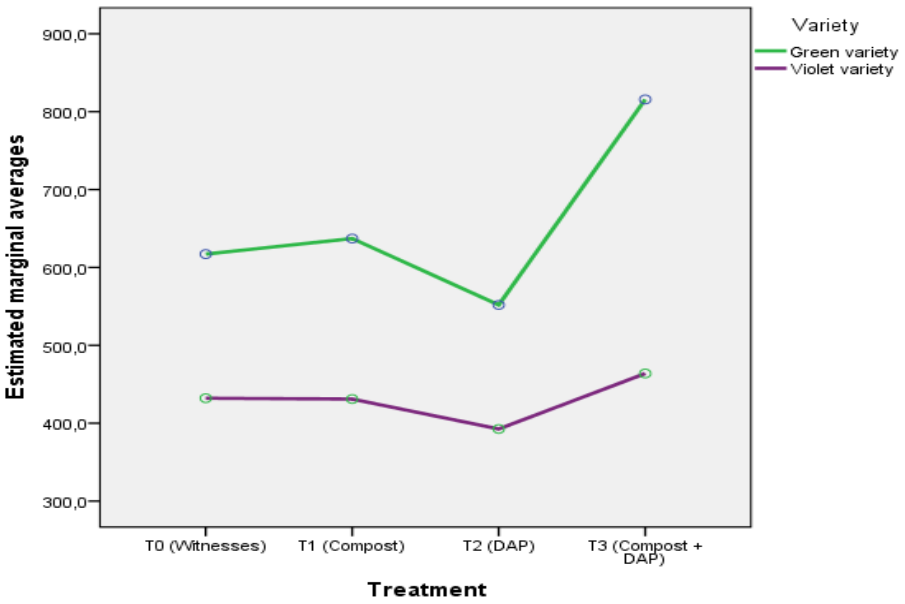

Figure 4. Profile of the response of the two varieties of *X. sagittifolia* to the fertilization

The profile of response to the varieties of the various types of fertilizer indicates that the green variety overall produced a great leaf area compared to the violet variety (Figure 4). Indeed, the green variety showed an increase on the leaf area, particularly at the compost and the compost mixture-DAP.

The results relating to the analysis of the variance on the leaf area according to varieties tested of which the raw data are in appendix are consigned in Table 3.

Table 3. Leaf area according to the tested varieties

Source	Summon squares	ddl	Average squares	F	*P*
Variety	2034889,545	1	2034889,545	21,989	0,000
Treatment	591472,859	3	197157,620	2,130	0,099
Variety * Treatment	223716,761	3	74572,254	0,806	0,492
Error	14066398,879	152	92542,098		
Total	**64035320,270**	**160**			

The results of this table indicate that there exists a significant difference between the tested varieties (F = 21,989; *P* = 0,000) with regard to the leaf area. On the other hand, there is no significant difference between the two types of fertilizer used, including the interaction between the variety and the type of fertilizer.

Discussion

The results relating to the rate of resumption of rejections make it possible to note that all the planted rejections took again whatever the variety tested. These results are similar to those proposed by Vandenput (1981), Messiaen (1989), Janssens (2001), and Tshipamba *et al.* (2019), which confirms the cuttings of *X. sagittifolia* begin again at 100%, except in the event of preliminary attacks. By comparing our results with those obtained by Pama *et al.* (2017), there observed a difference which is explained by the used rejections. We think, the pedoclimatic conditions of the medium would have influenced and explained this difference. Indeed, Goma town and Kisangani town do not profit from the same pedoclimatic conditions.

With regard to the parameters of growth and vegetative development, their evaluation made it possible to say that the two varieties of *X. sagittifolia* had different behaviours.

Indeed, the measurement of the diameter to the collet of the seedlings, the number of formed leaves and the leaf area showed that the green variety produced on average of the greatest value. The most robust seedlings, the deployment of a greater number of leaves and the largest leaves were observed at the green variety compared to the violet variety (Figure 2, 3 and 4). This variability in morphology can be explained by the intrinsic character of each variety studied *X sagittifolia*, since the genes which control these morphological characters seem to be different at these varieties. Indeed, Mazliak (1972) agrees that the reaction of a plant to an unspecified physiological phenomenon is at the same time under control of the endogenous factors (genetic and hormonal) and exogenic (temperature, light, reaction of the ground, moisture).

However, by comparing the four treatments tested, a slight difference is numerically observed, elucidated in the following way according to parameters observed. Compared to the diameter with the collet of the seedlings, the results obtained indicated that there is no significant difference between the treatments tested (P = 0,468). What shows the increase in the size of the seedlings is not explained by the tested treatments (Table 1). However, the observation of Figure 2 indicates that the seedlings of *X. sagittifolia* installed under T_3 (compost + DAP) are most vigorous compared to those planted under the other treatments tested. Concerning the number of formed leaves, it was observed that it varied almost one treatment to the other for all the varieties tested (Figure 3). These slight differences show that the number of formed leaves is a characteristic of the variety. Indeed, for the same variety, the number of formed leaves is in general the same one (Janssens, 2001). Being aware of that, we used two varieties of *X sagittifolia* belonging to the same family; we assume that this assertion of Janssens (2001) is also valid for our case. However, it should be noted that the rate/rhythm of deployment of the leaves is also influenced by the level of feeding as confirmed by Mazliak (1982) quoted by Pama *et al*. (2017).

As for the leaf area, the results obtained showed that there is no significant difference between the tested treatments (P = 0,099). It indicates the increase in the dimension of formed leaves do not depend on treatments tested (Table 3). Nevertheless, Figure 4 shows that the compost mixture-DAP (T_3) produces the largest increase in terms of size of leaves compared to the other treatments put in experiment. These results are explained by the strength of the seedlings.

Conclusion

The purpose of presenting this study was to evaluate the effect of the variety and the fertilizers (compost and the mineral manure DAP) on the resumption and the growth in seedbed of the rejections of *Xanthosoma sagittifolia* under the conditions of Goma town. To this end, a case study was carried out in the enclosure of the Catholic University Sapientia following a device of the complete randomized blocks comprising 4 treatments of 20 rejections, corresponding to 4 repetitions by treatment. The observations carried out during this investigation were related primarily to the rate of resumption of the planted rejections, the diameter with the collet of planted rejections, the number of formed leaves and the leaf area of the seedlings.

The two varieties of *X. sagittifolia* put in gardening season under the pedoclimatic conditions of Goma town had a variability at the level of the parameters of growth and vegetative development. A good vegetative growth was observed at the green variety which obtained seedlings having the largest diameters and are characterized by the deployment of a greater number of leaves of big sizes. Although by comparing the averages of the various treatments tested within the varieties, there is no significant difference of the point of considering above mentioned parameters, it is released from the whole of the results obtained

that the green variety responds to the organomineral fertilization well and is well adapted to the pedoclimatic conditions of the experimental site.

Moreover, it comes out from this case study that the mixture of the compost with mineral manure DAP (T_3) constitutes the best treatment from the numerical value point of view obtained of the whole test.

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Appendix: Raw data of various parameters observed

I. GREEN VARIETY

Diameter with the collet of the formed rejections (cm)

Treatment / Blocks	T_0 (Witnesses)	T_1 (Compost)	T_2 (DAP)	T_3 (Compost + DAP)
B_1	6,10	7,00	3,40	9,30
B_2	6,80	7,00	6,40	5,80
B_3	7,10	6,80	5,10	5,90
B_4	5,00	4,30	6,40	5,30
Summon	25,00	25,10	21,30	26,30
Average	6,30	6,30	5,30	6,60

A number of formed leaves

Treatment / Blocks	T_0 (Witnesses)	T_1 (Compost)	T_2 (DAP)	T_3 (Compost + DAP)
B_1	11,00	10,00	10,00	12,00
B_2	11,00	13,00	12,00	11,00
B_3	12,00	11,00	12,00	11,00
B_4	10,00	9,00	12,00	11,00
Summon	44,00	43,00	46,00	45,00
Average	11,00	11,00	12,00	11,00

Leaf area (cm^2)

Treatment / Blocks	T_0 (Witnesses)	T_1 (Compost)	T_2 (DAP)	T_3 (Compost + DAP)
B_1	542,10	1050,20	230,90	2667,20
B_2	1069,90	1147,80	829,80	933,30
B_3	1300,80	923,50	595,60	735,80
B_4	639,70	625,10	1305,40	848,90
Summon	3552,50	3746,60	2961,70	5185,20
Average	888,10	936,70	740,40	1296,30

II. VIOLET VARIETY

Diameter with the collet of the formed rejections (cm)

Treatment / Blocks	T_0 (Witnesses)	T_1 (Compost)	T_2 (DAP)	T_3 (Compost + DAP)
B_1	6,30	5,10	5,90	4,60
B_2	4,90	2,60	3,70	7,50
B_3	5,10	5,70	5,00	5,30
B_4	4,90	4,40	4,30	3,40
Summon	21,20	17,80	18,90	20,80
Average	5,30	4,50	4,70	5,20

A number of formed leaves

Treatment / Blocks	T_0 (Witnesses)	T_1 (Compost)	T_2 (DAP)	T_3 (Compost + DAP)
B_1	12,00	10,00	9,00	9,00
B_2	10,00	9,00	11,00	12,00
B_3	11,00	12,00	10,00	11,00
B_4	11,00	10,00	11,00	10,00
Summon	44,00	41,00	41,00	42,00
Average	11,00	10,00	10,00	11,00

Leaf area (cm^2)

Treatment / Blocks	T_0 (Witnesses)	T_1 (Compost)	T_2 (DAP)	T_3 (Compost + DAP)
B_1	788,30	732,00	594,80	334,60
B_2	518,80	259,80	335,60	1218,30
B_3	570,40	753,20	601,00	624,10
B_4	560,40	647,20	597,30	362,40
Summon	2437,90	2392,20	2128,70	2539,40
Average	609,50	598,10	532,20	634,90