Response of the Growth of Cowpea Varieties Submitted to Organic Fertilization Produced under a Regosol in the Semiarid Region of Paraiba

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

ABSTRACT

The objective of this work was to compare growth parameters of traditional varieties of cowpea with commercial varieties based on agroecological processes in the semi-arid region of Paraiba. The experiment was installed in the factorial scheme of 3 blocks x 4 treatments x varieties: T1- control (without addition of inputs), T2- 10 t ha⁻¹ organic compound (being, bovine manure + vegetal materials), T3- 4.2 t ha⁻¹ rock powder, and T4- 5 t ha⁻¹ of rock dust + 2.1 t ha⁻¹ organic compound, x 3 varieties, being, 02 commercials identified as, 1- New Age and 2- Guaribas (provided by EMBRAPA), and 01 traditional, 3- Sedinha (already in common use by farmers). The field project was developed in partnership with the Advisory and Services in Alternative Agriculture (AS-PTA), which was also used as an experimental unit, located in the city of Esperança - PB, the soil of the area was classified as a Regosol, the growth parameters were: number of plants (NP), plant height (AP), leaf number (NF), leaf area (FA), stem diameter (DC). The Sedinha variety was the one that stood out in relation to the others when comparing growth parameters such as height and leaf area, while the Guaribas variety obtained a larger caulinar diameter. The treatment with the organic...
compound proved to be the most efficient for all varieties, but for the treatment with rock dust, it will require further studies due to the high levels of sodium and low phosphorus, which may explain the low development.

Keywords: Agroecology; manure; fertility; bean; rock powder.

1. INTRODUCTION

Beans play an important role in the diet of the population and also in the income generation of small producers who use family labor. The production of this grain is very widespread throughout the country and distributed in three harvests throughout the year, Brazil being the third largest producer in the world, behind Myanmar and India [1]. The largest Brazilian producers in 2015 were Mato Grosso (127,000 tons), Ceará (107,291 tons), Piauí (55,278 tons), Pernambuco (52,406 tons), Maranhão (50,314 tons) and Bahia (20,890 tons). Ceará presented the lowest grain yield, with 270 kg ha\(^{-1}\), while Mato Grosso, the highest productivity, with 1,095 kg ha\(^{-1}\) [2].

In the current season 2016/2017, common bean production accounted for 63.2% of the volume produced, that of black beans, 15.2%, and that of cowpea, 21.6%. Black common bean is concentrated in the south of the country and about 63.5% of its production comes from the 1st crop. The cowpea variety, cultivated in the North / Northeast Region and in Mato Grosso, is concentrated in the second crop, except for the state of Bahia [3]. The cowpea (\textit{Vigna unguiculata} L., Walp) is widely cultivated by small producers in the North and Northeast of Brazil and is of significant importance in the socioeconomic context of these regions [4], is one of the main components of diet, especially in rural areas, because it has high protein content [5]. It is a culture of great socioeconomic relevance, due to the large amount of labor demanded in its [6], generating several direct and indirect jobs. although it is one of the most important crops of the region, it is also used as green fodder, feed flour, and can also be used as green manuring and soil protection [7].

The green manuring complements the no-tillage system [8] with the aim of keeping the soil covered [9] and favor the physical, chemical and biological aspects of the soil [10]. The use of organic substrates with characteristics appropriate to the planted species makes it possible to reduce cultivation time and consumption of inputs, such as chemical fertilizers, pesticides and labor [11]. The no-tillage system is based on the reduction of the use of machines, the non-tilling of the soil and the use of cover crops as green manures, which increases biodiversity and improves the flow of nutrients and organic matter, nourishing the successor crop and avoiding erosions [12]. In addition to the new cultivars, soil preparation systems and the use of cover crops have a direct influence on soil structure [13].

In addition to adverse environmental conditions, the lack of technical information on both the most appropriate management of the soil for bean cultivation and the more resistant and productive bean varieties has led the region's agricultural systems to be extremely vulnerable to productivity [14]. The efficient use of natural resources in organic production systems is fundamental to achieving the ecological balance and sustainability of the productive system [15].

Because they receive an expressive number of creole varieties and, or, traditional, family farmers, they do not always know the genetic potential of each material and its adaptations to its diverse production environments, especially soil fertility conditions. One of the ways to evaluate the development of the crops is through evaluative parameters of growth and development of the same, when submitted to different fertilization conditions. The identification of varieties that meet the needs of family farmers provides the possibility of forming a seed bank, which will later provide a field of multiplication of this variety in rainy season, and in times of drought these grains can meet the food needs of these communities.

Considering the above, the objective of this work was to compare the growth parameters of cowpea (\textit{Vigna unguiculata} L.) varieties, fertilized with organic compost (bovine manure + vegetal remains) and rock dust, based on agroecological processes in the region semiarid.

2. MATERIALS AND METHODS

The experiment was carried out in an area classified as Neosol Regolítico, located in an...
area belonging to the Advisory and Services in Alternative Agriculture (AS-PTA), in São Miguel
district, Esperança-PB, inserted in the semiarid
region of Paraíba. Paraíba is a Brazilian state
situated east of the Northeast region, with a
territorial area of 56,469,778 km², corresponding
to 3.63% of the area of that region. It is located
between latitudes of 06°00'11.1" and 08°19'54.7"
South, and longitudes of 34°45'50.4" and
38°47'58.3" West. All actions developed in the
area had the participation of the group of family
farmers involved in the project. At the installation
of the experiment, four simple soil samples were
collected per block in the 0 - 20 cm layer, thus
forming a composite sample for soil chemical
analysis (Table 3). The analyzes were performed
according to [16].

The factorial design of 3 blocks x 4 treatments x
varieties: T1 - control (without addition of inputs),
T2- 10 t ha⁻¹ organic compound (being, bovine
manure + vegetal materials), T3- 4.2 t ha⁻¹ rock
powder, and T4- 5 t ha⁻¹ of rock dust + 2.1 t ha⁻¹
organic compound, x 3 varieties, being, 02
commercials identified as, 1- New Age and 2-
Guaribas (provided by EMBRAPA), and 01
traditional, 3- Sedinha (already in common use
by farmers). The plots, corresponding to the
treatments, were subdivided into three subplots
for the planting of the varieties. In order to
determine growth parameters, the six central
plants of the subplot were used, following the
following spacing (Fig. 1).

The weekly evaluations were: Number of Leaves
per plant (NLP), Plant Height (PH), using a ruler
for measurement, Leaf Area (LA) and caulinar
diameter (CD) in centimeters using the digital
caliper In order to determine the productivity
parameters, the number of plants (NP) was
checked weekly by counting the number of bean
plants developed within each useful plot were
determined in the organic compound (Table 1),
macronutrients: N, P and K, according to the
methodology of [17].

For the characterization of the rock powder
(Table 2), the sulfuric acid solution was
determined and the contents of P and K were
determined according to the methodology of [17].

Soil chemical analyses (Table 3) were carried out
in the Laboratório de Química e Fertilidade do
Solo do Departamento de Solos e Engenharia
Rural do CCA-UFPB, being three replicates per
treatment and consisted of: pH in water in
proportion 1:2.5 (soil/water) and the phosphorus
(P), potassium (K) contents were extracted with
Melich 1 solution; The P was determined by
photocolorimeter (ammonium molybdate and
ascorbic acid) and K by flame photometry,
calcium (Ca), magnesium (Mg) were extracted by
KCl solution and its determination in atomic
absorption spectrometry, exchangeable acidity,
acidity (H + Al) was extracted by buffered
solution of calcium acetate at pH 7 and
determined by NaOH solution in the presence of
phenol-ain as indicator, per unit titration of
ferrous ammonium sulphate (0.05 mol L⁻¹) in the
presence of diphenylamine as indicator after
oxidation of the organic matter with K2Cr2O7
and H2SO4 and soil organic matter, as well as
the sum of bases, the ability to exchange cations
and the saturation by bases, following the
methods of [16].

The results were obtained by the Tukey test,
using the statistical program SISVAR.

3. RESULTS AND DISCUSSION

In Fig. 2, it was observed that the number of
leaves per plant (NFP) was higher in plants that
were fertilized with the T2 - organic compound
(bovine manure + vegetal remains) in relation to
the other treatments, except for Sedinha that
obtained higher result in T3 - rock powder.

These results corroborate with those found by
[13] and [18] who observed, in their works an
Table 1. Chemical characterization of organic compound

<table>
<thead>
<tr>
<th>Organic compound</th>
<th>P</th>
<th>K</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.51</td>
<td>57.38</td>
<td>9.62</td>
</tr>
</tbody>
</table>

Table 2. P and K contents of the rock powder

<table>
<thead>
<tr>
<th>Rock powder</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>226.15</td>
<td>27.39</td>
</tr>
</tbody>
</table>

Table 3. Chemical characterization of the regosol in the experimental area, located in the city of Esperança-PB

<table>
<thead>
<tr>
<th>Block (1:2.5)</th>
<th>pH</th>
<th>P mg kg⁻¹</th>
<th>K⁺ mg dm⁻³</th>
<th>Na⁺</th>
<th>H⁺Al cmol. kg⁻³</th>
<th>Al³⁺</th>
<th>Ca²⁺</th>
<th>Mg²⁺</th>
<th>COT g kg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>6.8</td>
<td>0.39</td>
<td>13.49</td>
<td>0.02</td>
<td>0.93</td>
<td>0.00</td>
<td>0.48</td>
<td>0.05</td>
<td>0.02</td>
</tr>
<tr>
<td>B2</td>
<td>6.1</td>
<td>0.21</td>
<td>12.07</td>
<td>0.01</td>
<td>0.40</td>
<td>0.32</td>
<td>0.91</td>
<td>0.28</td>
<td>0.03</td>
</tr>
<tr>
<td>B3</td>
<td>6.4</td>
<td>0.29</td>
<td>17.23</td>
<td>0.01</td>
<td>0.33</td>
<td>0.03</td>
<td>1.18</td>
<td>0.48</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Fig. 2. Number of leaves per plant (NLP): A = T1 (control); B = T2 (organic compound); C = T3 (rock powder) and D = T4 (rock dust + manure)

increase in the production of leaves due to the organic fertilization.

Regarding plant height, the Sedinha variety, when submitted to treatments T1, T2 and T3, (Fig. 2) obtained a higher final height in relation to the others. According to [19] observed in their studies that plant height may be influenced by increasing doses of manure, but may have the opposite effect when doses are high. When the treatment was with the mixture of rock powder + compound T4, (Fig. 3) the Guaribas variety was the one that obtained the highest result.
Fig. 3. Height of plants (AP): A = T1 (control); B = T2 (organic compound); C = T3 (rock powder) and D = T4 (rock dust + manure)
Fig. 4. Leaf Area (LA): A = T1 (control); B = T2 (organic compound); C = T3 (rock powder) and D = T4 (rock dust + manure)
Fig. 5. Caulinar Diameter (CD): A = T1 (control); B = T2 (organic compound); C = T3 (rock powder) and D = T4 (rock dust + manure)
Higher values were found by [20] using biofertilizers in beans (11.04 cm²) when compared to mineral fertilization (3.96 cm²), showing the performance of biological, physical and chemical attributes of the soil, increasing its productivity. However, successive applications of organic compounds in soil can cause negative effects on soil and plants [21].

For Leaf area (Fig. 4), it was observed that the Sedinha variety obtained higher values for this parameter in all the treatments used. The increase of the organic compound T2 and the T3 rock powder, did not prove efficient in the improvement of this parameter, since it did not differ from the T1, when there was no incorporation of the inputs.

Differing from the results obtained in the present study, satisfactory results were obtained with the use of cattle manure and chicken bed reported by Galbiatti et al. [21], with increasing leaf area, height, stem diameter, and cowpea yield. Regarding the Caulinar Diameter presented in Fig. 5, it can be noted that the Guaribas variety presented a larger diameter compared to the other varieties under T1, T2 and T4 treatments, but it was well below the other varieties when it was fertilized only with powder of rock. It was observed that in spite of the ephemeral improvement, the increment of the organic compound, promoted better responses for the parameter evaluated, being able to be a source of nutrients of low cost and of easy access for the producers in system of familiar agriculture [22]. One of the benefits is that the more robust the stem, the more support will give the plant, a voiding lodging.

Generally small producers do not have the financial resources to invest in application technologies, chemical products, soil fertilization, among other factors that help to increase production and profitability [12]. According to [19], the use of organic compounds in order to substitute or supplement chemical fertilization have several benefits, including low cost, waste management, maintenance of productivity, improvement of soil structure and fertility and less use of chemical fertilizers soluble.

4. CONCLUSIONS

The treatment with organic compost (bovine manure + vegetable materials) was the most suitable for all varieties;

The utilization of organic compost is sustentable as well as being a good alternative of low cost, since farmers can often use the compound produced on their own property with low cost and guaranteed efficiency.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


