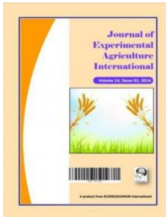

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Fertilisation with Pure Seaweed and in Consortium with Other Sources for Corn Crop

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Authors' contributions

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

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ABSTRACT

Use of seaweed as a source of nutrition to evaluate the performance of maize hybrids (*Zea mays*), compared to a control. The experiment was conducted at the Agricultural Microbiology Laboratory, at the Agricultural Sciences Center, Federal University of Alagoas - UFAL. The design was completely randomised, with five treatments and four replications. The evaluated parameters were leaf height and fresh matter weight. According to the results, the cultivar that received pure algae fertilisation obtained the best response.

Keywords: Alternative; control; corn; fertilization; grains; sargassum.

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1. INTRODUCTION

In the city of Maceió, Alagoas, located in northeastern Brazil, it is very common the accumulation of seaweed of the Sargassum type at the edge of the sea, characterized by a characteristic and robust smell that bothers to the tourists and that demand of the local authorities a solution, however, the end that is given to them is the sanitary landfill of the municipality [1].

One of the solutions raised in this work is the use of these algae as a source of nutrition for maize production by local family farmers who do not have access to agricultural inputs with ease, thus being a solution for both [2].

Corn is grown more than 7,000 years, its origin is not clear, but it is indigenous origin cultivated in parts of Mexico and Central America, where its oldest findings were found [3]. A chemical analysis of seaweeds recuperated, done in 2004 in the Analytical Central office, Maceió – AL, (Table 1).

Table 1. Chemical analysis of seaweed [4]

Substrato	Algas Arribadas
N (%)	0,765
P_2O_5 (%)	0,074
K_2O (%)	2,892
Ca (%)	1,60
Mg (%)	3,159
Cl (%)	3,142
NA (%)	5,897
Fe (ppm)	366
Zn (ppm)	9
Cu (ppm)	4
Mn (ppm)	17

Today it is one of the most widespread and consumed cereals in the world. By itself of a highly domesticated crop, allowed the development of cultivars adapted to different climatic conditions, to enable their cultivation with good productive indexes in almost all national territory, throughout the year [5].

The need to find alternative sources of fertiliser for arable crops has been intensifying in recent years, thanks to the price of chemical inputs, which has been increasing overwhelmingly and scaring farmers, from the big to the small, mainly. Faced with this reality, researchers from various entities are seeking interesting solutions, experimenting with multiple types of raw materials and obtaining surprising results with organic inputs, which have improved soil fertility and facilitated aeration and water absorption [6]. According to Levring et al. [7], algae were explored as a source of inorganic elements after the discovery in the 19 th century of the presence of iodine and bromine in them. At present they have been widely used as a source of food and organic chemicals.

For Dapper et al. [8], the main applications of marine algae in agriculture are control of phytopathogens by the antimicrobial activity of the extracts, induction of plant defence and plant growth promotion.

Seaweed extract is often used in conjunction with other compounds, which makes it difficult to evaluate the effect of the extract exclusively on the crop. In addition, surveys are often carried out with smaller numbers of plants, usually in more favourable conditions for culture, among other factors that end up interfering with efficient results [9].

It has been proven that the fertiliser value of algae is much higher than that of manure due to its high content of nitrogen, phosphate, potassium and sodium salts, organic materials and other important mineral elements such as boron and magnesium [10]. On the other hand, algae mixed with superphosphate are very effective fertiliser for the improvement of sandy soils [11].

In contrast, we have corn (*Zea mays*) which is a well-known cereal grown in much of the world. It is extensively used as human food or animal feed, due to its nutritional qualities, since it has almost all known amino acids [12]. There are several species and varieties of maize, all belonging to the genus Zea. It is believed, according to studies already carried out, that the corn is of American origin.

It is a plant of high productive potential that responds satisfactorily to the technology, proof of which is that its cultivation is generally mechanised. Its biggest producer in the United States. In Brazil, São Paulo and Paraná lead the production of this cereal that has already transformed Brazil into a major producer and exporter [13].

The present study aims to determine the use of seaweed as a source of nutrition to evaluate the performance of maize hybrids (*Zea mays*), in compared to a control set.

2. MATERIALS AND METHODS

The present work was conducted in the Microbiology laboratory, located in the Center of Agricultural Sciences, Federal University of Alagoas, located in Rio Largo, Alagoas, Brazil. Two-liter pet bottles in green colour were used to make it difficult for freshwater microalgae to appear, which received sand washed and sterilised. In this way, the bottles were placed in counters, so that they all received the same light conditions, even so, to ensure this, every three days there was a rotation of the place.

Two varieties of hybrid maize (AG405 and AG1051) were used, seeded in the washed sand and only received distilled water until germinated. Both showed germination at 80% (germination test carried out in the seed laboratory of the Agrarian Sciences Center).

The algae collected were collected manually in August 2006 during the low tide period at Ponta Verde beach in Maceió. After collection, the fresh algae were packed in polyethene bags and transported to the Laboratory of Microbiology of the Agrarian Sciences Center, where they were submitted to constant washes under running water. Then the algae were placed in a continuous flow oven at 65° C until dehydrated (since fertilisers for agricultural use are made from dehydrated stems, our experiment had the same principle). After this period the algae were crushed in a forage machine.

It was used a completely randomised design with 5 treatments and 4 replications, in a factorial design with two collection times and two maize varieties, with the following treatments:

- T1: N, P + Algae: 3 mL of NH_4 H_2 PO_4 and 20 g of Algae for 7 mL of distilled water
- T2: Mixture of humus + algae: 15g of Humus + 15g of algae for 20mL of distilled water
- T3: Algae fertilization: 20g of Algae for 10 mL of distilled water
- T4: Organic compound + algae: 15g of organic compound + 15g of algae for 20 mL of distilled water
- T5: 15 mL of solution containing N, P, K, Fe-EDTA, Mg, S, Cl, B, Ca, Cu, Zn, Mn and Mo. - Complete fertilization (control).

The results were submitted to analysis of variance and the Scott Knot test at 5% probability. Three fertilisations were done: 7, 17 and 32 days after planting - as recommended by Embrapa.

The cultivation was carried out in 2L PET bottles containing washed sand substrate using Embrapa's recommendation for fertilization of the corn crop: micronutrients (Boron, Copper, Iron, Manganese and Zinc) between 0.6 and 12 mg / dm^3 according to with the nutrient, in this case, an average was made and the nutrient solution of Hoagland was used.

For the treatment T5 (control) was fertilised with micronutrients and the equivalent amount of sand was placed, that is, each bottle received 0,054 g of Nitrogen (N), 0,09 g of Potassium (K) and 0,11 g of Phosphorus (P).

3. RESULTS AND DISCUSSION

The 5% probability Scott-Knott test detected significant differences among the varieties for the fresh matter weight parameter.

As verified, the AG405 variety stood out against the AG1051 variety for all treatments. For the AG405 variety, the best result was obtained with T4 that differed significantly from the others and provided a 92% increase in relation to the control (T5), which did not differ significantly from T1. For AG1051, the best result was verified in the T5 (control) treatment (Fig. 1).

There are some disadvantages of tissue analysis other than labour and cost, such as (i) contamination of plant samples with soil particles or pesticides residue can lead to erroneously high results for iron, Al, Mn or Cu, (ii) decomposition of plant samples before it reaches to the laboratory can result in a loss of carbon through respiration thereby increases the concentration of other nutrients, (iii) measurement of N uptake by plants does not necessarily indicate the N requirement of the plant as several studies have indicated that N concentration in shoot can be greater than the minimum plant requirements for maximum growth [12,14], (iv) As N supply decreases, N uptake, translocation and remobilization are also affected.

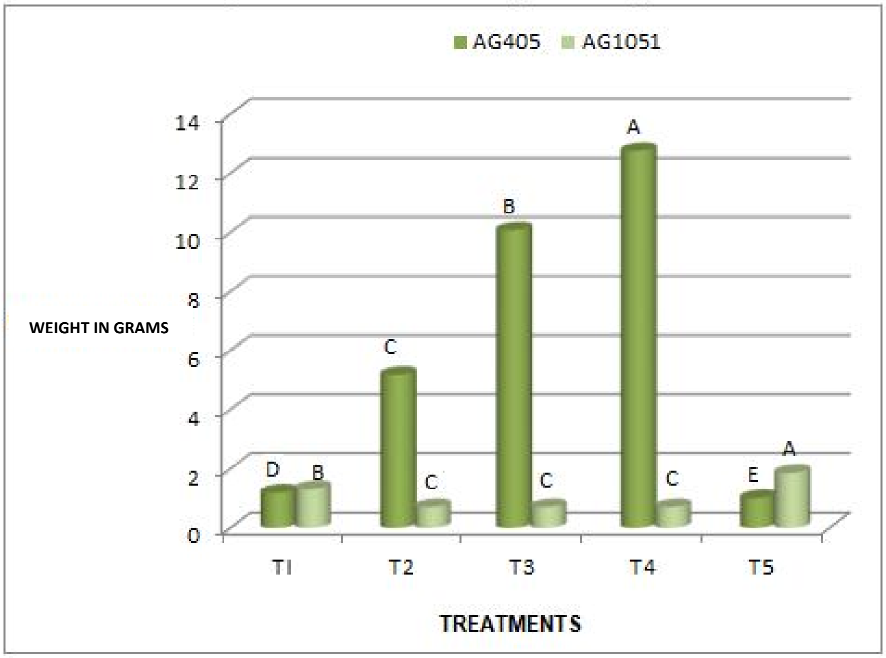

Fig. 1. Fresh matter weight of maize varieties AG405 and AG1051 (horizontal letters do not differ by scott Knott's test at 5% probability

For leaf size, the Scott-Knott detected significant differences at 5% probability between varieties and within sampling time, however, the interaction was not significant indicating that there was no dependence between the two factors.

The result collection time the best result was obtained for T4 in the two collections. At 30 days T4 promoted an increase of 55, 70, 64, 65, 70 and 48% in relation to T1, T2, T3, and T5 respectively. For the collection performed 60 days after sowing T3 showed increases of 49, 71, 69, 60, 69 and 62% compared to T1, T2, T4 and T5, respectively.

The results for the AG405 variety T3 and T4 treatments promoted the best results not differing significantly, providing an average increase of 64% in relation to T5 that did not differ from T1. For the variety AG1051 the best result was verified with T3 treatment that differed significantly from the others and promoted an increase of 17% in relation to the control (T5).

Tissue tests provide an overall scinario of the nutrient level within the plant at the time of sample taken. Generally, good relationships can be developed between soil nutrient supplies, nutrient levels in the plant, and crop yield for a given location in a year. However, differences in locations, variety, time and management often cause variations in these relationships and make them difficult to interpret [11,15].

Of the only treated with T5, it was observed that the leaves began to lighten at the tips and some of them became burning. The largest leaf is measuring 28 cm in both AG405 and AG1051. Aspects of development in corn varieties AG 405 and AG1051 submitted to T3, the darkening of the stem base was observed.

The maize varieties submitted to T2 fertilisation showed a deficiency in the leaves, which appeared to be burning and leaves up to 26 cm in size in both AG405 and AG1051. Fertilisation with T1 had a good response. However, stem reddening occurred in large leaves, up to 40 cm and all healthy.

4. CONCLUSIONS

Considering the methodology, the conditions under which the experiment was conducted, and the Scott-Knott test that was applied, we can conclude that the T4 treatment presented the best results for the AG405 variety, while the AG1051 variety showed that it did not have a good response to treatment with algae, with the control being the best response. The treatment with algae, in places where raw material is available, is an alternative of use for the sargassum removed from the beach, which is often discarded in landfills, and in other cases may be used in local (and family) agriculture as a source cheaper fertilizer for maize production of the variety AG 405, showing sustainability and social responsibility.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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