



Original Article

The Effects of the Fertil Verde Fertilizer on the Growth and Yield of Chili Pepper (*Capsicum annuum* L) in Southern Algeria

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ARTICLE INFO

Article history:

Received 01 Aug 2020

Revised 16 Aug 2020

Accepted 30 Aug 2020

Keywords:

Chili pepper;

Capsicum annuum;

Fertil Verde;

weight of fruit;

vegetative growth;

yield.

ABSTRACT

A field experiment was conducted on a private farm in El Oued State of Algeria to study the efficiency of using Fertil Verde as a fertilizer by foliar spray on hot pepper seedlings. The treatment by Fertil Verde increased all growth. The increase was significant in the number of main and secondary stems, the size of the leaves, and the weight of the dry leaves. While, the weight of the wet leaves did not significantly increase.

Moreover, the use of Fertil Verde has led to a significant increase in the yield qualities of the plant: the weight and shape of the fruits, fresh yield of the plant, the content of pigment, and the size of the plant.

Thus, the combination of fertilizing is common and Fertil Verde is a promising low-cost option in the production of high yields.

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1. Introduction

Hot peppers (*Capsicum annuum*) are members of the *Capsicum* genus and the *solanaceae* family that includes tomato and potato plants. They are thought to be native of the southern part of North America [1, 2, 3]. Nowadays their cultivation has spread to all continents and serves mainly for food and pharmaceutical uses [4, 5, 6]. The continuously growing population puts pressure on agriculture to produce more crops, so there has been keen interest in raising production regardless of the quality, which has led to an increase in the use of chemical additives which exacerbated and increased the harmful effects on health and the environment, and the toxic effects of pesticides [7, 8]. As a result of the negative effects of chemical additives concerns have shifted in many countries to encourage organic agriculture whose products are characterized as clean and free from the residual effects of

pesticides and chemical fertilizers. Organic agriculture is one of the modern applied agricultural environmentally friendly technologies. It has grown and developed very widely in recent years as a result of the rising need to sustain agriculture [9, 10] and preserve the fertility and productivity of soil. Several studies confirmed that biological fertilization leads to an increase in the production of some vegetable crops such as tomato, reduces the use of mineral fertilizers to 25-50 % compared to the control [11], and increases the yield of potato tubers by 17.3 %. The addition of organic fertilizers leads to a significant increase in the yield of many crops [12]. The use of organic fertilizer has been reported to improve the flavor and quality of vegetable crops. Organic manure derived from various green waste contains variable amounts of major nutrients and is a valuable source of

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DOI : <https://doi.org/10.57056/ajb.v1i1.24>

plant nutrients. Among various sources of organic matter [13, 14, 15] Fertil Verde has been recognized as having considerable potential as a medium for the growth of plants and amendment of soil. There is growing interest in the potential of organic manure. As the cost of inorganic fertilizers is very high and they are not always available on the market, farmers fail to apply inorganic fertilizers to the crop field in optimal time. Peppers are still usually grown with the conventional applications of inorganic fertilizers and pesticides [1]. The objective of the experiment was to discover the effects of Fertil Verde on the growth and yield of *Capsicum annuum*.

2. Materials and Methods

The place and the experience design

This study was carried out during the 2019/2020 season on a farm by the peasant investor of Ghemam Amara Mohammed Khazzani in the town of Hassi Khalifa, EL-OUED in southern Algeria. It is characterized by sandy soils.

The experiment was conducted on an area of 160m². The experimental design was the Complete Type Randomized (R C B D). Two treatments with three replications of each treatment were used in this study. There were 30 pepper shrubs on every block which measured 0.75 x 6 m (with the surface of 4.5 m²) with 1m gaps between the blocks.

We used the organic manure Fertil Verde. The treatments were including:

T1 - no manure (control)

T2 - Fertil Verde

Soil analysis and irrigation water

A homogeneous sample of the soil was taken from mixing samples of each experimental plot. Chemical analysis was carried out at the Fatilab laboratory (quality control and compliance analysis). Mechanical and physical analyses were carried out at the Public Works laboratory for the south in El Oued according to [16]. The chemical, mechanical, and physical properties of the soil are given in Table 1. Water for irrigation was analyzed at the laboratory of the Algerian Water Corporation. The chemical analyses of the irrigation water are presented in Table 2.

Table 1. Physiochemical analysis of the soil

Parameter	Soil
Sand (%)	97.2
silt (%)	2.8
clay (%)	/
pH	7.2
EC mm hos	1.86
NO ₃ ⁺ ppm	13.29
NH ₄ ⁺ ppm	25.35
NH ₃ ppm	23.9
P ppm	1.5
K ppm	51.05

Table 2. Chemical analyses of the irrigation water

Parameter	Eau
pH	6.79
EC mm hos	2.69
NO ₃ ⁺ ppm	70.47
NH ₄ ⁺ ppm	12.11
Ca ⁺⁺ ppm	701.4
Mg ⁺⁺ ppm	87.5
Na ⁺ ppm	412.5
K ⁺ ppm	30.4
So ₄ ⁻ ppm	1319.6
HCO ₃ ⁻ ppm	262.3
Cl ⁻ ppm	535.34

Plant material

Hot pepper seedlings (*Capsicum annuum* L) were sown in the experimental area in mi February 2019. The organic fertilizer was chicken and sheep manure. The recommended inorganic chemical fertilizers were added to all the treatments (plots) through drip irrigation.

Hot Peppers is one of the distinguished cultivar groups of *Capsicum annuum*. It is a member of the *Capsicum* genus and the solanaceae family that includes tomato and potato plants.

Chilli peppers (*Capsicum annuum* L) are produced in significant quantities in the valley region where seedlings are planted in February and harvested from May to October. This pepper is a slow growing short-term standing densely branched perennial flowering singly with elongated fruits usually upright, measuring up to 5 cm x 3 cm, green to yellowish green when immature, red when mature, with smooth walls and extremely pungent [17].

Fertil Verde manure

Fertil Verde is a concentrated organic liquid extracted from Leonardite, produced by the Italian company Bio-Alternativa, the fertilizer is used in small quantities during all stages of the plant 0.4 l/ha. rich in humic acids, fulvic acids, amino acids, vitamins, and trace elements dissolved at the molecular level in specially prepared water. It is a compound used to improve the properties of soil and plants. Can be used with all types of fertilizers in all climate zones and all types of soil. Table 3 illustrates its characteristics (<https://fertil-verde.bio/en/products.html>).



Figure 01: Fertil Verde fertiliser Product photo

Table 3: The characteristics of Fertil Verde

Parameters, measure	Test units	Test results
pH		7.5
Humified organic matter chemically active	%	88.2±0.1
(from total organic matter)		
Organic matter (on dry matter)	%	67.1±0.1
Total Humic acids	grams/liter	140.0±1.4
Total Fulvic acids	grams/liter	79.9±3
Organic carbon	%	30.1±0.01
Phosphorus (P ₂ O ₅)	grams/liter	1.25±0.08
Nitrogen	grams/liter	24.7±0.02
Potassium, K ₂ O	grams/liter	103±1
Density	grams/cm ³	1.113

Properties measurements

- properties the Growth of Chilli Peppers

- The leaves area (cm²)
- Wet and dry weight of leaves (g)
- Number of main stems
- Number of secondary stems
- The status of stems

- The yield properties

- Wet and dry weight of green and red fruit (g)
- Yield ton/hectare
- The color level of the green fruits
- The shape of the fruits

Statistical analysis

Data were subjected to statistical analysis by the T test and 5% level of probability was used to compare the means of treatment.

3. Results and Discussion

The Effects of Fertil Verde on the Growth of Chilli Peppers

The focus of the study was to investigate the effects of the source of fertilization on hot pepper crops to find suitable alternatives to the conventional nutrient solutions. We tested the response of the pepper plant to fertilization by Fertil Verde in the growth parameters.

The application of Fertil Verde manure had a significantly positive effect on the plant height, number of branches, number of secondary stems, status of the stems, leaf area, and the weight of the dry leaves. It did not affect the weight of the wet leaves.

Pepper plants treated by Fertil Verde yielded the highest growth in the number of main and secondary stems, the size of the leaves, soft and dry weight of the peppers. They were substantially higher than those of the control treatment.

The results showed statistically significant differences by applying the T test in Excel. The calculated t values were 2.66, 2.77, 1.25, 2.32, 4 for the growth parameters (leaf area, weight of the dry leaf, weight of the wet leaf, number of branches, and number of secondary stems) respectively. See Table 4.

The results also showed that the number of branches increased by 100 %, and the difference between the weight of the dry leaf and the number of secondary stems was 40 % over the control plants. The difference was 25 % in the weight of the wet leaf and the size of the leaves. Table 4.

Table 4: The effect of Fertil Verde on the growth parameters of hot pepper (*Capsicum annuum* L)

Properties	T1 Control	T2 Fertil Verde	T _{stat}	T _{critical}	P _(0.05)
Number of main stems	3	6	2.32	2.13	0.04
Number of secondary stems	7.33	12.33	4		0.008
the leaves area (cm ²)	22.71	30.5	2.66		0.028
dry weight of the leaves(g)	0.12	0.2	2.77		0.025
The wet weight of the plant leaf (g)	0.63	0.8	1.25		0.14

Visual Observation

Application of Fertil Verde resulted in darker green leaves of the peppers (*Capsicum annuum* L).

Most of the main and secondary branches erected by plants were treated with compost in addition to their dark green fruits. Figure 2

This finding is in accordance with the observations of [10, 18] in the contribution of organic fertilizers added by sprinkling or sprinkling the soil in improving the number of main and secondary stems.



Figure 2: The effect of spraying with Fertil Verde on the color and status of the hot pepper (*Capsicum annuum* L). Application of Fertil Verde was also responsible for variation in the growth characteristics (Significant Tcal P < 0.05) where the Fertil Verde fertilizers have a regulatory ability to release nutrients resulting in an increase in the growth characteristics of the plant. This means that Fertil

Verde was able to provide enough nutrients for the appropriate growth of hot pepper plants.

It seems likely that some growth promotion is due to plant hormone-like activity related to microflora associated with Fertil Verde and to metabolites produced as a consequence of secondary metabolism.

The most important effect of Fertil Verde on vegetables is its plant growth-promoting quality and reported improvement of chemical and biological properties of the soil. The use of Fertil Verde can also result in better initiation of roots, increased root biomass, and general development.

Vermicompost has previously enhanced growth variables such as the size of leaves and the weight of dry roots in species such as marigold, cornflower, tomato [19], and pepper [20, 21].

II- The effects of Fertil Verde on the weight of chilli pepper fruits

The results in Table 5 show that the application of Fertil Verde results in higher yield, more intense green color of the fruits, and heavier average weight of the fruits. Combined application of organic manure with usual fertilization significantly surpassed the application of the usual fertilization alone.

This promising treatment significantly promoted the yield per hectare to 60.96 t with each individual plant producing 1.53kg. Production per hectare in the control treatment was 39.23 t and 0.98 kg per plant. The increase of the yield of the recommended treatment over the control treatment reached 55 %. The results also showed that the addition of fertilizer reduced the deformation of fruits, especially twisting of the pods. We recorded 80 % of straight fruits when adding Fertil Verde as against 60 % when treating with the usual fertilization. Figure 3

The mean values of the weight of the fruits were higher with Fertil Verde (12.6 g) as against 10.86 g in the control treatment. Table5

Organic manures play a role in higher yields and improving the quality of fruit. This is attributed to the increase in the release of most nutrients. The results of [22, 23] confirmed the beneficial effects of using organic manure on growth and fruiting of crops.

This is in line with studies by other researchers who reported improvement in yield and the quality of fruit [24, 25].

Table 5: The effect of Fertil Verde on yield parameters of hot pepper (*Capsicum annum L*)

Yield parameter	T1 Control	T2 Fertil Verde	T _{stat}	T _{critical}	P _(0.05)
Fresh yield (kg h-1)	39.5	60.96	3.6	2.13	0.011
Fresh yield (g plant-1)	0.98	1.53	-3.7		0.01
fruit weight g	10.86	12.6	1.03		0.18
straight fruits %	60	80	/	/	/

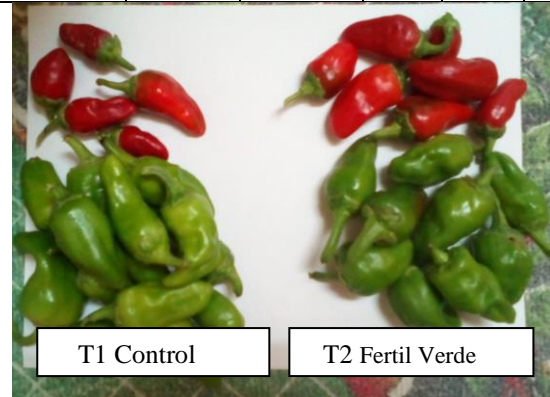


Figure 3: The effect of spraying with Fertil Verde on the shape of the hot pepper fruits

The increase in the average weight of the fruit and the yield of the fertilizer treatment may be due to the increase in plant growth as a result of the role of the natural organic metabolite in the activation of photosynthesis and its influence on permeability. Cell membranes, increased respiration rate, protein synthesis, and enzyme activation in the processes of biological metabolism lead to an increase in the productivity of the chili pepper plant, which is in agreement with the results of [26, 27].

This might be explained by the fact that the organic manure application rate resulted in higher nutritional content in crop vegetative and generative organs. Furthermore, sustained a steady, orderly, and smooth supply of nutrients that might create favorable conditions for plants.

4. Conclusion

The addition of Fertil Verde to traditional fertilization yielded better characteristics in the growth of chili peppers, which made it highly efficient in the production and quality of fruits as production increased by 55 percent.

Also, the outcome of the experiment indicated that there were significant interaction effects on many of the parameters considered.

the growth parameters (the plant height, number of branches, status of the stems, leaf area, and the weight of the dry), This resulted in improved production characteristics and fruit quality (higher yield, more intense

green color of the fruits, heavier average weight of the fruits and twisting of the pods).

Further studies are required and highly recommended to understand the deep effect of application of the Fertil Verde manure on chili pepper production and other yields.

Appendix

Appendices, if needed, appear before the acknowledgment.

Conflict of Interest

The authors declare that they have no conflict of interest

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Recommended Citation

GHEMAM AMARA D. *, KHERRAZ K., ALIA Z., CHAMSA A. K., LAOUEDJ H. & SENOUSI M. M. The Effects of the Fertil Verde Fertilizer on the Growth and Yield of Chili Pepper (*Capsicum annuum* L) in Southern Algeria. *Algerian Journal of Biosciences*. 2020, 01;01:018-023.



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