

Research Article

Effects of Organic Amendments by Composts and Manure on Pepper (*Capsicum annum L.*) under Greenhouse

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Abstract

Four types of organic amendments were evaluated on two varieties, Chargui and starter, of pepper (*Capsicum annum L.*) under greenhouse. Six treatments were given: cattle manure (DM) to 55t/ha, German commercial compost (CG) 1 t/ha, mixture of 27.5 t/ha DM + 0.5 t/ha CG (CGDM), French commercial compost (CF) 2t/ha, Tunisian commercial compost (CT) 10 t/ha and control (T0). Organic amendments allow to improve pepper growing, fruit set, yield in number and weight and earliness. The CGDM, DM and CG led to the best yields in weight and number of fruit Chargui variety, with a maximum improvement of 38% in the fruit number and 40% in yield under CT compared to the control. CT, DM and CGDM generated the best yields for the starter variety, with a maximum improvement in the fruit number of 34% and 51% in yield of CGDM compared to control. The earliness of pepper was enhanced by organic amendments with a maximum of 64 % of DM compared to control for the variety Chargui and 61 % of CT versus control for var. starter. The behavior of pepper crop under organic amendments on plant height, flowering and fruit quality remains dependent on the varietal response. Amendment by different types of organic matter did not cause effects on stem diameter, number of bifurcation, leaf area and plant dry matter of pepper.

Keywords: Compost, organic amendment, pepper, crop parameters, yield, earliness.

1 Introduction

Agriculture since the 60s has undergone a revolution that is based on improved high yielding varieties, chemical fertilizers, chemical pesticides and the massive use of non-renewable energy in order to maximize returns to increase the sufficiency level for continuous increasing population (Beji, 2010). This agricultural intensification puts pressure on ecosystem which leads to decreased soil fertility (Laurence, 1998; Ibrahima et al, 2010; Delate, 2002).

The use of these chemicals (fertilizers and pesticides) is more pronounced in intensive vegetable crops (Odet, 1989). Thereby intensive conventional vegetable crops under greenhouses are often characterized by the use of high doses of inputs such as fertilizers and pesticides with climatic conditions (Temperature and high humidity) and intense mineralization processes of organic matter (OM) in the soil, which can lead in the case of insufficient organic inputs to significant decreases in soil OM (Thuries et al, 2000; Bressoud and Arrufat, 2009).

Fertilization based exclusively on the use of inorganic fertilizers can ensure sustainable soil fertility. The maintenance or improvement of soil fertility requires the maintenance of soil organic matter in the soil which is done by a steady supply of good humus amendments used properly. Organic matter is the basis of soil fertility (Aboudrare, 2009). The addition of exogenous OM

increases the cation exchange capacity (CEC) and will help maintain the level of nutrients and stimulate several aspects of soil fertility (Calbrix, 2005).

Organic fertilizers come from various raw animal or vegetable origin, which can be composted (Mustin, 1987). These fertilizers are not soluble in water but most of the items they contain are rapidly mineralizable and available to plants. Compost improves the physical and chemical characteristics of the soil (Mustin, 1987; Fuchs, 2003; Maynard, 2000) brings nitrogen, phosphorus and potassium, but also sulfur, calcium, magnesium and trace elements. They enrich the soil with humus, stimulate the activity of living beings in the soil which they serve as food (Manlay et al, 2007), stimulates the growth and development of plants (Atyieh et al, 2000a; Atyieh et al, 2000b) and preserves the environment for reduce mineral fertilizers (Maynard, 2000).

This work aims to study the effects of four organic matter products, two Tunisians, one German and one French, used as soil conditioner on growth, crop parameters development and yield of pepper under greenhouses.

2 Materials and methods

2.1 Methodology

The present work aims to study the effects of organic

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Table1: Major elements content in each Organic amendment (g/kg) and treatment (Kg/Ha) used.

Trématent	N (g/Kg)	P (g/kg)	K (g/kg)	N (kg/Ha)	P (kg/Ha)	K (kg/Ha)
Control	0	0	0	0	0	0
DM	2,76*	2,64*	4,91*	151,8	145,2	270,6
CG	10	20	30	10	20	30
CGDM				80,9	82,6	150,3
CF	30	20	30	60	40	60
CT	17,8	2,8	9,7	178	28	97

* Obtained from the average of the results of analyzes of three samples

Table 2: Effect of organic amendments on pepper crop parameters var. Chargui starter at 150DAT

Paramètre	H (cm)		DS (cm)		NB		LA (cm2)		DW (g)	
Vi/Ti	Starter	chargui	Starter	chargui	Starter	chargui	Starter	chargui	Starter	chargui
T0	67,17bc	75,33a	1,33a	1,45a	5,33a	4,33a	1273,00a	1300,44a	19,00a	19,50a
DM	73,67a	67,50a	1,45a	1,37a	4,83a	5,00a	1248,18a	1174,49a	20,00a	16,00a
CG	65,17bc	77,33a	1,28a	1,37a	5,00a	4,83a	1239,13a	1226,85a	19,50a	17,50a
CGDM	74,83a	73,33a	1,47a	1,43a	6,17a	4,67a	1237,18a	1223,60a	21,00a	17,50a
CF	60,67c	71,67a	1,42a	1,38a	5,17a	4,67a	1161,59a	1174,63a	17,50a	16,50a
CT	76,83a	67,00a	1,47a	1,27a	4,83a	4,50a	1164,59a	1265,50a	18,00a	18,00a

NB: The values assigned by the same index are not significantly different at 5% risk of error.

amendments on greenhouse pepper. It proposes to compare six treatments:

- A control treatment (T0) for which no organic matter supply is made.
- T1 treatment for which 55 t/ha of well-rotted cattle manure (DM) .
- T2 treatment for which commercial German compost (CG) containing 85 % OM is made at 1 t/ha.
- T3 treatment for which CG at 0.5 t/ha (50% of the recommended dose) in addition to DM at 27.5 t/ha , 50 % of the usual dose greenhouse, (CGDM) is made.
- T4 treatment for which French compost (CF) containing 60 % OM is brought to a rate of 2t/ha.
- T5 treatment for which Tunisian compost (CT) containing 70 % OM is made at 10 t/ha.

The manure dose was chosen considering the soil characteristics (sandy), the initial OM content (1.7%) and the practices of the majority of farmers in the region. For the rest of organic products used in this experiment, the doses were suggested by the technical direction of the respective companies responsible for the marketing of each product. Table 1 summarizes the major elements of intake in g/kg of each product and kg/ha of each proposed treatment.

Mineral fertilization was similar for all treatments and was calculated on the basis of crop exports (Odet et al, 1989) for fruit yield expected of 80 t/ha.

2.2 Experimental device

The experiment was conducted at Soukra (Tunisia), located at 36 ° 52' N 10 ° 15' E, in three greenhouses oriented North-South. Planting was done in twin rows of Starter variety (V1) and Chargui variety (V2) of pepper.

The experimental design adopted is a split-plot in 6 repetitions with 2 variation factors: organic amendments and pepper varieties.

2.3 Measured parameters

- Crop Growth Parameters at 150 days after transplanting (DAT): Plant Height (H) cm, stem diameter (DS) in cm measured using calipers at the first bifurcation, the number of bifurcations (NB), the leaf area (LA) in cm² using a planimeter, and dry biomass of aerial parts (DW) measured after oven drying at 70°C for 48 hours.

- Flowering and Fruiting Parameters at 150 (DAT): Number of flowers present (Nf) Number of fruit set (Nfs)

- Yield Parameters at 150 (DAT): Number of harvested fruit (NFY), fruit weight harvested (WFY) and precocity (P) calculated by the ratio of WFY 150 DAT and cumulative WFY 150, 157, 185 and 210 DAT.

3 Statistical Analysis

Analysis of variance (ANOVA) of data for measured parameters was carried out by SPSS statistical program version 19, and means comparison was performed by Duncan test at 5% and 10% level.

4 Results and discussion

Amendments by different types of organic conditioner used did not cause effects on stem diameter, number of bifurcation, leaf area and plant dry matter of pepper at 150 DAT for both varieties tested (table 2).

Table 3: Effect of organic amendments on the flowering and fruiting parameters of var. chargui and starter pepper 150 DAT

Parameter	Nf		Nfs	
	Starter	chargui	Starter	Chargui
T0	14,83bc	13,33a	13,17c	14,83bc
DM	17,33ab	12,83a	19,00ab	18,17ab
CG	13,50bc	11,67a	14,83c	19,00ab
CGDM	16,67b	13,33a	17,83b	21,17a
CF	13,50bc	12,67a	12,00c	16,67bc
CT	13,83bc	12,00a	22,33a	13,83c

NB: The values assigned by the same index are not significantly different at 5% risk of error.

Table 4: Effects of organic amendments on yield parameters of var. chargui and starter pepper 150 DAT.

Paramètre	NFY		WFY (g)		mWFY (g)		P (%)	
	Starter	chargui	Starter	chargui	Starter	chargui	Starter	chargui
T0	10,50bc	21,67b	287,50bc	626,67c	27,38a	28,92c	7,80bc	12,28bc
DM	14,83ab	27,00a	390,83a	860,00a	26,35a	31,85ab	10,57ab	23,98ab
CG	12,50bc	28,00a	310,00bc	814,17ab	24,80a	29,08c	7,29bc	21,11ab
CGDM	13,67ab	29,17a	380,00a	947,50a	27,80a	32,49ab	9,97ab	21,32ab
CF	9,50c	18,67b	263,33bc	527,50c	27,72a	28,26c	6,14bc	14,50c
CT	14,50ab	22,83b	402,50a	762,50b	27,76a	33,39a	16,60a	19,17b

NB: The values assigned by the same index are not significantly different at 5% risk of error.

CT, DM and CGDM increased plant height of pepper starter variety 76.83; 74.83 and 73.67 respectively (Figure 1). This effect was not observed on Chargui variety, which tends to be higher than starter.

The DM showed a positive effect on flowering and fruit set of starter variety when applied alone or mixed with GC, but the best fruit set was recorded with the CT (Figure 2.3). For chargui variety CGDM, CG and DM had a significant impact on fruit set (Figure 3), although no significant effect on flowering was observed (Figure 2). Table 3 summarizes the effect of organic amendments applied to the parameters of flowering and fruiting of the two pepper varieties tested.

Response of starter and chargui varieties of pepper for the application of organic amendments on yield parameters was significant (10%) and highly significant (5%) respectively (Table 4).

Amendments application of CGDM, DM and CG led to the best WFY and NFY 947.5; 860 and 814.17 g and 29.17 ; 27 and 28 respectively, at 150 DAT for chargui variety (Figure 4 and 5), with a maximum improvement in the NFY of 38% and WFY of 40 % for the CT compared to control.

CT, DM and CGDM generated the best yield performance (WFY) for starter variety at 150 DAT: 402.5; 390.83 and 380 g respectively which also results in NFY (figure 4 and 5), with a maximum improvement in the NFY of 34% and WFY of 51% for the CGDM treatment compared to control.

Organic amendments CT, CGDM and CG improved fruit size calculated by the mean of the weight by the number of fruit yielded (mWFY) of chargui variety at 150 DAT (figure 6).

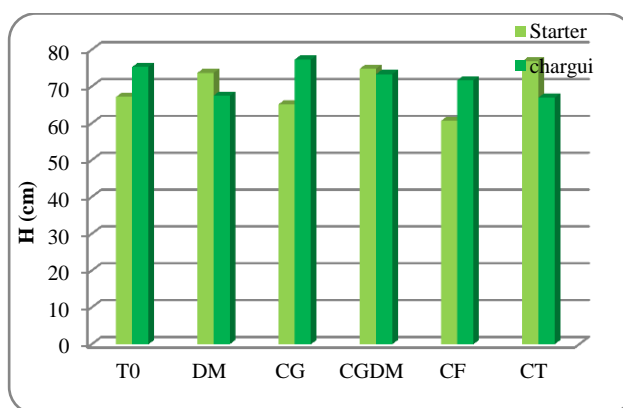
CT, DM and CGDM improved The precocity of pepper starter variety respectively to values of 12.6% ,

10.57% and 9.97% , with a maximum relative improvement of 61% for CT compared to control (figure 7).

DM, CGDM and CG helped to improve the precocity (P) of pepper Chargui at respective rates of 29.98 % , 21.32 and 21.11% , with a maximum relative improvement of 64 % for DM compared to control (figure 8).

The positive effects of organic amendments on pepper crop has been proven on the functional activity of the photosynthetic apparatus (Berova and Karanatsidis , 2009; Karakurt et al, 2009), the growth of stems, roots and leaf size (Berova and Karanatsidis , 2009).

Concentrations of humic acid in organic amendments could be the source of improving the precocity and fruit size and total yield of pepper (Karakurt et al, 2009) and quality and yield of cucumber (OzdamarUnlu et al., 2011), the growth of plants heights , leaf area and yield (El-Hefny, 2010) on cowpea crop; and plant growth, root

**Figure 1:** Effects of organic amendments on Height (H) cm at 150 DAT for var. starter and chargui pepper .

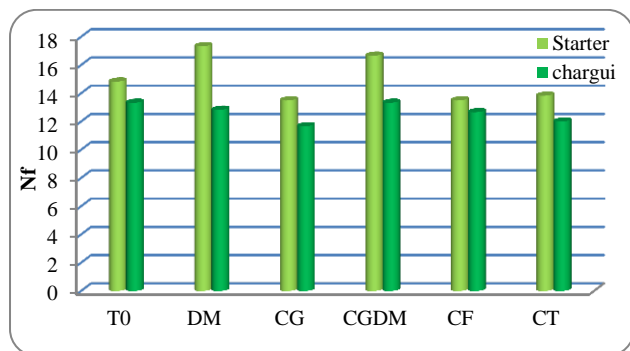


Figure 2: Effects of organic amendments on Number of flowers (Nf) at 150 DAT for var. starter and chargui pepper

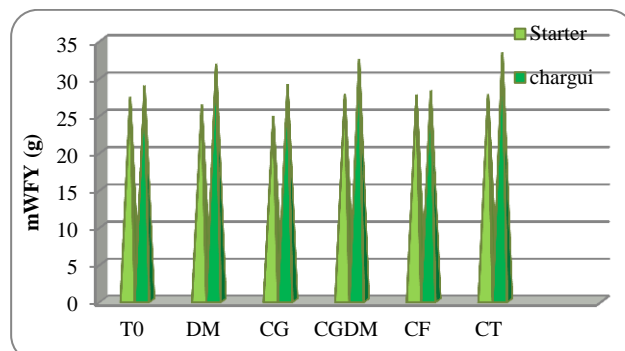


Figure 6: Effects of organic amendments on fruit size (mWFY) at 150 DAT for var. starter and chargui pepper

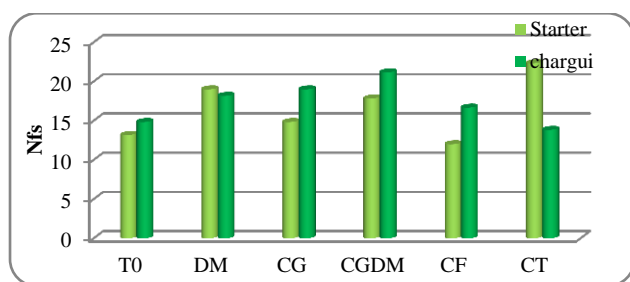


Figure 3: Effects of organic amendments on Number of fruit set (Nfs) at 150 DAT for var. starter and chargui pepper

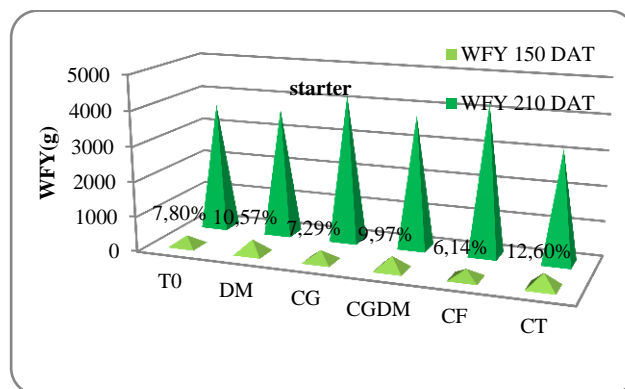


Figure 7: Effects of organic amendments on precocity of fruit for starter var. of pepper

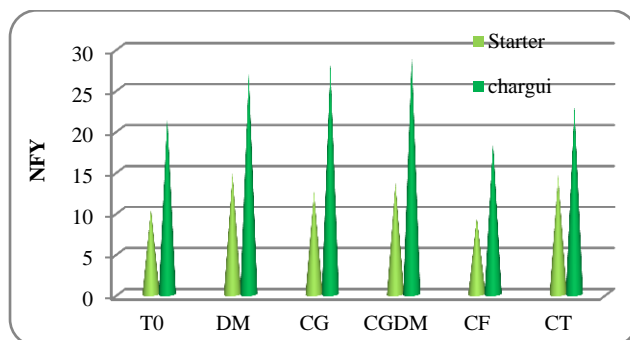


Figure 4: Effects of organic amendments on Number of fruit yielded (NFY) at 150 DAT for var. starter and chargui pepper

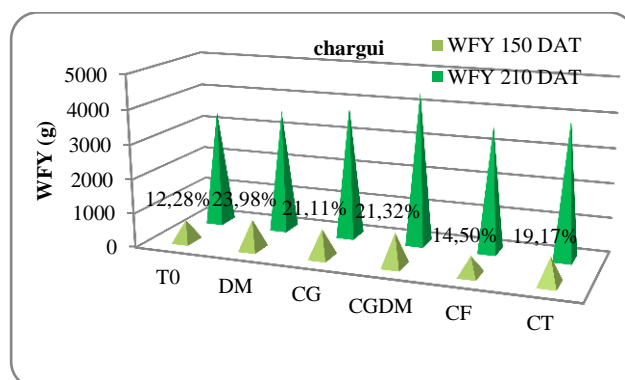


Figure 8: Effects of organic amendments on precocity of fruit for chargui var. of pepper

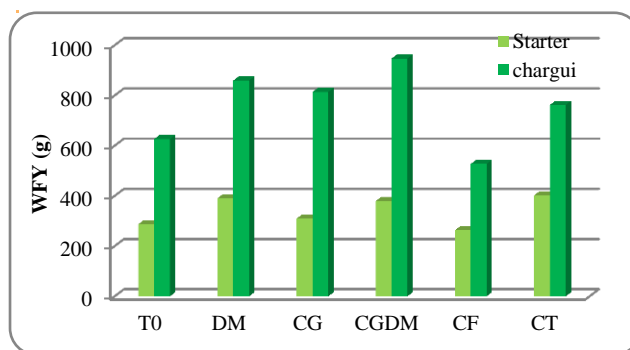


Figure 5: Effects of organic amendments on weight of fruit yielded (WFY) at 150 DAT for var. starter and chargui pepper

The improvement in the number of harvested fruit is the source of improvement of the registered yield (Maynard, 1996). The results found shows a difference in the effects of organic amendments on height growth, flowering, fruit set, fruit size and earliness of chargui and starter varieties that could be attributed to varietal behavior of pepper (Tarchoun and Mougou, 2009).

CF showed no significant effect on the two varieties of pepper crop, the dose of 2T/Ha proposed by the technical manager of the company selling the product can be insufficient in mineral intake (Table 1) and humic

contribution. Test of higher doses are needed to perform the suitable application for significant effects.

5. Conclusion

Organic amendments, manure or commercial composts alone or combined, allow to improve fruit set, yield in number and weight and earliness of pepper crop. The behavior of the pepper crop under organic amendments for plant height, flowering and size remains dependent on the varietal response.

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