Effect of Two Type of Organic Fertilizers on Productivity And Quality of Spring Potato Tubers (Solanumtuberosum) In Syria

MaisDeeb[1] , AliZidan[2] , Muhammad ManhalAlzoubi[3]

[1]*PhD student, Soil and water sciences Department, Faculty of Agriculture, Tishreen University, Lattakia, Syria*

[2]*Professor, Soil and Water sciences Department, Faculty of Agriculture, TishreenUniversity,Lattakia, Syria*

[3]*Researcher at General Commission of Scientific Agricultural Research- Damascus-Syria.*

ABSTRACT:

This research work was carried out at the Center for Agricultural Scientific Research, in Tartous, in spring season 2018, by studying the effect of organic fertilization of mixing and adding two levels of dry biogas manure (B), (40 and 120 m^3/h) with two levels of tobacco compost (T), (20 and 40 m^3/h), as well as the control treatment without fertilization, on growth and productivity of potato crop (cult. Spunta). The Completely Randomized Design was adopted in this work, with three replicates for each treatment and 27 plants per replicate.

The results showed a positive effect of adding the mixture of biogas manure and tobacco compost on improving the productivity and tubers quality of the potato crop. Where The mixed treatment of both biogasmanure and tobacco compost(40 m^3+40 m^3/h,gave the highest values for tubers production per plant (640 g/plant), and the unit area production (3.657 kg /m ^{2}) and tubers quality of market production, (3.326 kg/m^2). Also, gave the highest percentage of dry matter and starch contents in tubers (23.09%, 16.59%) respectively, and the lowest content of nitrate 137 mg / kg in potato tubers.

Keywords: *Organic fertilization,Biogas manure, tobacco compost, potato crop, productivity*.

I. INTRODUCTION

Plant residues from various sources are considered a biodegradable materials whether they are derived from householdresidues or from agricultural industries, city garbage and wastewater residues. These wastes are often disposed of by burning and dumping or leftover around to rot producing pollutantsubstances and unpleasant odors, as well as attracting mices, rats and other pathogenic animals.Even though, theycould be used to produce compost or treated for bioenergy production through fermentation under controlled conditions for biogas production as a source of energy, and production of organic biogas manure for agricultural uses. Composting is a controlled process ofmicrobial aerobic decomposition of organic substrates, where the fermentation temperature rise to about 45c^o, it can protect plants from soilor seed borne pathogens,[1][2].This option is the most economical and sustainable to manage organic waste. The resulting compost can be used to improve the physical, chemical and water relation properties of soils. It increases soil water retention,reduces water runoff, soil erosion and nutrient contamination[3], and increases nutrient efficiency, improves plant productivity, coverage area, as well as increasing soil buffering capacity. Also, it canimprove soil aggregation as well as microbial activity [4][5][6] .

In the recent years, organic agriculture has been growing and receiving increasing attention as a result of the deterioration of agricultural land on the one hand and because of the awareness of people of the catastrophic effects of the agricultural chemical on health and the environment.The indiscriminate use of chemical fertilizers and pesticides has had many adverse effects on soil, water and air [7].

Potato (Solanumtuberosum L), belonging to the Solanaceae, is one of the world's major crops after rice, wheat and maize for human consumption[8][9]. More than one billion people worldwide consume more than 300 million ton of potato rich in carbohydrates, vitamins, dietary fibers, simple sugars and minerals[10][11].As a result of the increased demand for organic potato production recently, the interest in its cultivation and organic production in many countries of the world has increased for several reasons had been mentioned by [12] in: increasing food awareness, consumer demand for potato and its clean production, where potato crop is considered one of easy growing crops with high nutritional value and

high yield.Also, potato crop has Theability of incubating before planting and during various stages of growth, which helps to get rid of herbs without the need for harmful chemical herbicides.with good tillage, hoeing,

Several experiments have been conducted to study the impact of organic fertilization on potato cultivation. The results showed that the agricultural production of this crop could be economically successful by adopting the organic farming system as a sound method of production, improving the soil properties, increasing the biological activity and yielding high quality crop [13][14][15][16][17] .

Many researchers [18][19][20] indicated to the great importance of organic fertilization in alternative environmentally safe agriculture and the production of high-quality potato tubers, with low nitrate level, heavy metals, radioactive materials and high contents of dry matter, carbohydrate, vitamins and mineral salts.

Also, [21][22][23] in many experiments and studieson the effect of the variety and different levels of organic fertilizers in organic potato production, found an increasein production per unit area when increasing the added amount of organic matter for all studied cultivars.Their was also a variation in the production of potato varieties at the same level of organic fertilization.

Therefore, because of the high importance of the potato crop from the economical and marketing points of view, and the recent environmental and health problems due to the excessive use of chemical fertilizers, the aim of this work was set to study the effect of the interaction between different levels of biogas manure and tobacco compost in productivity and tubers quality of potato crop.

II. MATERIALS AND METHODS

A. Description of the study area:

The study was conducted at the Center for Agricultural Scientific Research - Zahid site for Organic Agriculture - Tartous - Syria, in field conditions in 2018, at altitudeof 28 meters above sea level, under a mild wet climate.The soil of the experimental site is characterized by black mud soil, moderate pH, good organic matter content, good content of nitrogen, available potassium, and poor contents of phosphorus table(1).

Table(1): some selected Soil physical and chemical properties.

%			ppm		%				$EC_{1/5}$ ds/m^{-1}	$pH_{1/5}$
clay	silt	sand	available K	available P	Total N	Organic Matter	Active $CaCO_3$	Total $CaCO_3$		
60	14	26	493	4.4	0.166	4.20	traces	4.75	0.27	7.5

B. Experimental Materials:

- Potato seeds were used in this work,*(cult. Spunta)*, a Dutch origin, is characterized as a median delay in maturity (100-110 days of growing), large, long-tubers, yellowish-colored, light-yellow pulp, superficial eyes.
- Tobacco compost wasPrepared by aerobic fermentation of powdery tobacco waste in a heap method.
- Dry biogas manure was obtained from the solid waste of thebiogas production unit, resulting from the anaerobic fermentation of the waste of cows in the biogas digesterlocated at the Zahid site.

Table 2 shows some selected chemical characteristics of the used organic matter from the tow origins.

Table(2): Composition of the used organic matter

Organic matter origin	$pH_{5/1}$	$EC_{5/1}$ ds/m^{-1}	% N	%P	%K	%Or.C	C/N
Tobacco compost	7.93	4.17	1.9	0.44	1.76	30.4	16
Biogas manure	7.65	0.7	1.6	0.69	0.42	22.86	14.29

C. Treatments and Experimental Design:

The experiment consists of five treatments, including: Control M1(without any additions), M2(B_4T_2), M3($B_{12}T_2$), M4(B_4T_4), M5($B_{12}T_4$). The treatments consist of two levels of tobacco compost (40,20 m^3/h), and two levels of biogas manure (120,40 m^3/h). The complete randomization designwasadopted in this experiment, withthree replicates.Therefore, the total of15 experimentalobservations were established. The width and length of each plot was statedto be 2 x 2.5m.The distances between Treatments and plots were separated by 1m and 0.5m distance respectively.

Each experimental pot included three rows, the Plants were set at 25 cm distance, each plot included 27 plants, and the total area used totaled at 75 m^2.

D. Data collection and analysis:

The tubers crop was collectedafter 100 days from planting at full maturity, and some production parameters of ten randomly selected plants were measured and recorded from each treatment and replicate. Tubers were gradedin each replicate into three sizes according to [24].Where tuber's weight less than 35 g is considered small, tuber's weight between 30-80g is considered medium,and tuber greater than 80 g is considered large. Also, the average plant production (g/plant), the productivity of unit area (ton/hectare), and the marketing production portion (ton/hectare) were calculated. Then the percentage of dry matter (%) of tubers was recorded after drying at 105 C° until weight stability, and starch percentage wascalculated by using the following equation:

$\text{Starch } \% = 17.5 + 0.891(\%dry\ matter - 24.182)$

according to [25], while nitrate contents in fresh tubers (ppm) were estimated by using (Nitrate–Tester soeks) device.

The results were statistically analyzed using the statistical program Genstat-12 [26] and the least distance between each two rows was set at 70 cm. significant difference (LSD), at a significant level of 5% for comparing the averages.

III. RESULTS AND DISCUSSION

A. Effect of experimental treatments in tubers size:

The results of table (3) showa significant superiority of all the treatments on the control treatment in terms of their production of large tubers. The treatment M4 gave the highest weight of the large tubers 440.4 g/plant. All treatments except M2 were significantly higher than the control treatment in terms of quantities of their production of medium tubers. Treatment M4 , also, gave the highest quantity of the medium tubers 148.8 g/plant and the lowest quantity of small tubers, where the percentage value of small tubers from the total plant production decreased with the addition of organic fertilizers to give the lowest percentage value in treatment M4 9.04%. This result is similar to the results obtained by [22], when cow manure was used to fertilize the potato crop, where the tuber weightwas increased steadily with the increased amount of bovine clumps.

Table (3): Tubers weight and their proportion in the experimental treatments

Treatment	Tubers weight g/plant					
	Small<35g	% of plant productivity	Medium 35-80g	% of plant productivity	Big >80g	% of plant productivity
M1	22.70[a]	10.81	50.4[a]	23.99	128.5[a]	61.3
M2	47.65[a]	9.69	85.4[ab]	17.77	347[b]	72.54
M3	59.71[a]	11.15	130.8[b]	24.31	344.2[b]	64.64
M4	57.87[a]	9.04	148.8[b]	23.25	440.4[b]	68.81
M5	54.42[a]	9.41	123[b]	21.24	406.2[b]	69. 35
$LSD_{0.05}$	27.10	-	43.65	-	95.9	-

B. Effect of treatments on the productivity:

The results of table (4) show significant superiority of all treatments on the control in terms of plant production of tubers, productivity of unit area, and marketing production portion. Where the treatment M4 gavehigher production value 640 g/plant, and the highest productivity per unit area 36.57 ton/hectare and the highest marketing production portion of yield 33.66 ton/hectare. This is due to the abundance of the essential nutrients in the soil solution as a result of the addition of organic fertilizers containing makeable amounts of nitrogen, phosphorus and potassium in their composition. These nutrients have an important role in increasing plant growth and production throw increasing the amount of nutrients absorbed by the plant, thus increasing vegetative growth of the plant,increasing the surface area of the leaves, in addition to the role of these nutrients in raising the efficiency of photosynthesis, whichis reflectedonbetter production. These results agree with [27], which proved that the same amount of production could be achieved when adding quantities of organic fertilizers that compensate for the amount of nutrients found in mineral fertilizers.

Table (4): Effect of different treatments of mixing tow organic fertilizers on potato productivity

Treatment	Total productivity			Market production	
	g/plant	ton/h	%Increasing from control	ton/h	% of total production
M1	210[a]	12.00[a]	0	10.23[a]	85.29
M2	480.1[b]	27.43[b]	128.58	24.71[b]	90.31
M3	534.7[bc]	30.55[bc]	154.58	27.12[bc]	88.85
M4	640[c]	36.57[c]	204.75	33.26[c]	90.90
M5	583.6[bc]	33.35[bc]	177.92	30.27[bc]	90.59
$LSD_{0.05}$	142.2	81.13	-	7.39	-

C. Tubers dry matter (%):

Table (5) shows an increase in the percentage of dry matter content of the potato tubers in concurrence with the increase in the amount of organic fertilizer added to a certain limit, after that this percentage was slightly decreased. There was a significant superiority of all treatments on the control in terms of percentage of dry matter content in the tubers. Where the treatment M4 achieved the highest percentage value of 23.09% in comparison with 20% in the control treatment. This corresponds to the results of [28], which have linked the increase of dry matter in tubers to the positive effect of organic fertilization on all growth and production indicators, including the increase of dry matter in potato tubers.

D. Starch content of potato in tubers (%):

Table (5), also, shows that the percentage of starch in the potato tubers increased with the increase in the rate of addition of organic fertilization to a certain limit, then began to decrease slightly. All the treatments showed a significant superiority on the starch contents %, in the tubers over the control treatment. Where the treatment M4 recorded 16.59% of starch which is the highest percentage, compared with 13.82% in the control treatment. This result agree with the results of [29][30] [31][32]. In this respect, [33][34] point out that increasing the rate of organic fertilization increases the transformation of sugars in tubers into starch.

E. Nitrates content in fresh potato tuber (ppm):

The results of table (5) also show no significant differences between the control and the experimental treatments in terms of the content of nitrates in the tubers. The contents of fresh tubers of nitrates in all the treatments were less than the permissible limit of 250 ppmaccording to [35][36][37].

Table(5): Effect experimental treatments onthe fresh potato tubers quality.

Treatment	Dry matter%	Starch ratio%	Nitrates content (ppm)
M1	20[a]	13.82[a]	137[a]
M2	21.80[b]	15.43[b]	144[a]
M3	22.72[b]	16.58[b]	151[a]
M4	23.09[b]	16.59[b]	137[a]
M5	22.19[b]	15.78[b]	138[a]
$LSD_{0.05}$	1.383	0.845	15.77

CONCLUSION:

The following could be concluded:

1. Mixing treatments of tobacco compost and biogas manure always resulted in an increase in all studied production and tuber quality indicators in comparison with the control.
2. The mixed treatment of both biogas manure and tobacco compost (40 m^3+40 m^3/hectare), gave the highest values for tubers production per plant, the unit area production and tubers quality of market production proportion. And gave the highest percentage content of dry matter, starch and reduced the content of nitrate in potato tubers**.**

Therefore,It is possible to recommend:

The use of the mixture of organic fertilizers as in the M4 treatment in potato crop cultivation.

And follow up an experimental research on mixtures of different levels of biogas manure and tobacco compost for complete substitution for mineral fertilization under different seasonal cropping.

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