

# Influence of organic manure on the vegetative growth and tuber production of potato (*Solanum tuberosum* L varspunta) in a Sahara desert region

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**ABSTRACT:** Many studies have been carried out on the growth, productivity and nutritional properties of potato, including the effects of organic manures on tuber yield and quality. However, there are few studies on the effect of organic manure on potatoes agriculture in arid zones. The main objective of this study was to investigate the effects of natural organic manure on the growth and productivity of potato (*Solanum Tuberosum*, cv. Spunta) in a Saharian region (El-oued, Algeria). An experiment was laid out in a randomized complete block design (RCBD), with four replications and five treatments namely; control (no manure), the common fertilization treatment applied by the potatoes farmers 2 q/h (15-15-15 NPK) + 25 t/h poultry manure, 50 t/h of poultry manure, of sheep manure and 50 t/h of mixed manure poultry and sheep 1:1 w/w. Results showed an increase in the foliage area, plant cover area and the number of stems per plants by adding poultry manure, mixed manure more treatments of mixed manure (poultry and NPK) or sheep manure in comparison with control (no manure). The treatment by mixed manure showed significant increase in the number of tubers per plant in comparison with other treatments, but all the used treatments caused a significant increase in the tubers weight and the quantity of production and the percent of standard tubers in comparison with control. The treatments with poultry manure gave the highest yield in increasing the yield with high significant difference in comparison to other treatments. Thus the combination of natural organic manures and low rates of inorganic fertilizers is a promising low cost option in the production of high yields of potatoes.

**Keywords:** Potato, Organic Fertilizer, Growth, yield.

## INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of major crops contributing to the world's food requirement (Karam et al., 2009). It is the most popular salad crop in the world. It is one of the most important field crops and food not only to its local consumption but also to increase meeting income through its exportation (Kandil et al., 2011). Produced in 130 nations (Snapp et al., 2003). Topping the list of tuber crops in terms of quantity of production, it occupies wide importance in the food program of the states (Hawkes, 1990; Van Gijessel, 2005; McGregor, 2007).

Ranked fourth in production volume after rice, wheat and maize (Bowen, 2003; Stephen and Jackson, 1999; Spooner and Bamberg, 1994).

Potato growing produces a much higher value crop per hectare than cereal enterprises because it is a rich source of starch and having protein of a high biological value (Krylova et al., 2000; Stephen and Jackson, 1999). It is grown under a wide range of climates (Kandil et al., 2011; Saunders, 2001) and soil type, more than any other crop it is growing from sea level to 13000 feet (Dave Hollingsworth, 1987).

It is also an important alternative for grain as the staple food for the countries of Europe and the Americas, Africa and the wheat for eastern Mediterranean countries. Therefore grain, the high demand for potato growing in most countries.

The importance of this crop and the growing need and cared rights to lift production has therefore become fertilizer use means high importance.

Fertilizers is one of the most important inputs of increasing the productivity of crops and modern varieties of different crops (Anonymous, 1997; ALI et al., 2009). Fertilizer application has important effects on the quality and yield of potatoes (Leytem and Westermann., 2005). Potato is highly responsive to N fertilization and N is usually the most limiting essential nutrient for potatoes growth, especially on sandy soils (Errebhi et al., 1998). Nitrogen supply also plays an important role in the balance between vegetative and reproductive growth for potato (Alva, 2004; White et al., 2007). Many previous studies have shown that fertilizer N applications can increase dry matter content, protein content of potato tubers, total and/or marketable tuber yield (Bélanger et al., 2002; Kara, 2002; Zebarth et al.,2004; Zelalem et al., 2009 ; Ruiz et al.,1999)

Organic material is used to prevent or improve the negative stresses effects in plants and yield decreasing . It is material to decrease soil salinity .increase the organic matter , improve the soil structure and increase water and air permeability by root developing in soil . It is one the best used fertilizers (Anonymous, 2010; Hassanpanah andAzimi., 2012 ).

Nitrogen fertilisation was reported to increase the average fresh tuber , plant height, leaf number and tuber,weight per plant responded positively application and Leaf area increased (Kandil.,2011; Ruiz et al.,1999; Semiha., 2009)

In contrast to this, it was found that nitrogen fertilization had a negative effect on time of emergence and little or no effect on yield Due to the poor soil organic matter content in South Algeria(el oued very low) organic fertilizers are indispensable for potato cultivation.

In this area farmers often use expensive chicken manure as an organic fertilizer for potato production .

Organic fertilizers re indispensable for potato cultivation in this zone after using expensive chicken manure may offer farmers an equal effective , but less expensive alternative to chicken manure or use mixed manure (chicken and sheep per 1:1 ) or mixed manure (Chicken and N P K )

The aim of this work is to compare the effects of kind organic fertilizers on potato growth and yield .

## MATERIALS AND METHODS

### *location (place of Carrying of the experiment )*

The experiment was carried out in (Ghemamamarakhezzani) farm inHassikhalifa ,wilaya of EL-OUED ,south Algeria With sandy soils . The plants was cultivated in autumn Seasons in path 2010

## PLANTS MATERIAL

Use in this research plant potatoes( variety Spunta) which was from the production company AGRICO, This is one of the most cultivated varieties in south Algeria breed in the nether lands and grown widely in subtropical regions such as north Africa and south America (Douches et al., 2002) and they have a smooth yellow Skinned tubers of large size and elongated shapes . With very shallow eyes and pale yellow flesh , the yield is high, relatively resistant to heat and drought .It is a variety medium of early maturity (Jeff and Jeremy., 2006 ) .

### *landpréparation*

The experiment was laid out a Randomized Complete Bloke Design (R C B D ) .There were five treatment replicated four times . There were five plants on each block measuring 1.5 x 3m ( ie 4.5 m2) with a 1 m gap between plants and between blocks( figure 1) .Flat tilled land surface was made to define the experimented plants .The total land area used was 200m 2 .

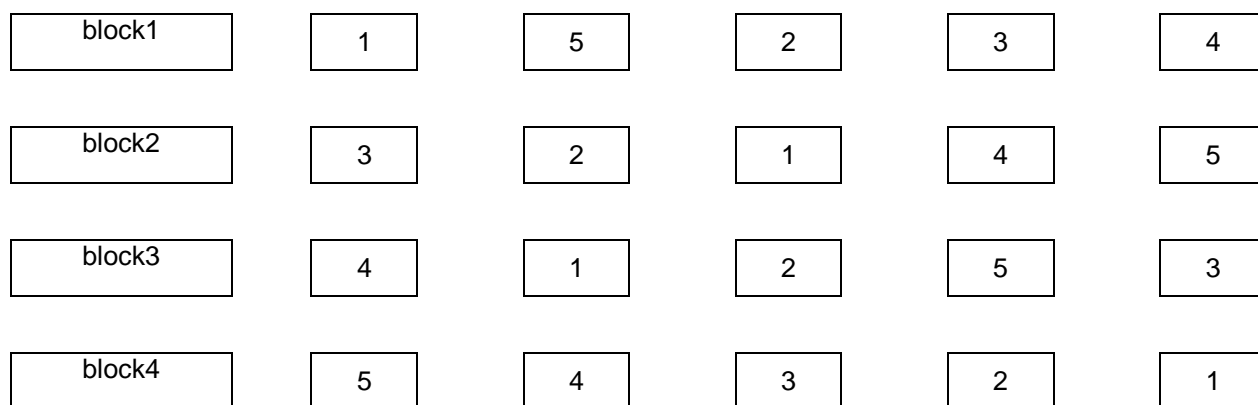


figure 1.The experiment Design

**treatments**

Organic manure (poultry chicken and sheep) and inorganic fertilizer N P K (15 15 15 ) were used. The treatments were include :

A; no manure use ( control )

B: N P K 2 qu /h + 25 t /h chicken manure(the commom fertilization treatment applied by the potato farmers )

C: 50 t/ h chicken manure

D: 50 t/ h sheep manure

E: mixed manure 25 t/h of poultry chicken manure and 25 t /h sheep manure .

**Planting**

There Were planted tuber s weighing between 80-100 g eat a depth of 10 cm with 30 cm dimension apart in the same line and 50 cm apart in between lines .were the field germination has been a day after 21 days of planting .

**Date collocation**

Growth and yield permetry measured for potatoes plants were ; Leaf area ,plants height, number stems, plants cover area ,tuber weight, yield and percent of standard tubers for five plants of all treatment of all block and physics analyses and chimic of soil and organic manure.

**6-1 Leaf area**

Measuring the width and length of five plants leaves got the leaf area multipling out with a constants (0.674)according method Saklova 1979 taken in 30 days and 70 days at planting (zidan.,2005)

**plants height and number stems**

The plants heights of potatoes plants were measured in 30 and 70 days after planting this was forming the base to the top of the plant and number stems air were measured

**plants cover area**

Measuring the width and length of five plants of all treatment we get cover area to multiplying ( length \*width ) .

**tuber weight g/ plant**

Measuring all tubers weight and multipling on number tuber

**yield and percent of stander tuber**

The production reflects KG/ M2 and percent of standard tubers (st) were measured (st) weight /Davison all weights multiplying ( 100)

**analyses of soil and manure**

The analyses of soil had been deposited before planting and manure was also taken for chemical and physical applications.

**statistical analysis**

The analysis of variance ANOVA procedure was carried out to determine the difference in parameter mean values were compared using the least significant difference (LSD) at 0.05 level of probability .

Table 1.some chemical and physical properties of soil and animals manures used in the experimental soils

	Sand	silt	clay	PH	CE	N	P	K
soil	97.2	2.8	0	7.2	4.2	28	31.2	130.3
sheep manure	/	/	/	8.5	2.1	1.9	0.75	3.1
chicken manure	/	/	/	8.8	2.6	3	2.7	2.3

**RESULTS AND DISCUSSION**

**soil chemical properties**

the chemical and physical properties of the experimental soils (before cropping) are presented in Table (1) The soil of the sites was sandy . Soil pH was 7.02. The soil was neutral . The total N content was 62.54ppm ( 0.062 g/kg) represents a deficiency and considering the 150- 200 ppm (0.15-0.20g/kg) critical level

by Sobulo and Osiname,1981 (Sherifat, 2010). while total K and availa were 51.05 ppm represents a deficiency end considering the 300ppm as being critical for sustainable crop production (Ayodele., 1984; Adeoye and Agboola., 1985). while free of p .it was required relatively large amounts of manures

**effect of organic nature manure in leaves area**

The results table (2) showed significant difference in leaves area amongst treatment and its increase significantly the leaves area of potatoes plants as compared with the control .

The leaves area was significantly higher in plants derived from chicken manure and the common fertilization treated plots and lowest in plants derives from chicken manure on first growing period . The main leaves area ( 5.8, 10.5, 7.6, 9.8 , 7.9, cm 2 / plant derived from ( control, the common fertilization, sheep manure, chicken manure, mixed manure chicken and sheep 1:1 w /w ) respectively.

while in the second growing period the chicken manure gave more leaves area on other all treatments and also the results showed increase in the leaves area in all treatments. Vegetative growth of leaves area was increased which obtained from chicken manure. The growth speed was 0.72 cm2 /d in comparison with other treatments

( control, the common fertilization, sheep manure, mixed manure chicken and sheep 1:1 w /w ). they were (0.26, 0.42, 0.46, 0.51 ) cm2 /d respectively. This finding is in accordance with observation of Hamedan (2006) and Al-Balikh (2008)

The results showed cover area plants increased significantly in chicken manure and mixed manure as compared with other treatments and the treatments of the common fertilization, sheep manure increased significantly as compared with the control . The results obtained from the experiment on number of leaves Javed, (2001).(2006) plant–1 was conformity with Vimala, (2006); Pankaj Interaction effect of variety and different types manure and fertilizer

Table 2.effect of organic nature manure in leaves area

Treatment		T1	T2	T3	T4	T5	LSD	C.V%
leaves area	38 days	5.8	10.5	7.6	9.8	7.9	2.48	19.41
cm <sup>2</sup> /plant	70 days	13.65	23.25	20.25	31.30	23.14	4.23	12.31
cover area plants m <sup>2</sup>	40 days	0.031	0.061	0.037	0.106	0.101	0.02	19
	70 days	0.084	0.187	0.136	0.338	0.281	0.177	55.92

**effect of organic nature manure in plants height and number stems**

A- the number stem :The results showed in the table( 03 ) increase significantly the numbers stems for both treatments ( the common fertilization, sheep manure, mixed manure chicken and sheep 1:1 w /w ) as compared with the control. where the main numbers stems (2.5, 2.4, 3.64, 3.5 ) for plants respectively. While the control treatment reached ( 1.5 ) This finding is in accordance with observation of Ayoola and Makinde ., (2007) and Al-Balikh ( 2008)

B - the plants height : The results showed that stems length is increasing in all treatments to day 70 of planting date. Which is the last period of vegetative growth.

The results table (3 ) showed significantly all manure treatments in plants height as compared with the contrôle .yet, chicken manure and mixed manure application had significant increase for the common fertilization and sheep manure

This result signifies the marked contribution of manure to growth the main effect of chicken manure was highly significant while ( 0.4cm/ day) But, other treatments (mixed manure chicken and sheep 1:1 w /w , the common fertilization , sheep manure, control ). they were in sequence (0.3 , 0.19 , 0.14 ., 0.05 ) cm/ day. This finding is in accordance with observation of Adeyemi et al. (1987); Ajari et al., 2003 ). and it increased the plant height of amaranthus. Also, Tindall (1975)

Where organic fertilizer has slow nutrient release capacity that caused lower plant height. Results under the present experiment on plant height was supported by Souza et al. (2008).

Table 3 .effect of organic nature manure in number stems and plants height

Treatment		T1	T2	T3	T4	T5	LSD	C.V%
number stem		1.5	2.5	2.4	3.64	3.5	0.67	31
plants height	38 days cm	6.14	8.28	9.54	16.7	15.13	2.25	13.14
	70 days cm	10.60	14.27	11.14	31.72	24.95	5.30	17.72

**effect of organic nature manure in tubers number and standard tuber**

The results presented in table ( 4 ) have demonstrated that tubers number per plant was influenced by the application of kinds manure used, significant increase potato yield was observed in kinds of application as compared with the control.

The potato used exhibited significantly response with regards to the number of tuber per plant application of mixed manure as compared with other treatments, There was also no significant difference in number of tuber per plant, Among various treatments. This finding is in accordance with observation of zidan (2005 ), hamouz et al (2005). hamedan (2006) and Al-Balikh (2008)

Also the results showed increase in the percentage of standard tuber in all treatment fertilizing various treatments

The application of mixed manure has indicated maximum increase in percentage of standard tuber . at 80.84 % then it is followed by the chicken manure treatment at 76.65% then the common fertilization at 72.83% , the sheep manure at 69.8 % , and no manure at 61.45 % . This finding is in accordance with observation of zidan ( 2005 )

Table 4.effect of organic nature manure in tubers number and standard tuber

Treatment	T1	T2	T3	T4	T5	LSD	C.V%
number of tubers per plant	4.33	6.46	6.36	6.66	7.97	1.13	11.95
the percent of standard tuber	61.45	72.83	69.80	76.62	80.84	-	-

**effect of organic nature manure in Tuber growth**

The results table (5) showed no significant difference between Tuber growth rate in growth stage I . there was also significant influence by the fertilizer treatments compared with the control treatment that gave 70.16 g/ tuber in growth stage II . The highest tuber weight was observed with chicken manure applied

Moreover, the significant two fertilizers interaction effects (common fertilization and mixed manure chicken and sheep 1:1 w/w ) and sheep manure could not significantly improve this trait (Table 5).

also the Results in table ( 5 ) exemplified that there was a significant difference in tuber bulking between the treatments of organic manure

the fertilizer treatments had significantly different effects (P = 0.05) on tuber weight increase. Chicken Manure

gave higher weight increase than all the other treatments. that gave 1.5g/ day while mixed manure chicken and sheep 1:1 w/w , the common fertilization , sheep manure, control ) yielded (0.73 , 0.67 , 0.3 0. 11) g/ day respectively This finding is in accordance with observation of (Avdinco et al., 2003; Murashov2003; Tindall, 1992). which underlines the organic manure important Impute of increase tuber weight and optimal growth .(manrique 1995 ruiz et al 1999 anon 1997)

Table 5.effect of organic nature manure in Tuber growth

Treatment		T1	T2	T3	T4	T5	LSD	C.V%
tuber weight g/ tuber	days75 stage I	67.43	92.10	73.75	91.10	89.25	35.39	27.75
	days100stage II	70.16	11.037	81.22	128.88	106.39	18.65	12.17

**effect of organic nature manure in productivity**

The results presented in Table( 6) have demonstrated that productive increase varies according of kinds the organic manures the added.

Regarding the effect of interaction between fertilizers treatments, results reveal that the highest mean values of tuber weight were recorded when the chicken manure . On the other hand, the lowest values was obtained when the sheep manure, whereas, the same trend was observed when control treatment (without addition of fertilizers) . The significant values of production gram per meter cube or grams per plant (g/ m<sup>2</sup> or g/plant) was observed when all treatments of fertilizers compared to control treatment (without addition of fertilizers) .

the highest significant values were obtained in yield g/ m<sup>2</sup> when plants treated with chicken manure or mixed manure chicken and sheep 1:1 w/w compared to other treatments .

The Percentage yield increase over the control ranged from 74.12 to 191.2 The lowest percent increase (74.12%) obtained from sheep manure treatment and the highest percentage yield increase (191.2%) was obtained from chicken manure treatment then it is followed by chicken manure treatment with sheep manure then the common fertilization.

Also the results showed increase in the percentage production of standard tuber for both treatments as compared with the control. treatment. it was varied according of kind manure.

Results reveal that the highest Standard proportion of tubers were recorded when treatment the chicken manure only (96.26 %), then it is followed by the treatment of mixed manure chicken and sheep (95.90

%) .then respectively treatments of sheep manure (93.53 %) , treatment of chicken manure with NPK fertilize ( 92.27 %)and the control. Treatment (88.60%)

These results indicate that poultry manure or chicken manure mixed with fertilizer sheep provides the plant greatly benefit from the nutrients leading to increased production and quality (increase the size of tubers), These results are compatible with the research Darojkina1972 proved that we can get the same production when adding quantities Of organic fertilizers an alternative source of nutrients in mineral fertilizers and this was evident in the two treatments T2 and T4.also accordance. And with result fedotova , (2002) which present increase in the percentage of production of standard tuber increased by application of organic manure and inorganic. with observation of Al-Balikh 2008 organic chicken manure resulted in highest values of number of tubers/plant, total tuber yield/ha, marketable tuber yield/ha

These results are in agreement with those obtained by Tsyganov et al. (2000) , Ferreira and Goncalves (2007) with observation of Al sahaf and Atee,(2007) . Havlin et al ,(2005) . Adediran et al ,(2004) . zidan (,2005 ) which was presented that fertilizer is one of the most important inputs of increasing the productivity of crops plants

Table 6.effect of organic nature manure in productivity (g/ m<sup>2</sup>, g/plant and percent production of standard tuber

Treatments	T1	T2	T3	T4	T5	LSD	C.V%
productivity g/ m <sup>2</sup>	2352.6	4740.3	4096.37	6850.8	6738.7	817.56	10.70
productivity g/plant	294.07	592.53	512.05	856.35	842.31	102.2	10.7
percent production on control	100	201.49	174.12	291.2	286.43	-	-
the percent production of standard tuber	88.60	92.27	93.53	96.26	95.90	-	-

**correlation matrix for the parameters measured on potatoes**

the results in table 7 shows a contrast in the correlation among the traits (studied features)

**clear from those results that the correlation is positively full**

between the leaf area and stem length (+0.85) , the tuber medium weight(0.95+) , productivity(+0.88) and tuber standard rate is (0.78+)

between the plant cover and leaf area (0.92+), stems numbers (0.97+), tuber numbers (0.75+), tuber medium weight((0.92+), productivity(0.97+) and tuber standard rate (0.88+)

between stem length and tuber medium weight (0.85+) productivity (0.9+) and tuber standard rate(0.78+)

between stems numbers and tubers numbers (0.87+) tuber medium weight((0.92+) productivity (0.99+) and tuber standard rate (0.95+)

between tubers numbers and productivity(0.88+) and tuber standard rate((0.96+)

between tuber medium weight and productivity(0.88+) and tuber standard rate((0.8+)

between productivity and tuber standard rate((0.96+)

from the results shown in table 7 , the correlation is positively medium.

between leaf area and tubers numbers (0.65+)

between stem length and tubers numbers (0.61+)

between tubers numbers and tuber medium weight (0.65+)

Table 7.is the correlation matrix showing relationships between traits studied features qualities of plant growth and harvest quality.

parameters	Leaf area (LA)	cover plant	Stem length	numbers stems	numbers Tubers	Tubers medium weight	productivity	Tuber standard rate
Leaf area (LA)	1							
cover plant	0.920***	1						
Stem length	0.855**	0.973***	1					
numbers stems	0.891**	0.972***	0.914**	1				
numbers Tubers	0.655	0.750***	0.614**	0.869***	1			
Tubers medium weight	0.95***	0.923***	0.852***	0.863***	0.656**	1		
productivity	0.885***	0.973***	0.907***	0.996***	0.881***	0.883***	1	
Tuber standard rate	0.781484	0.886**	0.780**	0.951***	0.967***	0.803**	0.966***	1

\*low correlation \*\* medium correlation \*\*\* full correlation

**CONCLUSIONS AND SUGGESTIONS**

Organic fertilization treatment led to an increase in vegetative growth in one hand a leaflet area and coverage, reaching the highest level in the treatment of chicken manure with no significant differences between them and the common fertilization.

increasing the stems amount and length in all treatments by adding organic fertilizer more than with chicken manure treatment ostensibly on other treatments

increasing formed tubers amount in plants as a result of adding organic fertilizer with no significant differences between fertilization treatment and the traditional treatments but the fertilizer type in tuber standard rate, therefore, the treatment of mixed fertilizer and chicken manure outperformed from the rest of the treatments.

Organic fertilization with chicken manure rises productivity, size, tubers standard rate and we find differences between them and common treatments.

correlation between leaflet area and tubers amount, productivity, tubers standard rate and between stems and tubers amounts.

the medium correlation between leaf size and tubers amount, tubers amount and tuber medium weight.

Suggestions:

for rapid growth of the plant we suggest fertilizing with chicken manure with the addition of chemical fertilizers

for The rapid growth of the plant and for the production of early potatoes, we propose the use of chicken manure or mixed with sheep manure.

for good tuber standard rate in productivity we propose the organic fertilization with chicken manure

## CONCLUSION

the effect of animal manure sources on the yield of potato is given in table 3, the application of animal manure sources showed a significantly higher ( $p < 0.05$ ) yield of potato over the control, However; poultry manure application gave the highest potato yield followed by mixed manure and the common fertilization and then sheep manure

The number of tuber per plant and tuber weight, are important yield determining factors, and reflect the extent of tuber development. These yield components were also significantly influenced by the fertilizer treatments

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