

## RESPONSE OF SOME POTATO CULTIVARS TO ALTERNATIVES TO MINERAL FERTILIZATION

Abdel-Rehim, G.H., M.S.S Al-Bassuny and A.A. El-Drany

Department of Horticulture – Faculty of Agriculture – Al-Azhar University , Assiut Branch

### ABSTRACT

Two field experiments were conducted during 2013 and 2014 summer seasons at a special Farm in El-Basunia Village, Fayoum District, Al-Fayoum Governorate, Egypt, to study the effect of Eight fertilization treatments i.e. Chicken manure, Cow manure, Chemical fertilizer, bio-fertilizer, 1/2 NPK + Chicken manure, 1/2 NPK + Cow manure, 1/2 NPK + bio-fertilizer and control (without fertilization) , on yield and quality of four potato cultivars i.e. Spunta , Nicola , Hermes and Lady Rosetta .

The added rates organic fertilizer 10 ton / fed. chicken manure , 10 ton / fed. cow manure , 160:175 (N) unit per fed 75 (P) unit per fed 75 (K) unit per fed.

The results indicated that potato plants fertilized with half recommended dose of NPK + Chicken manure treatments gave significant effects on total yield of potato tubers (ton / fed.), weight of non- marketable tubers (kg / fed.), total yield of potato tubers (g / plant), number of potato tubers per plant ,crud protein content (%), total carbohydrates content (%), and total sugars content (%) .

The results indicated that the potato cultivars varied significantly where, Spunta exceeded other cultivars in all characters studied.

The type spunta and the following type Nicola gave the highest crop for fed in ton and for plants in (kg ) in each of the two seasons , type spunta the best in protin rate and the type Hermes the best in carbohydrate total in tubers , the type Nicola the best in sugar the character of crop was effected and its continents and so the quality , and the chemical for potatoes tubers in the fourth characters for potatoes significant with the treatment fertilizers the highest value for all characters under studying and so that with fertilization with half recommended mineral fertilizer chicken manure fertilizer in all both to season but the treatment of comparison without fertilization led to short significant for all this characters in both seasons

**Key words : Potato, Organic manure, Bio-fertilizer**

### INTRODUCTION :

Potato (*Solanum tuberosum* L.) is one of the most important vegetable crop grown in all over the world . It is one of the most important energy vegetable crops of the world (Kandil, et al.2011). In Egypt it is cultivated not only to local consumption but also for exportation . It has a great potential to provide nutritious.

food in diversity of environments for increasing hungry world and ranks after wheat, rice and maize as the fourth most important crops for human consumption (**Kandil, et al.2011**).

Organic fertilizer could be accepted as a healthy fertilizers for different crops. The role organic fertilizer is very important for plant growth and yield, because it provides stable supply of both macro- and micronutrients, and improves soil physical, chemical and biological properties, and consequently supports the maximum yield . There are many investigators working on organic manure and came out similar results , in this connection, **Hussain et al. (1988)** reported that organic manures increased the efficiency of chemical fertilizers . They also demonstrated that beneficial effects of farmyard manure on crop production through improved fertility and physical properties of soil are an established fact.

**Jafari and fonooni (2014)** showed that increased manure usage manure causes increased tubers yields per fed., number of tubers per plant and tubers yield per plant. **Abu El-Khair and Nawar (2010)** found that phosphorus application to potato plants reflected a significant increase on number of tubers per plant , average tuber weight and tubers yield per plant . **Kandil et al (2011)** reported that application of 60% inorganic nitrogen (238kg / ha) + 40% organic chicken manure (158kg N / ha ) resulted in highest values of number of tubers / plant, total tuber yield / ha, marketable tuber yield / ha . **Indiresh, et al,(2003)** showed that individual and combined inoculation of *Azotobacter chroococcum*, *Acetobacter diazotrophicus* and *Pseudomonas striata* gave significant effect on increasing percent emergence of tubers, number of tubers, tubers weight per plant, total tubers yield and marketable tubers yield .

## **MATERIALS AND METHODS**

Two field experiments were conducted during 2013 and 2014 summer seasons at a special Farm in El-Basunia Village, Fayoum District, Al-Fayoum Governorate, Egypt . Each experiment included 32 treatments ( arranged in split-plot design with three replicates ) which were the combinations of :

1) Four potato cultivars (the main plots) i.e. Spunta , Nicola , Hermes and Lady Rosetta.

2) Eight fertilization treatments (the sub- plots ) i.e. Chicken manure, Cow manure, Chemical fertilizer, bio-fertilizer, 1/2 NPK + Chicken manure, 1/2 NPK + Cow manure, 1/2 NPK + bio and control (without fertilization) . The added rates organic fertilizer 10 ton/fed. chicken manure , 10 ton / fed. cow manure , 160:175 (N) unit / fed. 75 (P) unit per fed. 75 (K) unit per fed.

### **Mechanical and chemical analysis of soil :**

Soil samples were taken at random from the experimental field area at a depth 0-30 cm from soil surface before soil preparation during the growing

seasons to measure the physical and chemical soil properties according to standard method described by Jackson (1973) as shown in Table (1).

**Table (1): Some physical and chemical analysis of the experimental site in 2013 and 2014 seasons.**

Soil properties	First season 2013	Second season 2014
Clay (%)	38.25	38.4
Silt (%)	35.42	36.0
Sand (%)	26.33	25.6
Texture grade	Clay loam	Clay loam
pH	7.8	8.10
EC (ds/m)	1,09	1,06
Organic matter (%)	1.50	1.48
CaCO <sub>3</sub> (%)	6,1	6.0
Total N (ppm)	75	152
Available P ( ppm )	13.7.	22.50
Available K <sup>+</sup> ( ppm )	161	152

Some samples were taken at random from the two organic fertilizers (Chicken manures and Cattle manures ) before planting to measure the (NPK) as shown

**Table (2).**

Samples No.	N %	P %	K %
Chicken manures	3.3	0.60	2.26
Cow manures	0.9	0.20	3.66

Potato (*Solanum tuberosum, L* ) was sown on 25 of January in both seasons .

The experimental unit area was 10.5m<sup>2</sup> (3 m length and 3.5 m width) and consisted of 5 ridges each is 3 meter in long and 0.7 meter in wide. the harvesting time were conducted at 105days from planting in the two successive growing seasons potato cultivars harvested in 8 May in both seasons . Other recommended practices of growing potato were followed .

Data recorded :

At harvesting ,potato tubers were dug from the central two ridges of each plot, collected by hand. The following measurements were recorded :

**A.Yield characters:**

- 1-Total yield of potato tubers (g/plant)
- 2-Number of potato tubers per plant
- 3- Total yield of potato tubers (ton/fed.)
- 4- Non- marketable potato tubers yield (ton/fed.)

**B.Chemical characters:**

- 1- Nitrogen % (g/100g dry weight ) was determined, using the Micro-Kjeldahl

method (A.O.A.C.,1970) and protein percentage was then calculated, using the following equation :

$$\text{Protein \%} = \text{Nitrogen \%} \times 6.25$$

2- Total carbohydrates content was determined to the method adopted from Shaffer and Hartman (1921).

3- Total sugar content % (g/100g dry weight ) was determined, using the

### Statistical analysis:

All data obtained in both seasons were subjected to analysis using ANOVA table in GenStat statistical computer software (edition12). Treatment means were compared using the least significant differences (LSD) test according to Steele and Torrie (1982) at the 5% level of significance .

## RESULTS AND DISCUSSION

### Total yield of potato tubers (g / plant ) :

Data in Table (3) shows the effect of different fertilizer sources organic, biofertilizer and NPK mineral fertilizer on total yield of potato tubers (ton / fed.) in the two seasons of 2013 and 2014 .

In general, the results illustrated that the application of different fertilizer sources or their combinations gave significant increases in total yield of potato tubers (g / plant ) compared with the control (without fertilization).

The half recommended NPK + Chicken manure gave the highest values of total yield of potato tubers (g / plant) . Similar trends were mentioned by many investigators Al-Moshileh and Motawei(2007) and Farag et al (2013).

**Table (3): Effect of organic, mineral and bio-fertilizer on total yield of potato tubers of some potato cultivars (g / plant) during 2013 and 2014 seasons.**

Fertilizer	2013					2014				
	Cultivars					Cultivars				
	Spunta	Nicola	Hermes	L,Rosetta	Mean	Spunta	Nicola	Hermes	L,Rosetta	Mean
T1	495.3	434.7	416.5	418.6	441.3	512.6	452.3	427.7	431.0	455.9
T2	397.3	382.2	331.7	286.9	349.5	420.7	411.4	343.5	308.2	371.0
T3	562.5	533.4	503.5	453.1	513.1	605.6	563.3	515.8	498.7	545.9
T4	410.8	470.6	309.8	267.7	339.7	428.5	392.6	330.8	319.6	367.9
T1+0.5 T3	714.4	676.1	544.1	471.4	601.5	752.2	632.5	571.7	543.9	625.1
T2+0.5 T3	669.7	632.4	459.7	469.8	557.9	698.2	675.1	515.2	506.1	598.7
T4+0.5 T3	501.8	481.2	416.0	420.3	454.8	555.8	502.6	465.7	439.5	490.9
T5	334.4	291.7	246.1	233.2	276.3	359.2	317.2	281.3	256.2	303.5
Mean	510.8	475.3	403.4	377.6		514.6	493.4	431.5	412.9	
L.S.D 0.05										
A	12.21					12.35				
B	13.66					11.59				
AB	27.31					23.19				

T1 : Chicken manure      T2 : Cow manure  
T3 :Chemical fertilizer    T4 : Bio- fertilizer  
T5 : Control

**Number of potato tubers per plant .**

Data in Table (4) shows that potato plants fertilized with recommended level of NPK mineral fertilizer or organic and biofertilizer only or the combinations with half amount of NPK reflected significant increases in the number of potato tubers per plant compared with the control (without fertilizer) in the two seasons . Also, the results indicated that 1/2 NPK + Chicken manure mixture gave the highest values of number of tubers per plant compared with other fertilizer treatments and control in both seasons . The present results are in harmony with those obtained by Kandil et al. (2011).

**Table (4): Effect of organic, mineral and bio-fertilizer on number of potato tuber per plant of some potato cultivars during 2013 and 2014 seasons.**

Fertilizer	2013					2014				
	Cultivars					Cultivars				
	Spunta	Nicola	Hermes	L,Rosetta	Mean	Spunta	Nicola	Hermes	L,Rosetta	Mean
T1	4.95	6.00	6.67	7.11	6.18	5.38	6.95	6.75	7.12	6.55
T2	5.08	5.67	7.12	7.33	6.30	6.41	7.33	6.85	7.33	6.98
T3	5.12	6.33	7.01	7.00	6.37	6.45	7.00	7.00	7.67	7.03
T4	4.33	5.12	6.18	6.13	5.44	5.43	6.67	6.13	7.00	6.31
T1+0,5T3	5.21	6.67	7.33	7.67	6.72	6.33	7.33	7.00	8.33	7.25
T2+0,5T3	5.00	5.33	6.00	6.33	5.67	6.00	7.13	6.67	7.33	6.78
T4+0,5T3	4.85	6.00	6.33	6.75	5.98	5.37	6.85	6.33	7.00	6.39
T5	4.50	5.33	6.10	5.67	5.40	5.25	6.67	6.00	6.67	6.15
Mean	4.88	5.81	6.59	6.75		5.83	6.99	6.59	7.31	
L.S.D 0.05										
A	1.14					1.20				
B	Ns					Ns				
AB	2.67					2.12				

T1 : Chicken manure      T2 : Cow manure  
 T3 :Chemical fertilizer      T4 : Bio- fertilizer  
 T5 : Control

**Total yield of potato tubers (ton / fed.) :**

Data in Table (5) shows the effect of different fertilizer sources organic, biofertilizer and NPK mineral fertilizer on total yield of potato tubers (ton / fed.) in the two seasons of 2013 and 2014.

In general, the results illustrated that the application of different fertilizer sources or their combinations gave significant increases in total yield of potato tubers (ton / fed.) compared with the control (without fertilization).

The half recommended NPK + Chicken manure gave the highest values of total yield of potato tubers (ton / fed.) . Similar trends were mentioned by many investigators Al-Moshileh and Motawei(2007) and Farag et al (2013).

Table (5): Effect of organic, mineral and bio-fertilizer on total yield of some potato cultivars (ton /fed.) during 2013 and 2014 seasons.

Fertilizer	2013					2014				
	Cultivars					Cultivars				
	Spunta	Nicola	Hermes	L,Rosetta	Mean	Spunta	Nicola	Hermes	L,Rosetta	Mean
T1	8.52	8.23	7.83	7.48	8.02	9.57	9.21	8.79	8.39	8.99
T2	7.29	6.92	6.12	5.37	6.43	7.91	7.51	6.63	5.84	6.97
T3	10.5	9.53	9.13	8.94	9.53	11.79	10.63	10.21	10.04	10.67
T4	7.12	6.77	5.99	5.14	6.26	8.00	7.59	6.69	5.71	7.00
T1+0.5 T3	13.05	12.52	9.43	9.24	11.06	14.24	13.66	10.29	10.08	12.07
T2+0.5 T3	12.77	11.65	8.95	9.02	10.60	13.05	12.38	9.48	9.65	11.14
T4+0.5T3	9.30	8.79	7.71	7.23	8.26	10.30	9.72	8.52	8.01	9.14
T5	6.33	5.64	4.56	4.26	5.15	6.61	6.01	5.19	4.85	5.67
Mean	9.34	8.76	7.47	7.09		10.18	9.59	8.23	7.82	
L.S.D 0.05										
A	0.41					0.39				
B	0.77					0.92				
AB	1.14					1.24				

T1 : Chicken manure      T2 : Cow manure  
T3 : Chemical fertilizer      T4 : Bio- fertilizer  
T5 : Control

#### Non-marketable potato tuber yield (ton / fed.) :

Data in Table(6) shows the effect of different sources of fertilizer and NPK on the Non- marketable potato tuber yield (ton / fed.) in the two growing seasons of 2013 and 2014 .

The results indicated that there were significant differences in Non- marketable potato tuber yield (ton / fed.) with various sources of fertilizers or their combinations in both seasons of 2013 and 2014 . The half recommended NPK + Chicken manure gave the highest values of non- marketable potato tuber yield (ton / fed.) .These results are in agreement with those obtained by Al-Balkh (2008) and Awad (2005) .

Table (6): Effect of organic, mineral and bio-fertilizer on weight of non-marketable tubers of some potato cultivars (kg / fed.) during 2013 and 2014 seasons.

Fertilizer	2013					2014				
	Cultivars					Cultivars				
	Spunta	Nicola	Hermes	L,Rosetta	Mean	Spunta	Nicola	Hermes	L,Rosetta	Mean
T1	393.3	363.5	326.7	266.7	337.6	430.5	395.1	355.7	288.3	367.4
T2	386.7	361.1	362.0	320.0	357.5	423.1	393.1	395.4	348.2	390.0
T3	412.0	408.0	400.0	395.0	403.8	451.5	447.0	438.1	432.4	442.3
T4	524.1	436.4	385.6	285.1	407.8	577.5	479.0	421.9	309.0	446.9
T1+0.5 T3	800.0	786.7	600.0	573.3	690.0	887.4	872.5	662.7	632.7	763.8
T2+0.5T3	626.7	600.0	506.7	400.0	533.4	692.7	662.7	557.9	438.1	587.9
T4+0.5T3	366.0	360.0	280.0	200.0	301.5	399.9	393.1	303.3	213.4	327.4
T5	280.0	220.0	190.0	215.0	226.3	303.3	235.8	202.1	230.2	242.9
Mean	473.6	442.0	381.4	331.9		520.7	484.8	417.1	361.5	
L.S.D 0.05										
A	7.53					22.95				
B	12.84					14.19				
AB	25.67					28.38				

T1 : Chicken manure      T2 : Cow manure  
T3 : Chemical fertilizer      T4 : Bio- fertilizer  
T5 : Control

**Crude protein content (%)**

Data illustrated in Table (7) show the reflections of application of different sources of fertilizer organic , bio and mineral fertilizer and half NPK mineral fertilizer mixture with the other sources fertilizer on crude protein content (%). In general , results showed that potato plants fertilized with half recommended dose of NPK + Chicken manure gave significant and progressive effects on crude protein content of potato tubers compared with control plants and those treated with other treatments in the two seasons . The results are in line with those obtained by Catherine et al.(2013).

**Table (7): Effect of organic, mineral and bio-fertilizer on crude protein content (%) of potato tubers of some potato cultivars during 2013 and 2014 seasons.**

Fertilizer	2013					2014				
	Cultivars					Cultivars				
	Spunta	Nicola	Hermes	L,Rosetta	Mean	Spunta	Nicola	Hermes	L,Rosetta	Mean
T1	12.81	12.58	12.23	11.56	12.30	12.67	12.44	12.09	11.41	12.15
T2	12.38	12.22	11.85	11.05	11.88	12.23	12.01	11.65	11.01	11.73
T3	14.08	13.63	13.17	12.92	13.45	13.94	13.45	13.03	12.78	13.30
T4	11.13	11.08	11.01	10.98	11.05	11.05	11.07	11.02	10.96	11.03
T1+0.5 T3	16.61	15.61	14.85	14.73	15.45	16.45	15.46	14.71	14.58	15.30
T2+0.5 T3	15.21	15.06	14.55	14.43	14.81	15.07	14.91	14.39	14.26	14.66
T4+0.5 T3	12.68	12.41	11.91	11.22	12.06	12.54	12.22	11.74	11.08	11.90
T5	9.85	9.36	9.21	9.13	9.39	9.91	9.46	9.34	9.14	9.46
Mean	13.09	12.74	12.35	12.00		12.98	12.63	12.25	11.90	
L.S.D 0.05										
A	0.046					0.035				
B	0.060					0.067				
AB	0.120					0.134				

T1 : Chicken manure      T2 : Cow manure  
 T3 :Chemical fertilizer      T4 : Bio- fertilizer  
 T5 : Control

**Total carbohydrates content (%)**

Data illustrated in Table (8) show the reflections of application of different sources of fertilizer organic , bio and mineral fertilizer and half NPK mineral fertilizer mixture with the other sources fertilizer on Total carbohydrates content ( % ) . In general , results showed that potato plants fertilized with half recommended dose of NPK + Chicken manure gave significant and progressive effects on Total carbohydrates content (%) of potato tubers compared with control plants and those treated with other treatments in the two seasons . The results are in line with those obtained by Jafari (2014) .

**Table(8): Effect of organic, mineral and bio-fertilizer on total carbohydrates content (%) of potato tubers of some potato cultivars during 2013 and 2014 seasons.**

Fertilizer	2013					2014				
	Cultivars					Cultivars				
	Spunta	Nicola	Hermes	L,Rosetta	Mean	Spunta	Nicola	Hermes	L,Rosetta	Mean
T1 chicken manure	12.47	12.14	14.83	14.03	13.37	12.36	12.25	14.94	14.14	13.42
T2	12.35	11.93	14.43	13.93	13.16	12.46	12.05	14.54	13.74	13.20
T3	12.17	12.93	15.73	15.63	14.12	12.13	12.82	15.63	15.52	14.03
T4	12.06	11.96	14.21	13.65	12.97	11.98	11.86	14.09	13.35	12.82
T1+0.5 T3	14.12	13.67	16.91	16.67	15.34	14.21	13.81	17.01	16.79	15.46
T2+0.5 T3	13.11	13.06	16.47	16.23	14.72	13.22	13.11	16.58	16.35	14.82
T4+0.5T3	12.97	12.86	15.95	16.01	14.45	12.86	12.76	15.85	16.12	14.40
T5	11.96	11.31	14.06	13.21	12.64	11.86	11.21	14.11	13.18	12.59
Mean	12.65	12.48	15.32	14.92		12.64	12.48	15.34	14.90	
L.S.D 0.05										
A	0.09					0.12				
B	0.08					0.07				
AB	0.15					0.14				

T1 : Chicken manure      T2 : Cow manure  
T3 : Chemical fertilizer      T4 : Bio- fertilizer  
T5 : Control

#### Total Sugar content %

Data illustrated in Table (9) show the reflections of application of different sources of fertilizer organic, bio and mineral fertilizer and half NPK mineral fertilizer mixture with the other sources fertilizer on total Sugar content %. In general, results showed that potato plants fertilized with half recommended dose of NPK + Chicken manure gave significant and progressive effects on total Sugar content % of potato tubers compared with control plants and those treated with other treatments in the two seasons. The results are in line with those obtained by Jafari (2014).

**Table (9): Effect of organic, mineral and bio-fertilizer on total sugars content (%) of potato tubers of some potato cultivars during 2013 and 2014 seasons.**

Fertilizer	2013					2014				
	Cultivars					Cultivars				
	Spunta	Nicola	Hermes	L,Rosetta	Mean	Spunta	Nicola	Hermes	L,Rosetta	Mean
T1	5.934	5.226	3.823	3.515	4.625	6.661	5.869	4.392	3.947	5.217
T2	5.212	6.023	3.646	3.412	4.573	5.853	6.741	4.084	3.832	5.127
T3	6.041	5.635	3.927	3.723	4.832	6.752	6.328	4.411	4.181	5.418
T4	5.541	5.223	3.625	3.621	4.503	6.113	5.865	4.071	4.066	5.029
T1+0.5 T3	5.024	5.721	3.923	3.412	4.520	5.642	6.425	4.406	3.832	5.076
T2+0.5T3	5.516	5.227	4.023	3.541	4.577	6.174	5.870	4.518	3.977	5.135
T4+0.5T3	8.826	5.331	3.828	3.825	4.703	6.543	5.987	4.299	4.295	5.281
T5	5.242	5.652	3.932	3.534	4.590	5.877	6.347	4.416	3.969	5.152
Mean										
L.S.D 0.05										
A	0.05					0.07				
B	0.04					0.06				
AB	.11					0.12				

T1 : Chicken manure      T2 : Cow manure  
T3 : Chemical fertilizer      T4 : Bio- fertilizer  
T5 : Control



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## استجابة بعض أصناف البطاطس لبدائل التسميد المعدني

جمال حسين عبد الرحيم ، محمد سليمان سليمان البسيوني ، احمد عبد الحليم الدريني

قسم البساتين كلية الزراعة جامعة الأزهر فرع اسيوط

أقيمت تجربتان حقليتان بمزرعة خاصة بقرية البسيونية - مركز الفيوم - محافظة الفيوم خلال موسمي ٢٠١٣ و ٢٠١٤.

وذلك لدراسة تأثير بعض معاملات التسميد المعدني والحيوي والعضوي علي المحصول والجودة والمحتوي الكيماوي لبعض اصناف البطاطس . حيث استخدم في هذه الدراسة اربعة اصناف من البطاطس هي :

صنف اسبونتتا . صنف نيكولا . صنف هيرمس . صنف ليدي روزيتا  
وثمانية معاملات للتسميد هي : سماد دواجن ( ١٠ طن للفدان ) ، سماد بقر ( ١٠ طن للفدان ) ، سماد معدني بالمعدلات الموصي به ١٦٠ : ١٧٥ وحدة ازوت للفدان و ٧٥ وحدة فوسفور ٧٥ وحدة بوتاسيوم للفدان.

سماد حيوي ١٠ لتر للفدان، نصف الموصي به من المعدني + مخلفات الدواجن، نصف الموصي به من المعدني + سماد البقر، نصف الموصي به من المعدني + السماد الحيوي، اخيرا الكنترول بدون تسميد.

اظهرت النتائج

اعطي الصنف اسبونتتا يليه الصنف نيكولا اعلي محصول للفدان بالطن وللنبات بالكيلو جرام في كلا الموسمين.

تفوق الصنف اسبونتتا في نسبة البروتين بينما تفوق الصنف هيرمس في نسبة الكربوهيدرات الكليه بالدرنات. وتفوق الصنف نيكولا في نسبة السكر تأثير صفة المحصول ومكوناته وكذلك الجودة والمحتوي الكيماوي لدرنات البطاطس الاربعة معنويا بمعاملات التسميد الموصي به من السماد المعدني + سماد مخلفات الدواجن في كلا الموسمين اما معاملة المقارنة ( بدون تسميد ادت الي نقص معنوي لتلك الصفات في كلا الموسمين.