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RESPONSE OF DASHEEN TO DIFFERENT ORGANIC FERTILIZER SOURCES AND RATES UNDER NEWLY RECLAIMED SANDY SOIL CONDITIONS

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ABSTRACT

Two field experiments were conducted during the two successive summer seasons of 2003 and 2004 at the experimental farm of South Tahrir Research Station to investigate the effect of organic manure application in the form of farmyard manure, compost manure or their combination on growth, yield and quality of corms for dasheen plants. Obtained results indicated that using farmyard manure at 20 m^3/fed combined with compost manure at 60 m^3/fed followed by compost manure at 80 m^3/fed solely were the most effective treatments on increasing the vegetative growth parameters i.e., plant height, number of leaves per plant and average leaf area, chlorophyll concentration of leaves, total corms yield and its quality as well as chemical constituents of corms (NPK, starch and protein percentages). Therefore, such treatment was the best for maximizing the growth and produced yield of Taro under sandy soil conditions.

INTRODUCTION

Taro or Dasheen (*Colocasia esculenta* L.) is the unique vegetable crop belonging to family Araceae it is cultivated for production of corms which are rich in starch, proteins, minerals and vitamins in comparison with potatoes and sweet potatoes (Moursi, 1955). Under sandy soil conditions, fertilization and irrigation are the most important and determinant agricultural treatments which affect growth and yield of taro. It is well known that reclaimed sandy soils are poor in their content of organic matter, water retention, macro and micro-nutrients and bio-mass. Therefore, cultivation of taro under such condition required using huge amounts of fertilizers especially nitrogenous fertilizers. Using and addition of organic manure as a source of slow release nitrogen fertilizer and soil amendment improved the physical, chemical and biological properties of soils and in turn improved the ability of plant to absorb nutrients (Harrison and Staub, 1986). In this respect, many investigators reported that application of nitrogen as organic or mineral nitrogen fertilizer increased the vegetative growth of plant. In this connection, Hossain and Rashid (1982) and Bhuyan and Quasem (1983) all working on taro mentioned that increasing the level of nitrogen fertilizer from 0 up to 80 kg N/ha gave the highest plant height. In addition, Payot *et al.* (1983) illustrated that increasing the rate of organic fertilizer application from 0 to 20 t/ha increased leaves production of taro plants from 12.6 to 20.3 kg/plot. Moreover, Barroso *et al.* (1986) and Jacops and Clarke (1993) illustrated that using nitrogen fertilizer increased the accumulation of dry matter for taro plants. Also, Abo Sedera *et al.* (2004a) indicated that the highest values in all studied growth parameters

i.e., plant height, number of leaves / plant as well as fresh and dry weight of different plant parts were obtained as a result of the highest used level of NPK fertilizer (120 kg N +64 Kg P_2O_5 + 120 Kg K_2O /fed).

Concerning the effect of nitrogen fertilizer as inorganic or mineral form on total yield of corms and cormels as well as its quality, Payot *et al.* (1983) illustrated that increasing organic manure application rate from 0 to 20 t/ha increased the total corms yield from 8.0 to 11.7 t/ha. Purea *et al.* (1997) found that organic fertilizer generally increased the late yield of corms compared to NPK fertilizer. In addition, Escalada and Ratlila (1998) reported that green manure application for taro plants at a rate of 7.23 and 10.48 t/ha. significantly increased large size corms which resulted in higher marketable and total yield compared with the control. Also, El-Sharkawy *et al.* (2003) indicated that the total produced yield and its components as well as starch, NPK and protein content of corms were significantly increased with increasing farmyard manure application up to 80 m^3/fed. Moreover, Abo-Sedera *et al.* (2004 b) declared that the highest tested NPK fertilizer level (120 Kg N + 64 Kg P_2O_5 + 120 kg K_2O/fed) significantly affected yield and its components expressed as number and weight of cormels, average weight of main corms, height and diameter of main corm, total yield per plant as well as yield per feddan.

Therefore, this study was conducted to investigate the effect of organic manure as sources of nitrogen in the form of FYM or compost as well as their combination on vegetative growth, corm and total yield and its quality of taro plants grown under sandy soil conditions.

MATERIALS AND METHODS

Two field experiments were conducted at South Tahrir Research Station, Horticulture Research Institute, during the two successive summer seasons of 2003 and 2004 to study the effect of organic fertilizers i.e., farm yard manure and compost manure as a source of N on growth, yield and chemical constituents of taro plants (*Colocasia esculenta* L.) grown under sandy soil conditions. The soil of the experimental field was sandy in texture with pH 7.8. The mechanical and chemical analysis of the soil were determined according to the method described by Jakson (1965) and are shown in Table (1).

The experimental design was a complete randomized block design with three replicates. A drip irrigation system with nozzles of 50 cm apart was used for irrigation during the two seasons of the experiment. Cormels (seed pieces) were planted at 50 cm apart within rows of 1.0 m width and 20 m length on 19th and 23rd of March in the two seasons of study, respectively. The area of the experimental plot was 20 m^2 and included 40 hills. The experiment included six treatments which were as follows.

1- Control: 40 m^3 farmyard manure + 200 kg ammonium sulphate + 150 kg calcium super phosphate + 200 kg per feddan potassium sulphate.
2- 80 m^3/fed farmyard manure only.
3- 80 m^3/fed compost manure only.
4- 40 m^3 farmyard manure + 40 m^3 compost manure.
5- 60 m^3 farmyard manure + 20 m^3 compost manure.
6- 20 m^3 farmyard manure + 60 m^3 compost manure.

Table (1): Chemical analysis of experimental soil and organic manure.

1-Chemical analysis of soil			
Soil characteristics		Values	
pH		7.80	
Ec (dsm^{-1})		1.40	
Mineral nutrients (mg/kg^{-1})	N	11	
	P	13	
	K	55	
Anions as mg/L	Ca^{++}	10.80	
	Mg^{++}	6.30	
	Na^{+}	6.90	
	K^{+}	2.30	
Organic matter (%)		1.90	
2- Chemical of organic Manure			
		Compost	FYM
pH		7.40	9.30
Ec (dsm^{-1})		10.70	13.80
Total of	N	1.2	0.17
	P	0.68	0.34
	K	1.80	0.45
C/N ratio		17.80	35.20
Organic matter		37.00	25.80

The amounts of organic fertilizers were added once during the soil preparation pre-planting, while the amounts of chemical fertilizers were divided into two equal portions and added at 90 and 180 days after planting. Chemical analysis for used organic fertilizers (FYM & Com.) was shown in Table (2).

Data recorded:

1- Vegetative growth parameters.

Five plants from each experimental plot were taken at 210 days after planting and the following data were recorded.

a- Plant height (cm).
b- Number of leaves / plant.
c- Average leaf area (cm^2) using L. 310 area meter.

2- Yield and its components.

At harvest (270 DAP) all corms were removed by digging soil around it from each experimental plot after removal of plant foliage above the ground surface then corms were cleaned from the residual of soil and the following data were recorded.

a- Average weight of corms / plant.
b- Average corm height and diameter (cm): it was measured by calipers.
c- Total yield of corms per plot (kg).
d- Dry matter percentage of corms. Corms samples were washed with normal water and then with distilled water and oven dried at 105°C and then at 70 C° to constant weight.

3- Chemical constituents.

a- Chlorophyll content, it was determined in leaves by using chlorophyll meters (SPAD-Soil).Total nitrogen, phosphorus, potassium, protein and starch content

of corms were determined according to the methods described by Kock and Mcmeckin, 1924; Troug and Meyer, 1939; Brown and Lilliland, 1946; Pregl, 1945 and Samogyi, 1952 for each of total nitrogen, phosphorus, potassium, protein and starch, respectively.

All obtained data were subjected to statistical analysis according to linear model procedure of SAS institute (1989). Fisher protected least significant differences (LSD) at $P<0.05$ was employed to separate treatments.

RESULTS AND DISCUSSION

Morphological characteristics:

Data presented in Table (2) show that all the studied vegetative growth parameters i.e., plant height, number of leaves per plant as well as average leaf area were significantly affected by the organic manure either as compost, farmyard manure or their combination compared to the control treatment. In this regard, application of organic manure as a mixture of farmyard manure at a rate of 20 m^3/fed combined with compost at 60 m3/fed reflected the highest values in plant height and number of produced leaves per plant during both seasons of growth compared to other tested treatments. In addition, using organic manure as farmyard at 40 m^3/fed mixed with 40 m^3/fed compost exhibited the highest average leaf area during the two seasons of growth. However, application of farmyard manure solely at a rate of 80 m^3/fed reflected the lowest values in all measurec growth aspects. Such increments in growth traits due to the addition of organic manure at 80 m^3/fed either as a mixture from 20 m^3 FYM plus 60 m^3 of compost / fed or 40 m^3 FYM plus 40 m^3 compost / fed., respectively compared with the control treatment or other tested treatments may be attributed to the main role of organic fertilizer as soil amendment, source of slow release macro-nutrients, improved chemical and biological properties of soil, increasing water retention especially under sandy soil condition and in turn, increased the availability and uptake of nutrients by plant which affect positively on plant growth. Similar results were reported by Harrison and Staub (1986). In addition, Hossain and Rashid (1982), Bhugan and Gusem (1983), Jacops and Clarke (1983) and Abo Sedera *et al.* (2004 a) illustrated that application of nitrogen fertilizer up to 120 kg N/fed significantly affected all the measured growth aspects. Moreover, Payot *et al.* (1983) on taro Abou-Hussein (1995) on potato and Mona *et al.* (2005) and Abdallah *et al.* (2006) on cucumber reported that using organic manure in the form of chicken manure at 20 m^3/fed, compost at 60 m^3 / fed and FYM at a rate of 10 m^3/fed either in a single form or in combination significantly increased plant height, number of leaves / plant and fresh as well as dry weight of plant for such crops.

2- Yield and its components:

Data illustrated in Table (3) show the effect of organic manure on total produced corms yield and its components expressed as corms yield / plant, average corm height and diameter as well as dry matter percentage and total corms yield per plot during the two seasons of study. Such data reveal that application of organic manure as a mixture of farmyard manure and compost manure at a rate of 20 and 60 m^3/fed respectively, followed by using organic manure as compost alone at a rate of 80 m^3/fed significantly increased all the aforementioned yield parameters compared with the control treatment and other tested organic fertilizer treatments. Obtained

results are true during both seasons of growth. On the other hand, such yield parameters i.e., corms yield per plant, average corm height and diameter as well as dry matter percentage and total corms yield per unit area were significantly decreased as a result of using organic manures at 80 m^3/fed in the form of farmyard manure only- during the two seasons of growth. In this respect, the superiority of using the organic manure at a rate of 80 m^3/fed either in the form of compost alone or as mixture of 20 m^3/fed farmyard plus 60 m^3/fed compost may be due to that such organic manure are higher in their macro-nutrient content Table (1) and act as a soil amendment which increased water retention of sandy soil and since taro plant is a semi aquatic plant therefore such conditions affect positively plant growth (Table 2) and consequently increased the produced yield. Obtained results are in agreement with those reported by Payot *et al.* (1983); Paurea *et al.* (1997); Escalada and Rotlila (1948); El-Sharkawy *et al.* (2003) and Abo-Sedera *et al.* (2004b) all working on taro reported that using nitrogen fertilizer either as a mineral or organic significantly increased the total produced yield and its components.

3- Chemical constituent of plant foliage and corms:

Data recorded in Figs 1, 2, 3, 4, 5 and 6 show the effect of organic manure at 80 m^3/fed as farmyard manure or compost alone or in a mixture as well as the control treatment (40 m^3/fed FYM+ the recommended dose of NPK mineral fertilizer) on chemical constituents of plant leaves (chlorophyll) and corms (NPK and starch as well as protein concentration). Such data indicate that application of organic manure at 80 m^3/fed as a either in the form of compost mixture of 20m^3 /fed farmyard manure and 60 m^3 /fed compost significantly increased the photosynthetic pigments concentration of plant leaves during the two seasons of study compared with other tested treatments. Obtained results were connected with the increase in vegetative growth (Table,2). In this respect, these increments in photosynthetic pigments (chlorophyll) may be due to the increase in NPK uptake by plants figs 3, 4 and 5 which are considered the main elements in the formation and constitution of chlorophyll in plants. Obtained results are in agreement with those found by Abd El-Rahman (1990) on carrot and Abo-Sedera *et al.* (2004) on Taro.

Concerning the effect of organic fertilization on mineral constituents of corms, data in figs 3, 4 and 5 show clearly that using organic fertilizer at a rate of 20 m^3/fed as farmyard manure plus 60 m^3/fed as compost reflected the highest values in total nitrogen, phosphorus and potassium concentration compared with the other tested fertilization treatments. Obtained results are true during the two seasons of growth.

Such increments in macro-nutrients due to the application of organic manures may be due to the highest content of such macro-nutrients in organic fertilizers (Table 1) and the slow release of macro-elements throughout the growing season due to microbial decomposition of these fertilizers and consequently increased its concentration in active roots zone and in turn increased its uptake by plants. Also the increase in NPK content may be attributed to the increase in water retention which affect the moveability of such elements and increased their availability and uptake by plants. Obtained results are similar to those reported by Abo Sedera *et al.* (2004b) on Taro, Abdallah *et al.* (2006) on cucumber and Hassan and Hasanein (2007) on cantaloupe.

Table (2): Effect of organic fertilizers on vegetative growth of taro (*Colocasia esculata* L.) at 210 days after planting, during the two seasons of 2003 and 2004.

Characters / Treatments	Leaf area (cm^2)		Plant height (cm)		Number of leaf/ plant		Chlorophyll (mg/100 g F.W)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	1143.4^{c}	1227.0^{d}	91.18^{c}	83.58^{c}	4.86^{b}	4.86^{b}	37.70^{d}	38.67^{c}
FYM	825.6^{d}	907.6^{e}	74.94^{d}	71.04^{d}	4.58^{b}	4.58^{b}	31.43^{e}	28.47^{d}
Compost	1650.7^{b}	1743.0^{bc}	103.52^{b}	93.72^{b}	6.68^{a}	6.68^{a}	38.70^{d}	46.40^{b}
½ FYM + ½ Com	1857.8^{a}	1964.8^{a}	81.48^{d}	82.35^{c}	5.19^{b}	5.19^{b}	46.20^{c}	48.83^{ab}
$^{1}/_{3}$ FYM + $^{2}/_{3}$ Com	1804.8^{a}	1877.7^{ab}	113.15^{a}	99.68^{a}	6.94^{a}	6.94^{a}	50.80^{b}	54.87^{a}
$^{2}/_{3}$ FYM + $^{1}/_{3}$ Com	1751.3^{ab}	1714.8^{c}	79.03^{d}	84.46^{c}	6.32^{a}	6.32^{a}	56.90^{a}	54.50^{a}
L.S.D. at 0.05	131.23	153.62	7.37	5.45	0.81	0.95	4.33	6.36

- Com =Compost ** FYM = farmyard manure

Table (3): Effect of organic fertilizers on average of fresh corm weight/plant, average corm height, corm diameter, DM% and total yield of taro during the two seasons of 2003 and 2004.

Characters / Treatments	Fresh weight (kg/plant)		Corm height (cm)		Corm diameter (cm)		Dry matter (%)		Total yield (kg/plot)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	0.650^{bc}	0.557^{c}	10.87^{b}	8.57	8.77	8.50	23.37	23.08	14.200	11.943
FYM	0.447^{c}	0.393^{d}	9.73^{c}	8.23	7.43	7.17	25.23	24.74	9.527	8.567
Compost	0.800^{b}	0.767^{b}	10.97	9.33	9.43	7.87	26.82	26.00	16.787	16.037
½ FYM + ½ Com	0.710^{b}	0.627^{c}	9.53	8.83	7.90	7.50	25.93	25.11	15.260	13.510
$^{1}/_{3}$ FYM + $^{2}/_{3}$ Com	1.133^{a}	1.117^{a}	12.20	11.07	9.77	9.77	27.02	25.97	23.333	23.643
$^{2}/_{3}$ FYM + $^{1}/_{3}$ Com	0.667^{b}	0.610^{c}	9.40	7.47	8.73	8.77	26.20	26.34	14.217	13.007
L.S.D. at 0.05	0.215	0.109	0.901	1.57	1.06	1.05	1.42	1.14	3.829	2.381

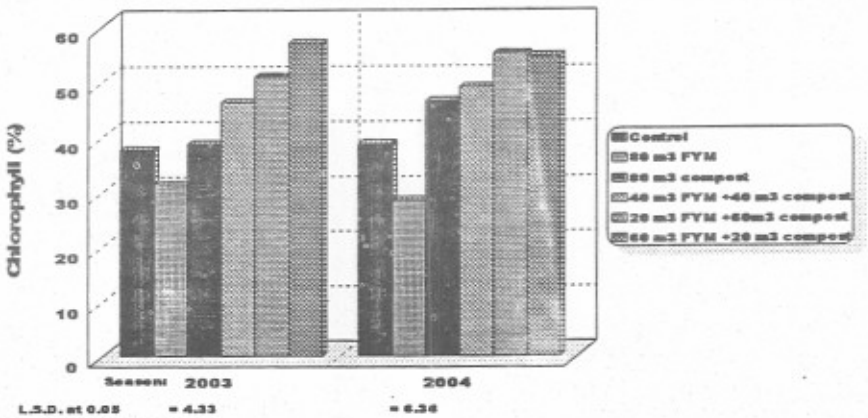

Fig.(1): Chlorophyll.

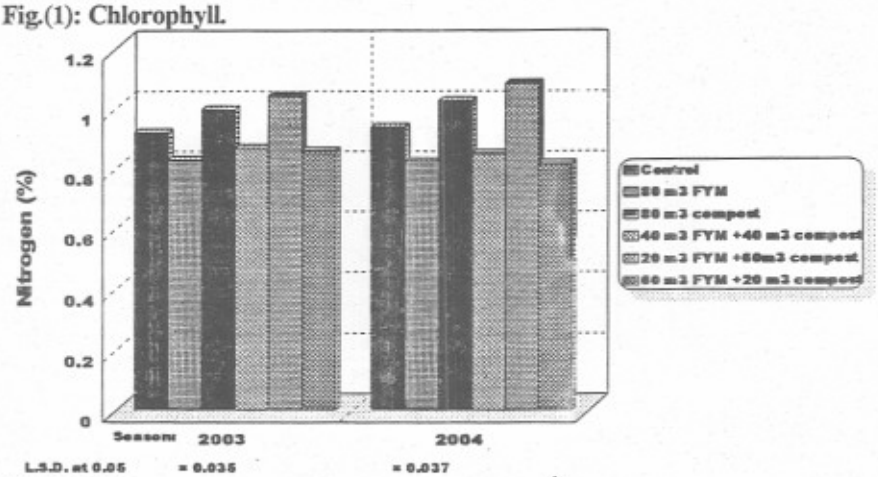

Fig.(2): Nitrogen.

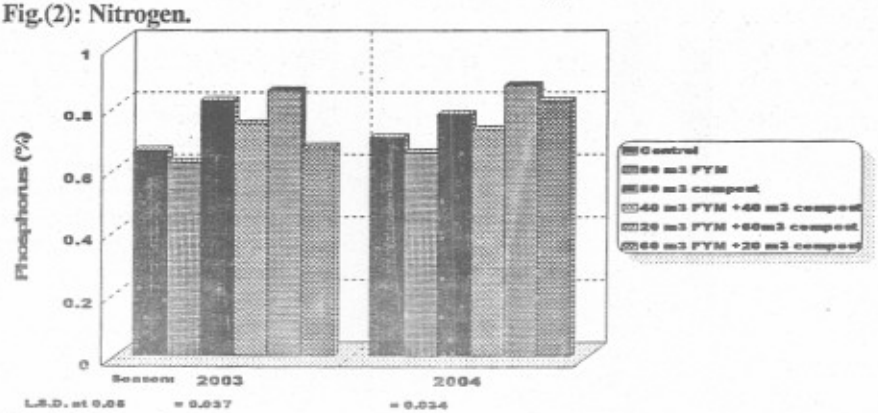

Fig. (3): Phosphorus

Figs. (1,2 and 3): Effect of farmyard manure, compost manure and their combinations on total chlorophyll (mg/100 g F.W), nitrogen and phosphorus percentage of taro corms during both seasons of 2003 and 2004.

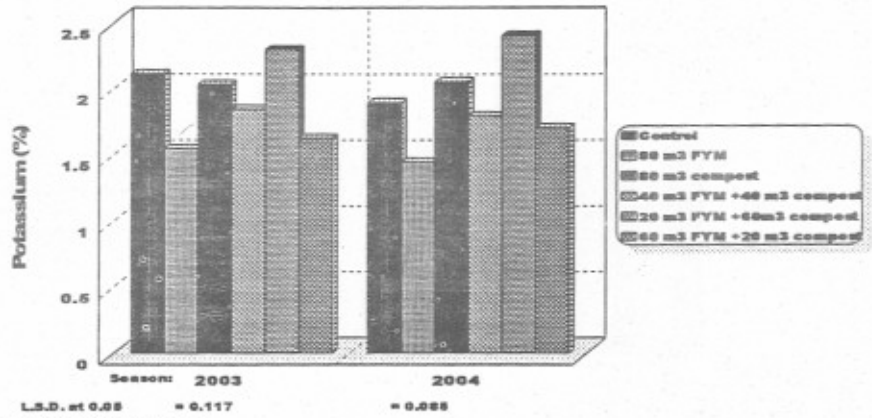

Fig.(4): Potassium.

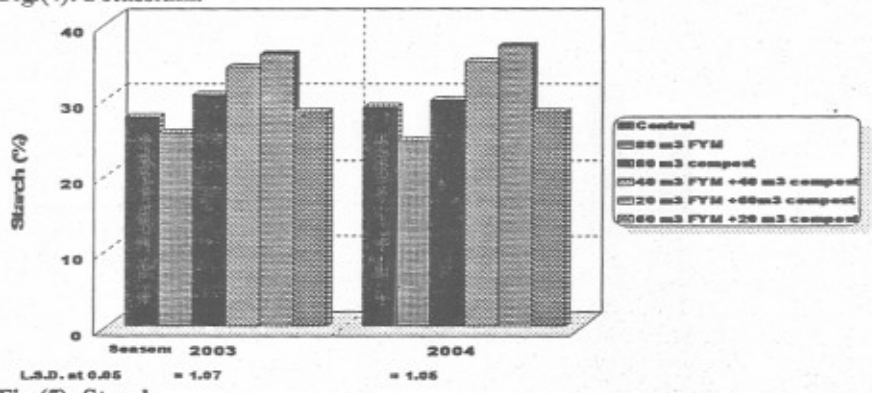

Fig.(5): Starch

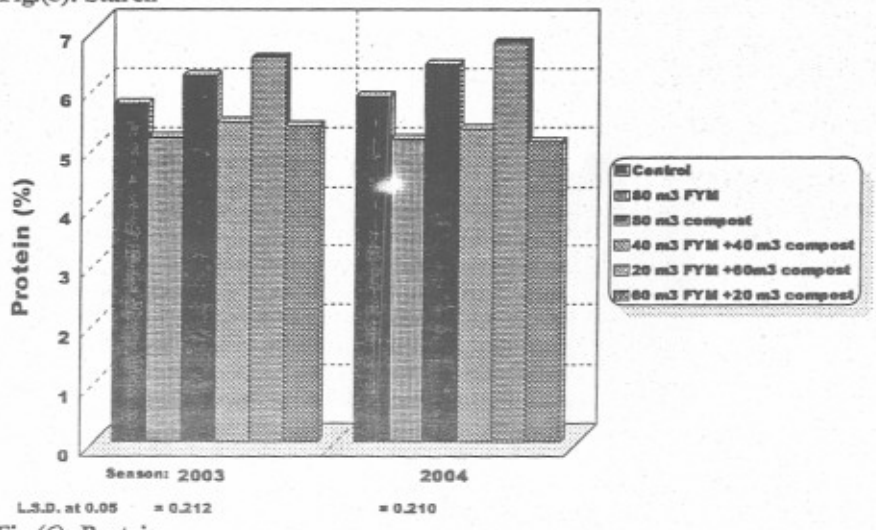

Fig.(6): Protein.

Figs. (4,5 and 6): Effect of farmyard manure, compost manure and their combinations on potassium, starch and protein percentage of taro corms during both seasons of 2003 and 2004.

As for the effect of organic fertilization on starch and protein contents of corms, data in figs. (5 and 6) show clearly that application of organic manure at 80 m^3/fed as farmyard manure or (20 m^3/fed) combined with compost manure at (60 m^3/fed) significantly increased the starch and protein percentage compared with the control treatment and other used fertilization treatments. Obtained results are similar in both seasons of growth. Such increases in both starch and protein concentration are connected with the increase in photosynthetic assimilates and NPK uptake which are considered the main molecules of starch and protein constituents. Similar results were reported by Mandal *et al.* (1982), Abd El-Hamed (1993) and Abo Sedera *et al.* (2004b) all working on Taro.

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استجابة محصول القلقاس لمعدلات ومصادر السماد العضوى تحت ظروف الأراضى المستصلحة حديثا

ظهرة عبد المولى الشرقاوى

قسم بحوث البطاطس والخضر خضرية التكاثر– معهد بحوث البساتين – مركز البحوث الزراعية

أجريت تجربتان حقليتان فى المزرعة التجريبية لمزرعة جنوب التحرير فى موسمى الزراعة الصيفى ٢٠٠٣ و ٢٠٠٤ لدراسة تأثير بعض مصادر السماد العضوى (سماد بلدى، سماد الكومبست والتفاعل بينهما) على النمو والمحصول والجودة فى كورمات القلقاس.

هذا وقد أشارت النتائج المتحصل عليها أن استخدام السماد البلدى بمعدل ٢٠ م^{٣} /فدان +٦٠ م^{٣} سماد الكومبست أو التسميد بسماد الكومبست بمعدل ٨٠ م ^{٣}/فدان منفردا قد أعطت أفضل النتائج على صفات النمو الخضرى والتى تمثلت فى كل من ارتفاع النبات– عدد الأوراق /نبات– المساحة الورقية – محتوى الأوراق من الكلوروفيل – المحصول الكلى للكورمات – صفات الجودة والمحتوى الكيماوى للكورمات (نتروجين– فوسفور– بوتاسيوم– نشا – بروتين) .

بصفة عامة التسميد بـ ٢٠ م^{٣} سماد بلدى +٦٠ م^{٣} كومبست هى أفضل معاملة حيث أعطت الحد الأقصى لصفات النمو الخضرى والمحصول والجوده والمحتوى الكيماوى لنبات القلقاس تحت ظروف الرى بالتنقيط فى الاراضى الرمليه.