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A Comparative Study of Conventional and Organic Farming Systems on Cowpea Yield Quality

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Abstract: Inclusion of legumes in cropping structure is an essential and crucial key component of a successful organic farming system. Therefore, two field experiments were conducted in 2017and 2018 summer seasons to compare inorganic fertilizersystem, organic fertilizer system and integrated (inorganic + organic) fertilizer system on cowpea (*Vigna ungiculata* L. Walp) green pods and dry seed yields in a newly reclaimed sandy soil. Two nitrogen fertilizer levels, i.e. 45 and 60 kg fed^{-1}, two levels (6 and 12 ton fed^{-1}) of organic fertilizers (compost and farmyard manure) and four integrated forms of organic and inorganic fertilizers. The results of cowpea yield showed significant effects of the treatments on number of green pods plant^{-1}, mean fresh weight pod^{-1}, green pod yield plant^{-1} and total green pod yield in both seasons. Fertilizer treatments effect on green pod yield plant^{-1} and fed^{-1} showed that the relative yields regardless the fertilizer levels applied compared to the control treatment could be arranged in the following order: integrated > organic > inorganic in both seasons. The results of different fertilizer treatments on cowpea dry seed yield characters of mean dry weight pod^{-1}, seed yield plant^{-1}, 100-seeds weight, seed and biological yields fed^{-1} showed significant effects. The estimates of nitrogen fertilizer replacement value supplied by different manures for cowpea revealed that there was N equivalency of 32% for compost and 69% for FYM relative to inorganic N applied. Significant differences among fertilizer treatments in N, P, K, Fe and Cu contents in cowpea plants and N, P, K and Mn in green pods were reported. Integrated application of compost or FYM surpassed inorganic application in micronutrients content in leaves and green pods regardless the rate of application.

Key words: Vegetable cowpea · Dry seeds cowpea · Organic farming systems · Yield · Fertilizer replacement value · Nutrient uptake

INTRODUCTION

Cowpea is one of the most important grain legumes in the world [1]. It is a summer vegetable crop grown in Egypt for local consumption and exportation. It represents a very interesting class of food crops due to its high protein content, heat tolerant, low fertilizer requirements and it can grow easily in the new reclaimed and different texture soils [2]. Kamara *et al.* [3] estimated that cowpea can fix between 20 and 100 kg N ha^{-1} with an estimated N fertilizer replacement value ranging from 10 to 80 kg N ha^{-1}. The N fixed is made available to associated or succeeding cereals. According to Adeyemi *et al.* [4] cowpea and other grain legumes are the essential sources of protein for about 700 million people, particularly in the developing countries of Latin America, Asia, Africa and Nigeria inclusive where plants provide 83% of total protein in the average diet. The crude protein from seeds range between 23 and 32% [5]. Cowpea as are drought and heat tolerant and fix N, making them a promising summer crop for organic production systems in the region [6]. They require few inputs and can enhance or maintain soil fertility through N fixation and efficient uptake of poorly soluble soil [7]. According to FAO, cowpea was

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grown on an estimated 12.3 million ha in Africa in 2014 with the bulk of production occurring on 10.6 million ha in West Africa, particularly in Niger, Nigeria, Burkina Faso, Mali and Senegal (Food and Agriculture Organization of the United Nations Statistics Division [8].

Organic farming (OF) can provide quality food without adversely affecting the soil's health and the environment. Many advantages of (OF) like improved organic matter content and labile status of nutrients and also soil physicochemical properties [9]. Addition of carbonaceous materials as crop wastes and residues could help in the composting characteristics of a manure. These materials reduce water content and raised the C:N ratio. Use of FYM and green manure maintained high levels of Zn, Fe, Cu and Mn as in rice-wheat rotation [10]. Organic fertilizers are derived from plant or animal materials. Raw materials commonly used in organic fertilizers include animal manure, postharvest plant materials and organic waste. These materials are converted into compost [11]. In organic farming, the use of chemical readily soluble mineral fertilizers is not allowed [12]. The cultivated organically area estimated in 2015 was more than 50.9 million hectares, in 179 countries around the world. In the 28 countries forming the EU, the fraction of organically cultivated land of total agricultural area has been steadily increasing up to 11.2 million hectares [13]. El-Bassel and El-Gazzar [14] found that compost manure application at a rate of 15 ton fed^{-1} with a half rate of recommended NPK (25 + 60 + 50 kg ha^{-1}) significantly affected the quality and mineral content of NPK in seeds of pea plants. Khosro *et al*. [15] found that content of phosphorus, zinc and other mineral in the chickpea plant increased under application of compost, farmyard manure and bio fertilizers. Grain legumes are strong component in cropping systems as a nutritional, protein-rich grains for the human diet [16, 17], animal feed and nourishment [18] and for their socio-economic impact [19]. Thus, legumes have an important and considerable responsibility in maintaining global food security, ecosystem buoyancy and support to the various environmental remunerations to the agricultural landscape, improving resource use efficiency.

Organic fertilization is very important for providing the plants with their nutritional requirements without having an undesirable impact on the environment [20]. So, the objective of the trial was to compare inorganic fertilizer system (IFS), organic fertilizer system (OFS) and integrated (inorganic + organic) fertilizer application system (IOFS) on cowpea (*Vigna ungiculata* L. Walp) green pods, dry seed yields and nutrient uptake in a newly reclaimed sandy soil.

MATERIALS AND METHODS

Field trials were conducted in the summer season of 2017 and 2018 on a private farm, Tawfik El Hakeem village, Nubariyah, El-Beheira Governorate, Egypt, in a newly reclaimed soil. The objective of the trial was to compare different organic farming systems: inorganic fertilizer, organic fertilizer and integrated (inorganic + organic) fertilizer application on cowpea (*Vigna ungiculata* L. Walp) green pods and dry seed yields in a newly reclaimed sandy soil. The experiment included 10 treatments which were two nitrogen fertilizer levels i.e.; 45 and 60 kg fed^{-1} and two organic fertilizers, i.e., compost (6 and 12 ton feed^{-1}) and farmyard manure (6 and 12 ton fed^{-1}) while the integrated were achieved by applying combined organic fertilizer levels and 45 kg N fed^{-1}. The treatments were as follows:

- 45 kg N fed^{-1} (control).
- 60 kg N fed^{-1}.
- Compost 6 ton fed^{-1}.
- Compost 12 ton fed^{-1}.
- FYM 6 ton fed^{-1}.
- FYM 12 ton fed^{-1}.
- Compost 6 ton fed^{-1} + 45 kg N fed^{-1}.
- Compost 12 ton fed^{-1} + 45 kg N fed^{-1}.
- FYM 6 ton fed^{-1} + 45 kg N fed^{-1}.
- FYM 12 ton fed^{-1} + 45 kg N fed^{-1}.

Organic fertilizers were added during preparing the soil for sowing. Nitrogen fertilizer was added in form of ammonium sulphate (20.6 % N) while phosphorus (31 Kg P_2O_5) was added in form of calcium super phosphate (15.5% P_2O_5) and potassium (37.5 Kg) in form of potassium sulphate (48% K_2O). The plants were Agricultural practices for cowpea production were followed according to the recommendation of Ministry of Agricultural and Land Reclamation.

The soil at Nubaria was sandy in texture (87% sand, 9% clay and 4% silt) with (pH 7.87; EC 0.22 dsm^{-1}; OM 0.73%; 5.2% CaCO3; total N 1256 ppm; total P 26 ppm; total K 864 ppm; total Fe 3684 ppm; total Mn 95.4 ppm; total Zn 18.7 ppm and total Cu 9.8 ppm). The chemical analysis of dried and ground samples organic manures applied to the field trials is reported in

Table 1: Chemical analyses of organic fertilizers applied to cowpea (Units: ds, VS, N, P, K and Fe as %; other elements as mg kg^{-1})

Organic fertilizer	OM (% ds)	pH	Total content (% ds) N	P	K	Fe	Total content (mg kg^{-1} ds) Mn	Zn	Cu
Compost	22.3	7.5	1.50	0.14	0.17	1.69	164	473	2.42
FYM	33.8	8.5	1.89	0.10	0.52	0.18	57	193	5.01

Table (1). The total N and K content of farmyard manure was greater than compost by 32 and 305%, respectively, while compost supplied greater (40%) amounts of total P in the dry solids.

The experimental design in the trial was complete randomized block design with 4 replications. Cowpea Karim-7 cultivar was sown in hills 15 cm apart on June 28th and 4th June in 2017 and 2018, respectively. The experimental united area was 12 m^2 consist of 3 ridges each (5 m length and 0.8 m width).

After 75 days from sowing the green pods were collected from three ridges allocated to determine the green yield of pods. After100 days from sowing dry seed harvest was done and 10 plants were taken randomly to determine No. of pods plant^{-1}, pod weight^{-1}, seed yield plant^{-1}, 100-seeds weight and the plants in the three ridges of each plot were collected, threshed and cleaned then seed yield plot^{-1} and per feddan was determined straw and biological yields.

To define the optimum dressings of compost and FYM for cowpea a model used to describe the crop yield take the numerical form equation according to [21, 22] as follows:

linear model: $y = a + b_1x$

where (y) is the measured yield variable (units: ton fed^{-1} or kg fed^{-1}); (b_1) is the regression coefficient representing the linear gradient (or slope) of the incremental yield response to increasing application rate; (x) is the fertilizer or manure (units: kg fed^{-1}, ton fed^{-1}); and (a)is a constant value (intercept) representing the yield obtained without fertilizer or manure.

The N fertilizer equivalency is calculated by dividing the regression coefficient for the manure, on the basis of its rate of total N application, with the coefficient obtained for the yield response to applied mineral N.

$$N\ equivalency\ (\%) = \frac{1/b(y-a)}{N} x100$$

where a is the regression intercept value, b is the regression coefficient, y is the mean root yield recorded for the plots supplied with compost or FYM at a rate of 6 ton fed^{-1} and N is the rate of N application at 6 ton fed^{-1} of farm yard manure or compost.

Five plants and green pods were taken for each treatment, the whole plant and the dry seeds were analysed to determine macro and micronutrient concentrations in cowpea parts. Since the number of samples was large, the samples of the two seasons were pooled.A composite sample of the two seasons of each treatment with four replicates were taken and homogenisedthen digestion took place.

Nitrogen was determined by micro-Kjeldahl according to [23]. After wet digestion of the samples according to [24], P was determined by spectrophotometry, K by flame photometer [25] and Fe, Mn, Cu and Zn were determined by atomic absorption spectrophotometry.

Statistical Analysis: The analysis of variance of complete randomized block design (CRBD) with 4 replications was carried out using Computer Software MSTAT-C [26]. Means of the different treatments were compared using the least significant difference (LSD) test at $P<0.05$.

RESULTS AND DISCUSSION

Green Pod Yield Characteristics: Significant effects of the treatments were observed for number of green pods plant^{-1}, mean fresh weight pod^{-1} and green pod yield plant^{-1} of 2017 and 2018 seasons in Table (2). The addition of fertilizers increased yields over the untreated control, although there were no consistent significant differences between the rates of application. It is clear also from the results that reversal relationship between mean number of green pods and weight. Significant differences among fertilizer types and rates on green pod yield plant^{-1} and the integrated application of both inorganic and organic fertilizer surpassed either inorganic or organic levels application especially at 6 and 12 ton fed^{-1} (Fig. 1). Furthermore, integrated application of both inorganic and organic fertilizers at 6 and 12 ton fed^{-1} increased significantly yields although 12 ton fed^{-1} did not provide additional yield benefit (Table 2). The addition of fertilizer to compost and FYM at 6 ton fed^{-1} increased yields further, albeit such increase was not significant, but at the highest rate of manure application, there were decreases in yield with the fertilizer addition.

Table 2: Green pod yield characteristic of cowpea in response to organic and inorganic fertilizers

Treatment	No. of green pods plant^{-1}		Fresh weight of pod		Green pod yield plant^{-1} (g)	
	2017	2018	2017	2018	2017	2018
45 kg N fed^{-1} (control)	25.61	33.3	2.49	3.2	49.03	63.7
60 kg N fed^{-1}	20.8	27.0	3.37	4.4	53.86	70.0
Compost 6 ton fed^{-1}	23.01	29.9	3.83	5.0	67.84	88.2
Compost 12 ton fed^{-1}	29.9	38.9	3.58	4.7	82.29	107.0
FYM 6 ton fed^{-1}	35.1	45.6	2.41	3.1	65.22	84.5
FYM 12 ton fed^{-1}	24.7	32.1	3.87	5.0	73.54	95.6
Compost 6 ton fed^{-1} + 45 kg N fed^{-1}	36.79	47.8	2.89	3.8	81.89	106.5
Compost 12 ton fed^{-1} + 45 kg N fed^{-1}	20.8	27.0	4.19	5.4	67.10	87.2
FYM 6 ton fed^{-1} + 45 kg N fed^{-1}	23.4	30.4	4.35	5.7	78.24	101.7
FYM 12 ton fed^{-1} + 45 kg N fed^{-1}	33.41	43.4	2.37	3.1	60.99	79.3
LSD at 0.05	5.58	7.3	0.67	0.9	6.22	8.1

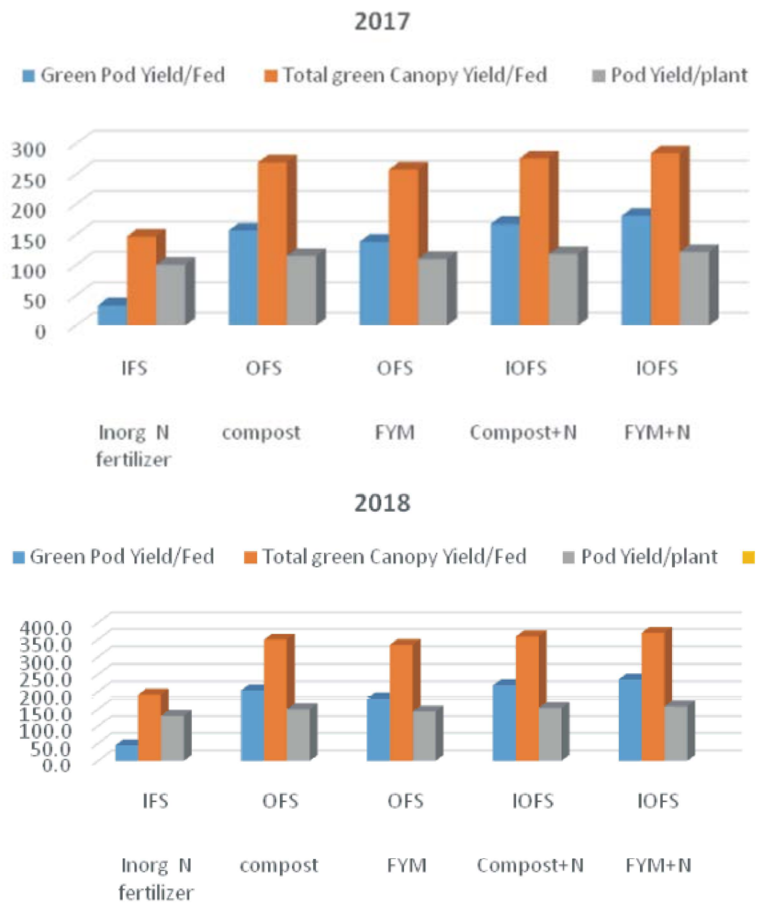

Fig. 1: Effect of inorganic, organic and integrated fertilization on relative yields green

Data illustrated in Fig. (1) indicate clearly consistent attitude due to organic farming system applied regardless treatment rates in 2017 and 2018 on its effect on green pod yield plant^{-1} and fed^{-1}. The relative yields regardless the fertilizer levels applied compared to the control treatment could be arranged in the following order for the three characters above mentioned: IOFS > OFS > IFS in both seasons of study. These results reflect the fact that the yields from the organic manure treatments were generally much greater than from fertilizer on its own, indicates that the manures are satisfying other growth factors, presumably related to organic matter and trace elements.

In other words, even organic farming system applied the green pods yields per plant and per feddan could surpass the traditional inorganic farming system adopted.

The obtained results are in accordance with those obtained by [20, 27] revealed that all the organic manure treatments recorded better growth and yield compared to the control treatment. The obtained results are in good accordance with those recorded by other investigators [28, 29, 30].

Abd El Lateef *et al*. [31] and [32] reported that K excreted in the wastes of domestic livestock is largely retained in the bedding material that forms the main bulk matrix of FYM. Consequently, FYM is relatively rich source of K compared with compost where the FYM was applied it contained more than three times the amount of K (0.51% ds) compared with the compost (0.17% ds). Ahn [33] reported that organic manures supplies most of the nitrogen, sulphur and half phosphorus needed by unfertilized crops. The regular addition of organic amendments to soil is very important in the developing world of the tropics, where most traditional farming systems are not sustainable while, Abd El-Lateef *et al*. [34] pointed out to the substantial amounts applied to field crops through organic manuring.

Seed Yield Characteristics: Data presented in Table (3) show that significant effects of the treatments were observed on cowpea as dry seeds crop *i.e.,* dry weight plant^{-1}, mean dry weight pod^{-1}, seed yield plant^{-1}, 100-seeds weight, seed and biological yields fed^{-1}. Data in the same table show significant differences among fertilizer treatments in mean pod dry weight and seed yield plant^{-1}. Generally, it is clear that either organic or integrated fertilizer treatment were better than the inorganic fertilizers in seed yield plant^{-1}. 100-seeds weight was significantly greater than control in both seasons. From the same table the addition of N fertilizer increased yields, although there were no significant differences between the rates of application. Compost and FYM applied at 6 and 12 ton fed^{-1} yields were significantly increased, although 12 ton fed^{-1} provided no additional yield benefit. The addition of fertilizer to compost and FYM at 6 ton fed^{-1} increased yields further, albeit not significantly, but at the highest rate of manure application, there were decreases in yield with the fertilizer addition. The highest seed yield fed^{-1} in both seasons resulted from the IOFS when 45 kg N fed^{-1} was combined with 12 ton fed^{-1}compost or FYM.

Meanwhile, the results indicate that the integrated addition of inorganic fertilizer with compost or FYM applied at 6 ton fed^{-1} achieve maximum yields in both seasons, (Fig. 2). The fact that the yields from the manure treatments were generally much greater than from fertilizer on its own indicates that the manures are satisfying other growth factors, presumably related to organic matter and trace elements.

Similar results with other crops were reported by [28] who reported that poultry manure applied at the rate of 4 ton ha^{-1} was comparatively better in contributing to the formation of pods in cowpea, promoting height of cowpea plants, seed yield and might be applicable to other grain legumes. Also, Ranganathan and Selvaseelan [30] found that application of spent mushroom and rice straw compost though comparable with FYM increased rice grain yields by 20 per cent over NPK fertilizer. Singh *et al*. [35] reported that the application of 7.5 ton FYM ha^{-1} produced significantly more grain and straw yields over unfertilized fields. All of the yield attributing characters of rice increased with increasing rates of FYM. Organic farming with dhaincha (*Sesbania aculeata* L.) made considerable improvement in grain yield of rice [36].

Fertilizer Replacement Value: The comparison of regression coefficients (Table 4) suggested N equivalency of 32 % for compost and 69% to FYM relative to inorganic N. However, the data suggest that yield may be increased further by N supplied in compost compared with conventional inorganic. This may be explained because, in addition to N, other physico-chemical attributes of the compost may beneficially ameliorate desert soils for crop production, thus maximizing the potential utilization of resources applied to the soil in the composted product. The estimates of nitrogen fertilizer replacement value for cowpea range from 10 kg N ha^{-1} to 60 kg N ha^{-1} [37]. Moreover, part of the nitrogen requirement of cereal crops can be satisfied by cowpea crop rotation.

Cowpea Nutrient Uptake

Nutrient Uptake by Cowpea Canopy: Data presented in Table (5) and Fig. (3) show significant differences among fertilizer treatments in N, P, K, Fe and Cu by cowpea canopy. The greatest N uptake was recorded by organic application of 6 ton fed^{-1} and the integrated application of organic FYM plus N fertilizer IOFS while inorganic application of 45 kg N fed^{-1} achieved the highest P and K in cowpea green canopy. It is clear from Fig. (3) that organic farming treatments OFS resulted the highest N uptake compared with the inorganic or integrated organic and inorganic applications.

Table 3: Effect of inorganic, organic and integrated fertilization on cowpea seed yield characteristics

Treatment	Dry pod weight (g)		Dry seed yield plant^{-1} (g)		100 seeds weight (g)		Seed yield fed^{-1} (kg)		Biological yield fed^{-1} (ton)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
45 kg N fed^{-1} (control)	0.43	0.56	8.5	11.1	10.3	13.4	596.3	775.2	2.6	3.37
60 kg N fed^{-1}	0.51	0.66	8.1	10.5	10.6	13.7	565.5	735.2	2.4	3.15
Compost 6 ton fed^{-1}	0.58	0.75	10.2	13.2	9.3	12.1	712.4	926.1	2.4	3.07
Compost 12 ton fed^{-1}	0.54	0.70	12.3	16.0	10.2	13.3	864.1	1123.3	3.3	4.29
FYM 6 ton fed^{-1}	0.36	0.47	9.8	12.7	9.7	12.6	682.5	887.3	3.6	4.67
FYM 12 ton fed^{-1}	0.58	0.76	11.0	14.3	11.4	14.8	772.2	1003.9	3.0	3.86
Compost 6 ton fed^{-1} + 45 kg N fed^{-1}	0.43	0.56	12.3	16.0	10.6	13.8	859.7	1117.6	3.2	4.11
Compost 12 ton fed^{-1} + 45 kg N fed^{-1}	0.63	0.82	10.1	13.1	10.8	14.0	704.6	915.9	3.3	4.25
FYM 6 ton fed^{-1} + 45 kg N fed^{-1}	0.65	0.85	11.7	15.3	11.1	14.4	821.6	1068.1	3.5	4.54
FYM 12 ton fed^{-1} + 45 kg N fed^{-1}	0.36	0.46	9.1	11.9	11.6	15.1	639.6	831.5	2.9	3.76
LSD at 0.05	0.14	0.16	0.12	3.2	2.5	0.9	63.0	199.0	0.7	1.27

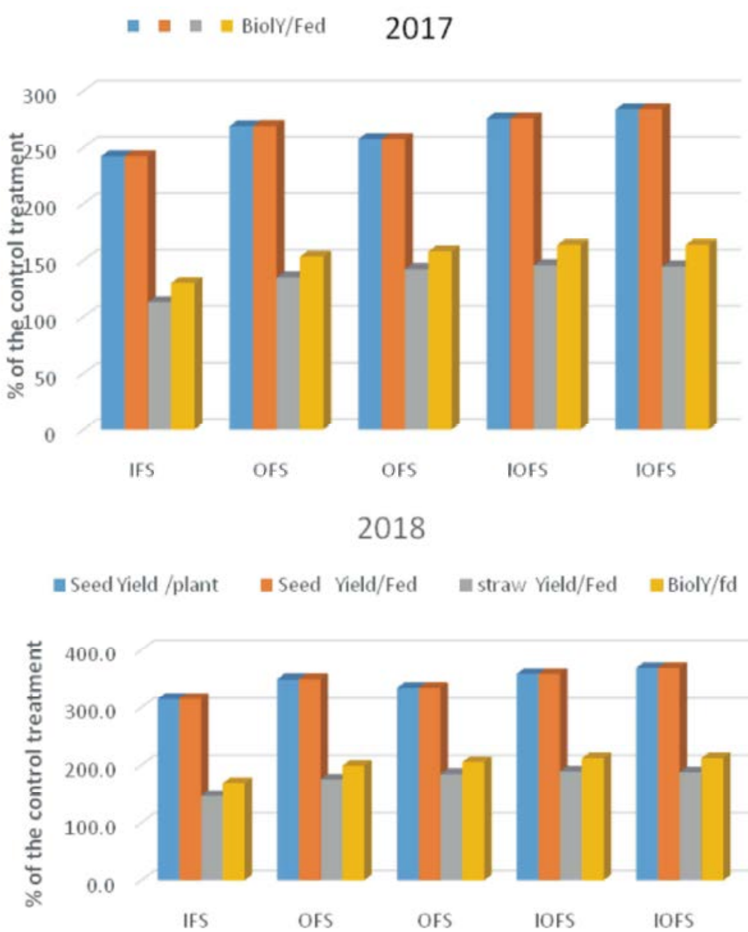

Fig. 2: Effect of inorganic, organic and integrated fertilization on relative yields of dry seed cowpea characteristics

Table 4: Nitrogen equivalency of organic manures applied to cowpea in reclaimed desert soil

Organic manure	Compost	FYM
Regression coefficient for compost N (a)	2.86	6.14
Regression coefficient for inorganic N (b)	8.87	8.90
% N efficiency (a/b*100)	32	69

Table 5: Nutrient uptake of cowpea green canopy (Units: Macronutrients as kg fed^{-1}, other elements g fed^{-1})

Treatment	N	P	K	Fe	Mn	Zn	Cu
45 kg N fed^{-1} (control)	23.5	19.3	3.51	1712.4	479.1	393.4	71.6
60 kg N fed^{-1}	34.8	10.7	1.40	1726.5	672.8	206.9	27.1
Compost 6 ton fed^{-1}	32.7	14.3	1.91	1600.2	796.4	348.3	46.5
Compost 12 ton fed^{-1}	23.7	15.0	2.67	2416.4	700.1	443.1	78.9
FYM 6 ton fed^{-1}	39.7	12.3	1.88	1591.3	926.3	287.0	43.9
FYM 12 ton fed^{-1}	35.2	15.2	3.02	2159.5	929.3	401.3	79.7
Compost 6 ton fed^{-1} + 45 kg N fed^{-1}	29.8	15.8	2.68	2316.1	875.9	464.4	78.8
Compost 12 ton fed^{-1} + 45 kg N fed^{-1}	57.3	14.5	1.12	1614.0	1380.3	349.3	27.0
FYM 6 ton fed^{-1} + 45 kg N fed^{-1}	31.2	15.8	1.18	2140.4	876.4	443.8	33.1
FYM 12 ton fed^{-1} + 45 kg N fed^{-1}	54.7	19.2	2.18	2156.8	1197.7	420.4	47.7
LSD at 0.05	11.1	0.6	0.47	180	ns	ns	25.3

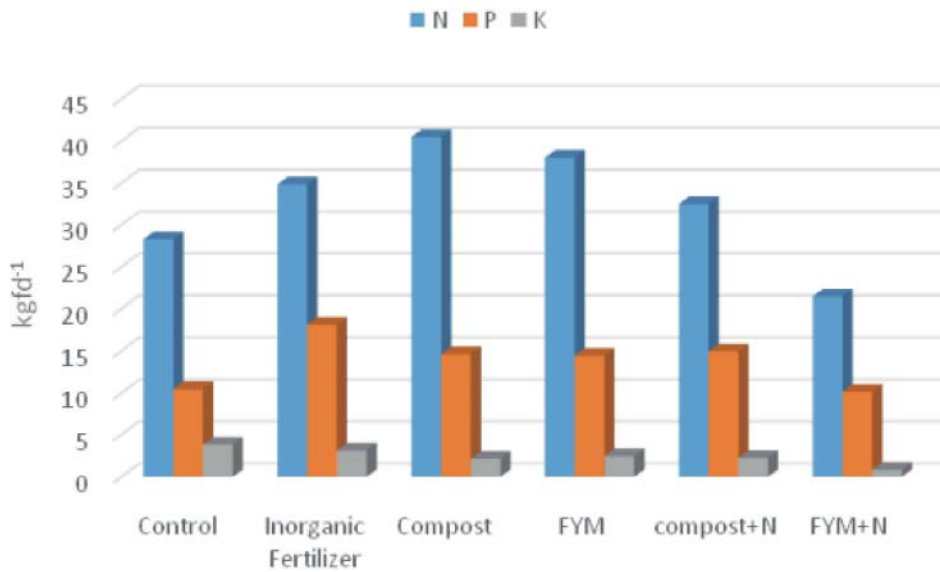

Fig. 3: Effect of organic and inorganic fertilizer treatment on macronutrient uptake by cowpeagreen canopy

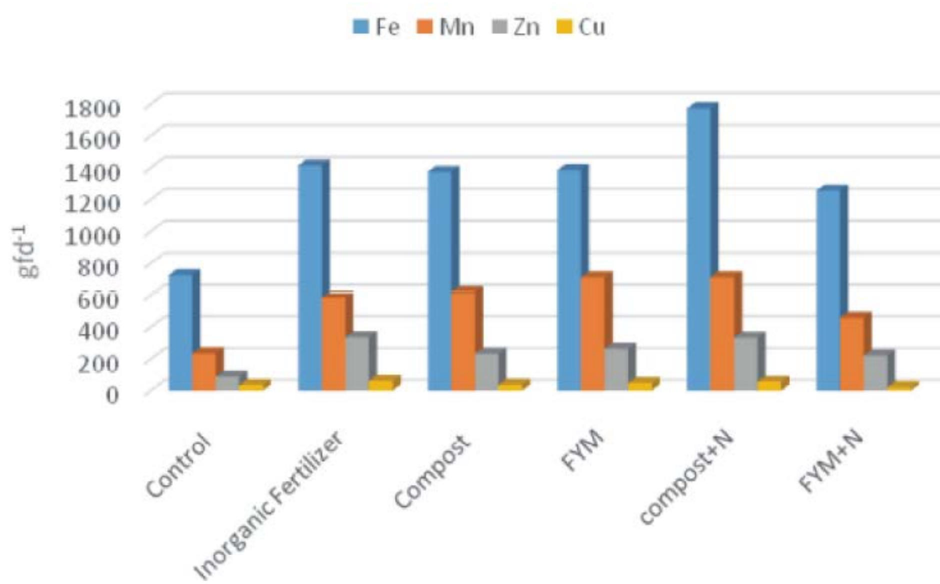

Fig. 4: Effect of organic and inorganic fertilizer treatment on micronutrient uptake by cowpea green canopy

Table 6: Uptake of green pods (Units: Macronutrients as kg fed^{-1}, other elements g fed^{-1})

Treatment	N	P	K	Fe	Mn	Zn	Cu
45 kg N fed^{-1} (control)	9.45	0.92	3.54	221.8	62.0	51.0	9.3
60 kg N fed^{-1}	10.35	0.73	3.71	259.0	100.9	31.0	4.1
Compost 6 ton fed^{-1}	12.60	1.24	4.68	240.0	119.5	52.2	7.0
Compost 12 ton fed^{-1}	17.55	1.64	8.11	362.5	105.0	66.5	11.8
FYM 6 ton fed^{-1}	11.69	1.54	4.83	238.7	139.0	43.1	6.6
FYM 12 ton fed^{-1}	13.94	1.47	4.32	323.9	139.4	60.2	12.0
Compost 6 ton fed^{-1} + 45 kg N fed^{-1}	14.77	1.28	5.69	347.4	131.4	69.7	11.8
Compost 12 ton fed^{-1} + 45 kg N fed^{-1}	15.07	1.05	5.38	242.1	207.0	52.4	4.0
FYM 6 ton fed^{-1} + 45 kg N fed^{-1}	16.18	1.31	6.36	321.1	131.5	66.6	5.0
FYM 12 ton fed^{-1} + 45 kg N fed^{-1}	12.38	1.60	4.93	323.5	179.7	63.1	7.2
LSD at 0.05	0.73	0.55	0.86	ns	33.9	ns	ns

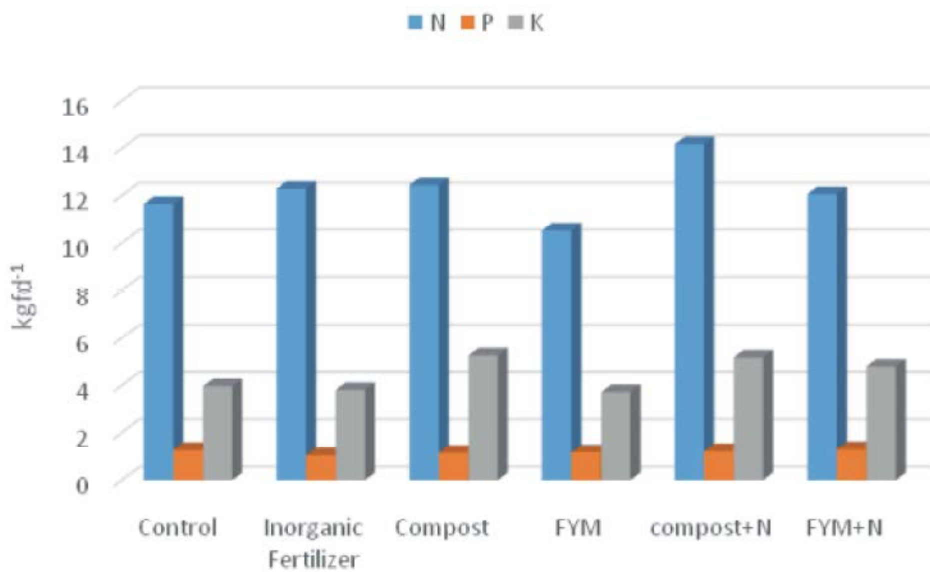

Fig. 5: Effect of organic and inorganic fertilizer treatment on macronutrient uptake by cowpea green pods

According to micronutrients in green canopy data in Table (5) and Fig. (3) show no significant differences among fertilizer treatments in Mn and Zn. On the other hand, Fe and Cu recorded the highest values with Compost 12 ton fed^{-1} treatment in the two seasons.

Green Pods: Data presented in Table (6), show significant differences among fertilizer treatments on green pods of cowpea uptake of N, P, K and Mn. Fig. (5) show that organic fertilizers compost or FYM as well as the integrated application of compost and inorganic N fertilizer were superior in NPK uptake regardless the rate of application. From the same table the data show that organic application of compost at 12 ton fed^{-1} reported the best treatments in NPK uptake by green pods. Similar attitude was reported by Compost 6 ton fed^{-1} + 45 kg N fed^{-1} treatment for the uptake of Zn. Generally the data in Fig. (6) show clearly that integrated application and organic applications of compost or FYM surpassed inorganic application in micronutrient uptake by green pods regardless the rate of application.

Dry Seeds Uptake: Data presented in Table (7) show that the greatest uptake of P and K due to organic fertilizer occurred when the plants were treated with compost at 12 ton fed^{-1} as well as integrated application of FYM at 6 ton fed^{-1} plus the N. Mn uptake by cowpea plants reached their maximum values when the plants were either fertilized with compost organic application of 12 ton fed^{-1}. The greatest uptake of Zn due to organic fertilizer occurred when the plants were treated with organic or integrated compost application at 12 ton fed^{-1}. Whereas the greatest Cu uptake due to organic fertilizer occurred when the plants were treated with compost at 6 ton fed^{-1}.

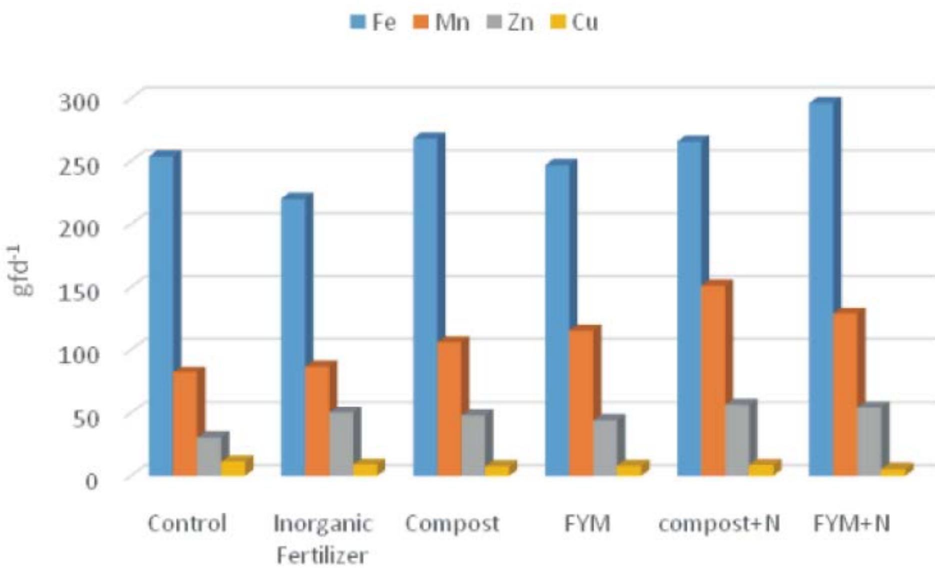

Fig. 6: Effect of organic and inorganic fertilizer treatment on micronutrient uptake by cowpea green pods

Table 7: Dry seeds uptake kg fed^{-1} (Units: Macronutrients as kg fed^{-1}, other elements g fed^{-1})

Treatment	N	P	K	Fe	Mn	Zn	Cu
45 kg N fed^{-1} (control)	17.2	1.5	3.2	19.7	2.3	7.0	1.9
60 kg N fed^{-1}	18.6	1.8	2.9	26.2	2.0	8.8	1.4
Compost 6 ton fed^{-1}	25.9	2.8	3.8	34.1	1.6	11.9	1.7
Compost 12 ton fed^{-1}	28.0	2.9	4.3	33.3	3.4	15.3	3.2
FYM 6 ton fed^{-1}	20.7	2.0	3.2	27.7	2.2	12.3	2.0
FYM 12 ton fed^{-1}	23.8	2.0	3.2	21.6	2.2	13.5	2.7
Compost 6 ton fed^{-1} + 45 kg N fed^{-1}	27.7	3.0	4.9	30.9	2.0	12.1	2.9
Compost 12 ton fed^{-1} + 45 kg N fed^{-1}	23.6	2.1	4.0	28.3	2.2	16.3	2.4
FYM 6 ton fed^{-1} + 45 kg N fed^{-1}	25.4	2.4	3.3	20.0	2.1	11.7	2.5
FYM 12 ton fed^{-1} + 45 kg N fed^{-1}	21.1	1.9	2.7	15.6	1.8	9.6	2.1
LSD at 0.05	2.73	0.55	0.86	2.83	0.77	0.41	0.96

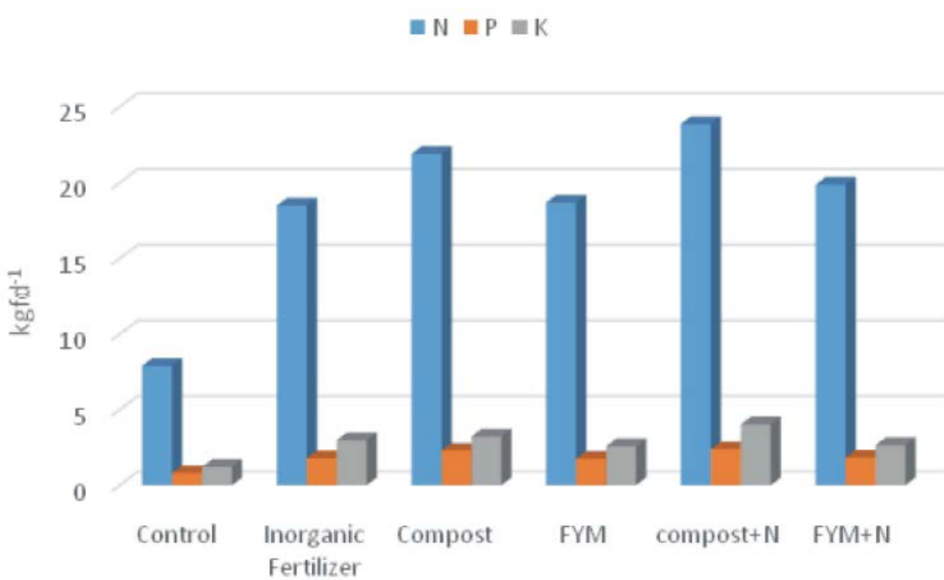

Fig. 7: Effect of organic and inorganic fertilizer treatment on macronutrient uptake by cowpea seeds

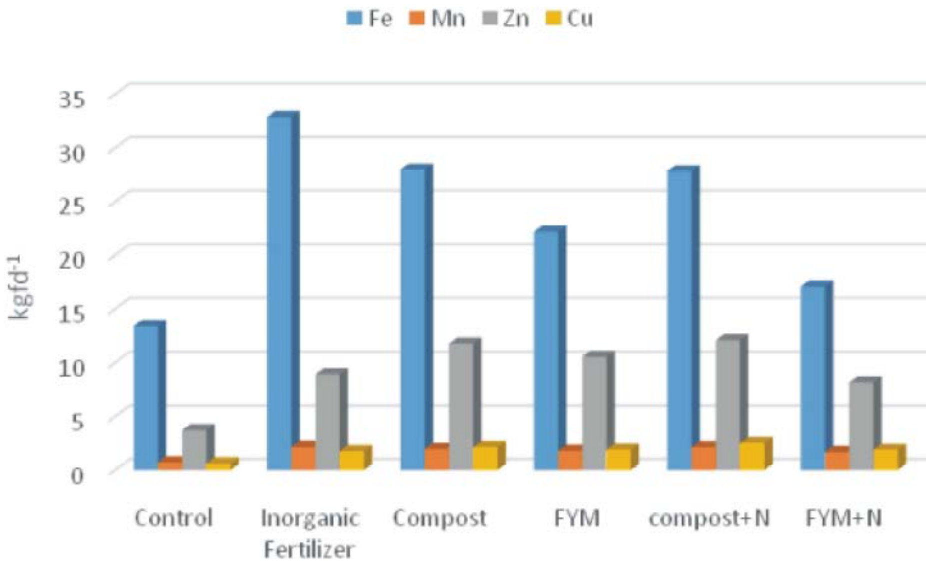

Fig. 8: Effect of organic and inorganic fertilizer treatment on micronutrient uptake by cowpea seeds

Data in Fig. (7) show that organic or integrated compost FYM application surpassed the traditional treatment application (inorganic N) in macronutrient uptake by cow pea seeds. Concerning the micronutrient uptake, data in Fig. (8) reveal a reversal magnitude for Fe uptake where the inorganic N treatment reported the highest Fe uptake content. However, other micronutrients Mn, Zn and Cu were greater in seeds by organic and integrated application fertilizers regardless treatment rates.

Similar results on cow pea uptake were obtained by Abd El-Lateef *et al.* [38] they reported substantial amounts of macro and micro nutrients removed by seeds. Similarly, nutrient-use efficiencies and production efficiency followed the trend of nutrient uptake. Waters and Sankaran [39] explained the greater uptake of nutrients than green pods that during the senescence stage of development, remobilization (*i.e*., net export of stored or recycled nutrients) of some nutrients occurs from vegetative tissues, such as leaves and stems. At the end of growing seasons, mass senescence typically occurs in leaves and other tissues. These remobilized nutrients are most likely moved to developing seeds in annual crop species, providing that the senescence and seed import are synchronized to provide source-sink relationships. While it is well established that remobilized N is a major source of seed protein components for wheat and barley [40-42] data for other mineral elements is less abundant, although older studies demonstrated remobilization of Cu, Fe and Zn in legumes [43, 44] and wheat [45-47] and some newer studies have found similar results [48, 39]. Singh *et al.* [49] and [37] observed significant enhancement in uptake of iron, zinc and manganese in the rice grain due to application of different organic source of nutrients.

It has been demonstrated that organically produced foods have lower levels of pesticides and medicinal and hormonal residues and in many cases lower nitrate contents. Thus, organic farming offers an opportunity to achieve the twin objectives of nutritional security and environmental sustainability. A steady increase in positive balance of Zn, Cu, Fe and Mn was recorded in organic significant positive co-relation between organic matter and micronutrient availability. Finally, Abd El Lateef *et al*. [38] reported thatthe optimum agronomic rate of addition of farmyard manure was 10 m^3 fed^{-1} (6 ton ds fed^{-1} or 14.2 ton ds ha^{-1}). In addition to supplying plant available N, organic manures and FYM provide other growth factors (trace elements and K) which increase the yield response of cowpea over that which can be achieved with N fertilizer alone.

Organic matter supplied to reclaimed desert soils in organic manures and FYM may improve the soil environment for root growth and development and increase soil water holding capacity. The patterns of N release for crop uptake from organic manures and FYM may be better synchronized with crop requirements for N compared with soluble inorganic fertilizer application reducing the potential leaching losses of N in drainage. The chemical composition of cowpea seeds produced on compost-treated reclaimed desert soil was comparable to with that with inorganic fertilizers and FYM.

From the obtained results the data of cowpea uptake indicate that the application of FYM consistently increased the K status of cowpea relative to the compost, inorganic N and control when high quality material was supplied. FYM is clearly a valuable source of this major plant nutrient in Egyptian agriculture. Whilst compost is an effective fertilizer replacement for N and P, it tends to be lacking in K, but this does not restrict yield performance in the short-term. However, the efficiency of N and P utilization from compost for crop production would be improved by balancing inputs of these nutrients in compost with FYM, to provide a supplementary source of K in the crop rotation. Nevertheless, compost is likely to be a more consistent and predictable fertilizer material than FYM, which is potentially of highly variable quality and is often in short supply.

CONCLUSION

Generally, it is clear that either organic or integrated fertilizer treatment were better than the inorganic fertilizers in seed yield plant^{-1}.Organic farming treatments resulted the highest N uptake compared with the inorganic or integrated organic applications. Using different organic farming systems: inorganic fertilizer, organic fertilizer and integrated (inorganic + organic) fertilizer application on cowpea (*Vigna ungiculata* L. Walp) green pods and dry seed yields could be arranged in the following order: integrated > organic > inorganic regardless the rate of application.

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