THE RESIDUAL EFFECT OF ORGANIC MANURES WITH OR WITHOUT BIO-FERTILIZER APPLIED TO WHEAT GROWN ON SANDY, CALCAREOUS AND CLAY SOILS, ON GROWTH AND NPK- UPTAKE OF ROCKET PLANTS

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Abstract

A pot experiment was conducted at the Plant Nutrition Research greenhouse, soils, water and Environment Research Institute Giza, Egypt, to study the residual effect of farmyard manure (FYM) and chicken manure (CM) each alone or both together combined with or without biofertilizer (BF), as a mixture of nitrogen fixing (*Azospirillum brasilense*) and phosphate dissolving bacteria (*Bacillus megatherium phosphaticum*) previously applied to wheat grown on sandy, calcareous and clay soils on the growth and NPK- uptake of the following rocket plants. Results revealed that all manure treatments whether combined with or without biofertilizer significantly increased the rocket dry weight in sandy and clay soils in comparison with the control treatment, the same trend was true in the calcareous soil only with CM 100%, CM 100% + BF and FYM 25 % + CM 75 % treatments. The response of the rocket plants to organic manure treatments was more pronounced in sandy and clay soils than that of calcareous one. Association of biofertilizer with the organic manures caused insignificant or significant changes in rocket plants dry weight. Although values of N, P and K uptake by rocket plants were higher in the clay soil, yet the response to organic manures was more obvious in the sandy and calcareous soils.

Key words: Organic manures – biofertilizer- rocket.

INTRODUCTION

Arid soils such as soils of Egypt are usually deficient in organic matter, nitrogen and micronutrients. Also, intensive use of agrochemicals in agriculture including fertilizers can lead to increase pollution in soil, water and food. The progressive rise in the cost of these fertilizers and their relative low efficiency, particularly in the developing countries such as Egypt, gives an account for finding out a partial and/or full substitution for the usual classic applied chemical fertilizers. Organic fertilizers and/or biofertilizers are potential substitutes for such chemical fertilizers. They are

environmentally safe and appropriately effective (El-Kholy, 1998). Moreover, many researchers found organic manures to be sources of many nutritive elements especially nitrogen (Neal and Posito, 1986, Williams *et al.,* 1987, Francis *et al.,* 1993 and El-Sayed, 1995).

In experiments, under both field and greenhouse conditions, Sharma and Mittra (1990) found that bio- and mineral fertilizers in rice based cropping system achieved a marked improvement in residual soil fertility, as estimated by organic carbon and available N, P and K contents, with organic matter application after crop harvest, which increased grain yield of wheat and rice grown during the subsequent seasons. Keshta and EL-Kholy (1999) found that farmyard manure applied to a clay soil, as organic manure to fertilize sunflower crop, increased the soil organic matter percentage, available N and P after sunflower harvesting.

The present work is performed to evaluate the residual effect of both farmyard manure and chicken manure with or without biofertilizer (*Azospirillum brasilense* +*Bacillus megatherium*) previously applied to wheat plant on growth and NPK-uptake by rocket plants .

MATERIALS AND METHODS

A Complete randomized design (Gomez and Gomez 1984) pot experiment was conducted at the Plant Nutrition Research greenhouse, soils, water and Environment Research Institute, Giza, Egypt, during February 2003, to study the residual effect of both farmyard manure and chicken manure with or without biofertilizer , previously applied to wheat plants grown on sandy, calcareous and clay soils, on growth and NPK- uptake by rocket plants. The pots (Each 18 cm in diameter and containing 5 kg soil) after cutting the wheat plants were planted with 11 seeds of rocket var. Balady (without addition of any fertilizers) and then watered to reach 55% of the soil saturation percent (the field capacity) . One week later, the germinated rocket seedlings were thinned to 7 plants per pot . After forty-five days, the grown rocket plants were cut just above soil, oven dried at 70° C to evaluate dry weight of the plant samples. The dried plants were ground and acid digested to estimate their contents of N (Chapman and Pratt, 1961), P (Olsen *et al.,* 1954) and K (Jackson, 1976). The previous wheat experiment comprised the following treatments in triplicates.

1-Control.

2-Control + (*Azospirillum brasilense* + *Bacillus megatherium phosphaticum*)

[Biofertilizer (BF)*]

3-Farmyard manure at a rate equivalent to 100 kg N fed^{-1} (FYM 100%)

4-FYM 100% + BF

5-Chicken manure at a rate equivalent to 100 kg N fed^{-1} (CM 100 %)

6-CM 100% + BF

7- Farmyard manure at a rate equivalent to 25 kg N fed^{-1} (FYM 25%) + Chicken manure at a rate equivalent to 75 kg N fed^{-1} (CM 75%)

8-FYM 25% + CM 75% + BF

9- Farmyard manure at a rate equivalent to 50 kg N fed^{-1} (FYM 50%) + Chicken manure at a rate equivalent to 50 kg N fed^{-1} (CM 50%)

10-FYM 50% + CM 50% + BF

11- Farmyard manure at a rate equivalent to 75 kg N fed^{-1} (FYM 75%) + Chicken manure at a rate equivalent to 25 kg N fed^{-1} (CM 25%)

12-FYM 75% +CM 25% + BF

* The method of biofertilizer inoculation of the previous wheat experiment was performed by spreading wheat seeds immediately before cultivation on a plastic sheet and thoroughly mixed with the biofertilizer inoculum which allowed to adhere to the seeds when rinsed with liquid Arabic gum and then air dried for two hours.

RESULTS AND DISCUSSION

Data in Table 1 indicate that the residual effect of organic manures combined with biofertilizer inoculation had resulted in a negative effect on the mean values of dry matter content of rocket plants. For instance, application of FYM 100 % with biofertilizer insignificantly decreased the mean values of the dry matter from 7.58 to 7.11 g pot^{-1}, while using of CM 100 % with biofertilizer significantly reduced the mean dry weight from 8.99 to 7.77 g pot^{-1}.

Concerning the effect soil type on the dry matter content of grown rocket plants, the clay soil gave the highest mean dry matter value (12.86 g pot^{-1}) in comparison with both the sandy and calcareous ones that gave 4.66 and 4.56 g pot^{-1}, respectively, the differences being significant.

Table 1. The residual effect of organic manures and biofertilizer on dry matter of rocket plants (g pot^{-1}), in different soils types.

Treatments	Soil type			Mean
	Sandy	Calcareous	Clay	
Control	2.41	3.18	10.59	5.39
Control + BF	1.03	3.12	11.43	5.19
FYM 100%	5.51	4.17	13.06	7.58
FYM 100% + BF	3.67	4.60	13.07	7.11
CM 100%	6.13	4.91	15.92	8.99
CM 100% + BF	5.17	5.96	12.17	7.77
FYM 25% + CM 75%	6.44	6.02	12.42	8.29
FYM 25% + CM 75% + BF	4.63	4.66	12.68	7.32
FYM 50% + CM 50%	6.16	4.61	12.40	7.72
FYM 50% + CM 50% + BF	4.34	4.52	13.71	7.52
FYM 75% + CM 25%	5.34	4.56	13.21	7.70
FYM 75% + CM 25% + BF	5.05	4.35	13.66	7.69
Mean	4.66	4.56	12.86	7.36

L.S.D. (P 0.05)

Soil (S)	0.45
Treatment (T)	0.89
Sx T	1.55

In the sandy soil, the residual organic manure treatments increased significantly the values of dry matter over either the control or control + BF treatments. The highest residual effect on the dry matter (6.44 g pot^{-1}) was due to FYM 25 % + CM 75 % treatment. This value was significantly higher than those recorded from the other manure treatments except the CM 100 % and FYM 50 % + CM 50 % treatments (Table 1). It was also observed that biofertilizer applied to wheat plants with organic manures did not encourage the growth of rocket plants. This trend may be attributed to that the inoculated microbes tended to immobilize the available nutrients in soil during their growth which in turn led to decrease the dry matter of rocket plants (Keshta and EL- Kholy, 1999).

In the calcareous soil, the organic manure effect due to FYM 25 % + CM 75 % treatment recorded the highest dry matter (6.02 g pot^{-1}) which was significantly different from those attained by the residual effect of the treatments FYM 100 %, FYM 50 % + CM 50 % +BF and FYM 75 % + CM 25 % which their dry matter weight values were 4.17, 4.52 and 4.35 g pot^{-1}, respectively. The residual effects of the other treatments did not significantly differ from the highest one. Application of organic manures with biofertilizer did not exhibit a residual effect on the rocket plant dry matter weights. On the other hand, the residual effect of organic manures, applied to wheat plants in combination with biofertilizer, led to insignificant decreases or increases in dry matter content of rocket plant compared to same treatments with organic manures only. For instance, the dry matter insignificantly increased from 4.17 g pot^{-1} (FYM 100 %) to 4.60 g pot^{-1} (FYM 100 % +BF), while it decreased insignificantly from 4.56 g pot^{-1} (FYM 75 % + CM 25 %) to 4.35 g pot^{-1} (FYM 75 % + CM 25 % + BF). This behavior may due to the residual effect of organic manures but not for biofertilizer inoculum which might decrease in population number to be not enough to fix nitrogen or to release phosphorus to encourage rocket plants growth (EL-Kholy, 1998).

In the clay soil, it could be noticed that the residual effect of organic manures on the rocket dry matter recorded higher values than the corresponding ones achieved in both sandy and calcareous soils (Table 1). The residual effect of all the manure treatments significantly increased rocket dry matter over those of the control or the control + BF treatments. The treatment of CM 100% exhibited superior residual manures effect on the rocket dry matter and recorded 15.92 g pot^{-1}. This residual

effect being significantly higher than those resulted due to the other residual manure treatments.

Dahroug and Gendy (1993) showed that when soybean cultivated in a sandy clay loam soil, previously planted with chickpea fertilized with farmyard manure, gave the highest significant amount of dry matter, pods number and seed yield. They explained that FYM exerted a beneficial residual effect on soybean plants growth. They owed this effect to the organic matter effect on the retention of soluble nutrients to meet plant growth requirements and consequently lessen their loss by leaching. Moreover, organic matter represents a good source of available nutrients, which increased from its decomposition gradually and slowly. Ramamurthy and Shivashankar (1996) declared that the residual effect of 10 tons ha^{-1} organic fertilizer resulted in a significant increase in dry matter and grain yield of maize. Abdel-Sabour *et al.* (1999) found that the residual effect of previous compost application significantly increased heads dry weight as well as seed yield of sunflower. They added that such increases could be attributed to the nutrients supplied by previously applied compost, which in turn may support the plant growth requirements.

With regard to nutrient uptake by rocket plants, data in Tables 2, 3 and 4 exhibited some positive responses due to the residual effect of organic manures. In the sandy soil, the highest NPK-uptake values were 208.98 mg N, 13.14 mg P and 293.80 mg K pot^{-1} due to the residual effect of FYM 25 % + CM 75 %, FYM 25% + CM 75% and FYM 50 % + CM 50% treatments, respectively.

In the calcareous soil, The highest NPK-uptake values were 166.35 mg N,17.29 mg P and 222.04 mg K pot^{-1} due to the residual effect of CM 100 % + BF, CM 100 % + BF and CM 100 % treatments, respectively.

Table 2 . The residual effect of organic manures and biofertilizer on Nitrogen uptake by rocket plants (mg pot^{-1}), in different soil types .

Treatments	Soil type			Mean
	Sandy	Calcareous	Clay	
Control	57.73	85.30	311.94	151.66
Control + BF	17.31	64.14	302.81	128.09
FYM 100%	157.90	93.47	455.33	235.57
FYM 100% + BF	86.71	81.79	360.88	176.46
CM 100%	145.71	153.53	366.30	221.85
CM 100% + BF	115.70	166.35	358.93	213.66
FYM 25% + CM 75%	208.98	160.37	390.51	253.29
FYM 25% + CM 75% + BF	104.42	99.72	387.49	197.21
FYM 50% + CM 50%	179.87	117.25	345.50	214.21
FYM 50% + CM 50% + BF	90.27	91.89	374.07	185.41
FYM 75% + CM 25%	138.58	108.97	360.10	202.55
FYM 75% + CM 25% + BF	112.79	108.16	401.22	207.39
Mean	118.00	110.91	367.92	198.94

L.S.D. (P 0.05)

Soil (s)	17.40
Treatment (T)	34.81
S x T	60.29

Table 3. The residual effect of organic manures and biofertilizer Phosphorus uptake by rocket plants (mg pot^{-1}) , in different soil types.

Treatments	Soil type			Mean
	Sandy	Calcareous	Clay	
Control	2.63	3.82	12.72	6.39
Control + BF	1.45	3.84	13.72	6.34
FYM 100%	9.09	7.91	15.68	10.89
FYM 100% + BF	7.38	7.63	18.56	11.19
CM 100%	13.88	13.38	37.31	21.52
CM 100% + BF	13.11	17.29	28.47	19.62
FYM 25% + CM 75%	13.14	16.49	23.22	17.62
FYM 25% + CM 75% + BF	12.26	11.79	26.33	16.79
FYM 50% + CM 50%	13.14	12.64	21.47	15.75
FYM 50% + CM 50% + BF	10.78	12.38	24.22	15.79
FYM 75% + CM 25%	12.12	11.59	22.32	15.34
FYM 75% + CM 25% + BF	10.10	11.17	26.07	15.78
Mean	9.92	10.83	22.51	14.42

L.S.D. (P 0.05)

Soil (S)	1.11
Treatment (T)	2.22
S x T	3.84

Table 4. The residual effect of organic manures and biofertilizer Potassium uptake by rocket plants (mg pot^{-1}), in different soil types.

Treatments	Soil type			Mean
	Sandy	Calcareous	Clay	
Control	79.87	115.26	404.31	199.81
Control + BF	19.82	88.87	405.21	171.30
FYM 100%	160.22	155.17	629.75	315.05
FYM 100% + BF	88.80	120.60	511.97	240.46
CM 100%	230.80	222.04	810.68	421.17
CM 100% + BF	180.80	211.31	543.46	311.86
FYM 25% + CM 75%	325.28	220.16	592.19	379.21
FYM 25% + CM 75% + BF	160.88	139.50	518.11	272.83
FYM 50% + CM 50%	293.80	176.16	505.58	325.18
FYM 50% + CM 50% + BF	123.82	134.49	564.23	274.18
FYM 75% + CM 25%	244.78	160.06	535.30	313.38
FYM 75% + CM 25% + BF	165.77	143.66	531.58	280.34
Mean	172.89	157.27	546.03	292.06

L.S.D. (P 0.05)

Soil (S)	25.97
Treatment (T)	51.92
S * T	89.94

In the clay soil, the highest NPK-uptake values were 455.33mg N, 37.31 mg P and 810.68 mg K pot^{-1} due to the residual effect of FYM 100%, CM 100 % and CM 100 % treatments, respectively. However, It was observed that NPK-uptake values in the clay soil were generally higher than the corresponding ones achieved for either sandy or calcareous soil. These nutrient uptake values were significantly higher than those of the control treatments in all the tested soils.

Such results are in accordance with those obtained by Hofman (1988), Sharma and Mittra (1991), Ramamurthy and Shivashnkav (1996) and Abdel –Sabour *et al.*, (1999) who found that chicken manure application to wheat significantly increased potassium content of peanut plants when followed wheat cultivation due to the increase in the dry matter production caused by residual influence of organic manure.

Generally, In case of using the organic manures, it is of advantage to be applied in the marginal poor soils such as sandy and calcareous ones other than the fertile clay soils, because they led to increase water retention, organic matter, soil aggregate size, Microbial population and soil available nutrients which in turn improve the cultivated plant growth (Sikander, 2001).

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الأثر المتبقى للأسمدة العضوية المستخدمة مع التسميد الحيوى أو بدونه فى زراعة القمح فى التربة الرملية و الجيرية والطينية على نمو نبات الجرجير ومحتواه من العناصر

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أجريت هذه التجربة فى صوبة تغذية النبات-معهد بحوث الأراضى والمياه والبيئة بالجيزة – وذلك لدراسة الأثر المتبقى التسميد العضوى الكامل مع التسميد الحيوى (*Azospirillum brasilense* + *Bacillus megatherium phosphaticum*) أو بدونه والمستخدم فى تسميد القمح النامى فى التربة الرملية والجيرية والطينية على نمو نبات الجرجير اللاحق المزروع بدون أى اضافة لأى نوع من الأسمدة وكذلك محتواه من العناصر مثل النيتروجين والفوسفور والبوتاسيوم.

تم قطع النباتات من فوق سطح التربة مباشرة بعد ستين يوما من الزراعة ثم جففت لتقدير الوزن الجاف لنباتات الجرجير وكذا محتواها من كل من النيتروجين والفوسفور والبوتاسيوم.وقد كانت أهم النتائج المتحصل عليها ما يلى:

١- أدى الأثر المتبقى للتسميد العضوى مع التسميد الحيوى او بدونه الى زيادة معنوية فى الوزن الجاف لنباتات الجرجير وذلك بالمقارنة مع معاملة المقارنة بدون اى تسميد.

٢- كانت استجابة نباتات الجرجير للأثر المتبقى للاسمدة العضوية أكثر وضوحا فى كل من التربة الطينية والرملية عنها فى التربة الجيرية.

٣- أدى كل من التسميد العضوى والحيوى مجتمعين الى بعض التغيرات المعنوية والغير معنوية فى الاوزان الجافة لنباتات الجرجير وكذلك لمحتواها من اى من النيتروجين والفوسفور والبوتاسيوم.

٤- كان محتوى النباتات من العناصر عاليا فى التربة الطينية بينما كانت الاستجابة أكثر وضوحا فى كل من التربة الرملية والجيرية.