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EFFECT OF RIZOBIUM INOCULATION AND COMPOST ADDITION ON CHICKPEA PLANT GROWN IN SANDY SOIL

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ABSTRACT: *A field experiment was carried out in a sandy soil during winter season 2007-2008 at Ismailia Agricultural Research Station to study the effect of rizobium inoculation and compost addition individually and combination on yield and nutrient contents of chickpea plant* ***(Cicer arietinum L.).*** *The experiment design was carried out in split plots based on randomized complete blocks design with three replicates with rizobium inoculation formed (inoculated and un -inoculated) the main plots and compost addition (0, 2.5 and 5.0 ton/fed) arranged as the sub plots.*

Results indicated that rizobium inoculation of chickpea or compost addition increased grain yield and weight of 100 grains. The grain yield increased by 9.1% due to rizobium inoculation and 28.8, 60% due the addition of 2.5 and 5 ton compost/fed respectively. Addition of 5 ton compost /fed with rizobium inoculation gave the highest grain yield, weight of 100 grain and protein percent where (734 kg/fed), 33.3 g/100 grain and 21.7%.

In addition nitrogen, phosphorous, potassium grain and protein contents% increased due to rizobium inoculation or compost addition and its combination, where the highest values for rizobium and compost were 18.31, 15.44, and 27.41 for N and 13.79, 11.11, and 33.33 for P.

After harvesting soil content (mg/kg) of available N and P significantly increased due to compost addition or rizobium inoculation. The increase in available N and P were more pronounced in case of compost addition combined with rizobium inoculation. There is non significant effect for all treatments on soil content (mg/kg) of available K after harvesting.

Key words: *Rhizobium, Compost, Sandy soil, Chickpea, Inoculation, Grain yield.*

INTRODUCTION

The chickpea (*Cicer arietinum* L) as a healthy vegetarian food has important role in human food. Its cheap source of high quality protein in the diets of millions of people in developing countries who cannot afford animal protein for balanced nutrition (Husiman *et al.,* 1994). Inadequate agronomic management significantly causes poor productively of chickpea. This in includes especially insufficient fertilizer and bacterial inoculation in new reclaimed soil.

To be sustainable organic farming need to be self sufficient in nitrogen (N) through fixation of atmospheric di-nitrogen (N) by legumes, recycling of crop residues and application of farmyard manure, compost and bio-fertilizer (Ravindra *et al.,* 2007).

Rizobia inoculation have been contribute to increase nitrogen fixation and yield in legumes crops that represent 70-80% of total nitrogen accumulated in plant (Catroux *et al.,* 2001). The microbial symbiosis is suggested to be ideal solution for the improvement of soil fertility or rehabition of arid land (Zahran, 1999).

Chickpea responds positively to inoculation when grown in soil contain native chickpea rizobia N_2 fixation in chickpea rang from 0 -to 176 kg/ha season depending on method of measurement, cultivar present of appapriate rizobia and environmental variable (Beck *et al.,* 1991). When native bacteria are ineffective less inoculation with selected rizobium bacteria strain may increase yield and N fixation.

Compost application to the soil is considered a good management practice in all agricultural production system because of increasing via sustainability by improving soil physical properties and increasing soil organic matter and fertility level.

Supplementation of soil with organic matter and rizobium inoculation has been

shown to enhance the survival and number of rizabia in soil and increase both nodulation and N2 fixation (Rymne *et al.,* 1994). The results indicates that although rizabia can surely paresis in soil, their efficacy can be enhanced by carbon addition in organic matter.

This study was carried out to investigate response of chickpea grown in sandy soil to rizobium inoculation and compost addition. Moreover investigating the effect of these treatments on content of soil available nutrients after harvesting.

MATERIALS AND METHODS

A field experiment was carried out during winter season 2007-2008 at the Ismailia Agriculture Research Station. The experiment was laid out in split plots based on randomized complete blocks design with three replications. The bio-fertilizer formed treatments the main plots (non-inoculated and inoculated), while the added compost level (0, 2.5 and 5 ton/fed) formed making the sub-plates, of each plot as 3 x 3.5 m. Compost was added before sowing and homogenously mixed with the top soil (0-20 cm).

Seed of chickpea inoculation with rizobia was done before sowing. Two to three seeds were placed in the furrows at the recommended spacing. The plants were thinned to one plant per hill after emergence. The other normal agricultural practices of growing chickpea were carried out.

Table (1) some plysical and chemical characteristics of the studied soil.

Surface soil samples (0-30 cm) were collected before planting and after harvesting and were prepared for the determination of chemical and physical analysis according Black *et al.,* (1965) and Page (1982). The used compost in this study was analyzed for its chemical composition according the methods described by Page *et al.,* (1982) and the obtained values were recorded in Table (2).

At harvesting, samples of grain were collected of each plot separately individual or in combination. Nitrogen, phosphorus and potassium grain contents were determined as described by Jackson (1973). Two yield parameters i.e. grain yield (kg/fed.) and weight of 100 grains (g) were measured.

Table (1): Some physical and chemical characteristics of the studied soil.

a- Physical characteristics

O.M %	$CaCO_3$ %	Particle size distribution %				Soil texture	Field capacity %	Wilting point %
		C.sand	F.sand	Silt	Clay			
0.32	0.3	80.00	13.2	3.7	3.1	Sand	9.1	2.9

b- Chemical characteristics

CEC meq/ 100 gm	pH 1, 2.5 Soil: water susp.	EC dS/m	Soluble cations meq/L				Soluble anions meq/L			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3	HCo^{-}_3	Cl	SO_4
6.5	7.1	0.25	1.4	0.69	0.38	0.22	-	1.15	0.90	0.64

Table (2): Some characteristics of compost

EC dS/m	OM %	O.C %	Total N%	C/N Ratio	Total	
					P %	K %
3.30	37.84	22.00	1.12	19.61	0.9	1.5

RESULTS AND DISCUSSION

The effect of rizobium inoculation and compost addition on chickpea grain yield, 100 grain weight and protein % are given in Table (3) and Fig. (1 a & b). Obtained data indicated that both rizobium inoculation and compost addition and interaction significantly increased grain yield and weight of 100 seed over produced by the control. The percentage of the increase in grain yield reached 9.1% for Rizobium inoculation compared to non-inoculation, and 28.8 and 60% due to the addition of 2.5 and 5.0 ton/fed compost respectively.

Addition of 5.0 ton compost /fed with inoculation of seed with rizobia gave the highest grain yield with respect to the addition of compost or Rizobium inoculation alone. Rymne *et al.,* (1994) stated that supplementation of soil by organic matter with rizobium inoculation of legume plants has been shown to enhance the survival and number of rizobia in soil and increase both early nodulation and N_2 fixation. This result indicates that although rizobia can has beneficial effect on legume crops, their efficiency can be enhanced by carbon addition in organic matter. In addition compost improving the poor physical properties of the sandy soil and contain high level of nutrient elements required to plant growth. These results are in good agreement with those obtained by Beck (1991) who stated that inoculated chickpea with rizobia increase yield and N_2 fixation. Catroux *et al.,* (2001) pointed out that Rizobial inoculation have been contributed to increase nitrogen fixation and yield in legume crops that represent 70-80% of total nitrogen accumulated in plant.

Grain N, P and K content

Rizobium inoculation and/or compost addition had significant effect on grain nitrogen content with respect to the control (Table 4) and Fig. (2 a & b). Means comparisons specified that the percentage of increase in N concentration reached 9.55 % for rizobium inoculation and 6.69 % and 18.31 %, due to the addition of 2.5 and 5.0 ton compost respectively. The highest N grain content obtained from rizobium inoculation with compost addition. The main reason is that compost can increase N availability to plant and enhancing nitrogen fixation by Rizobia Mohamnadi *et al.,* 2010 and Addel-Wehab *et al.,* (2007).

Table (3): Effect of Rizobium inoculation and compost addition on grain yield and weight of 100 grain

Bio	Compost ton/fed	Grain yield Kg/fed	Weight of 100 grain (g)
Non inoculation	0.0	409.00	23.30
	2.5	528.70	25.25
	5.0	663.70	30.10
Mean		533.80	26.2
Inoculation	0.0	445.00	25.7
	2.5	569.00	27.2
	5.0	734.00	33.3
Mean		582.67	28.70
L.S.D at 0.05	compost	20.2	1.35
	Bio-fertilizer	30.1	0.98
	Interaction	35.2	1.1

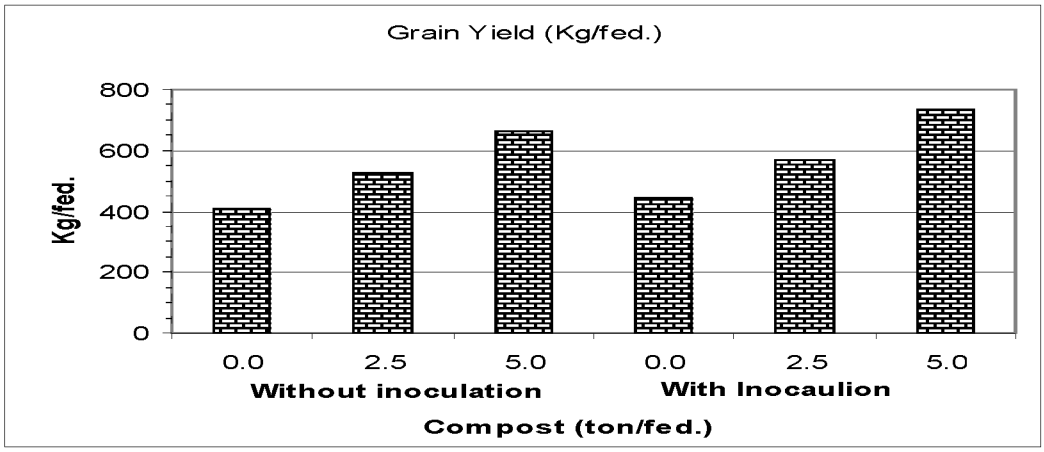

Fig (1 a): Effect of Rizobium inoculation and compost addition on grain yield.

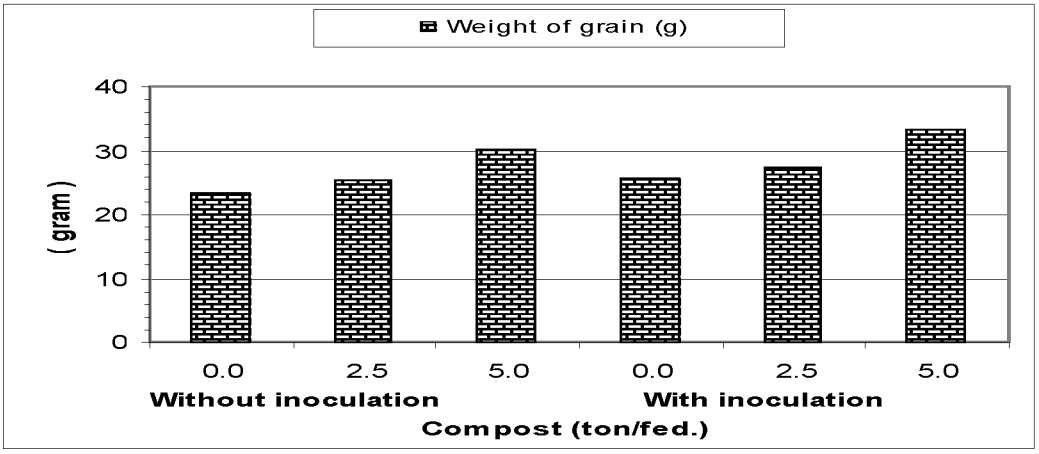

Fig (1 b): Effect of Rizobium inoculation and compost addition on weight of 100 Grain (g).

Table (4): Effect of Rizobium inoculation and compost addition on NPK contentand protein % of chickpea grains.

Rizobium inoculation	Compost Ton/fed	N %	P %	K %	Protein %
Without inoculation	0.0	2.70	0.25	0.65	16.74
	2.5	2.90	0.28	0.85	17.98
	5.0	3.21	0.33	1.10	19.84
Mean		2.93	0.29	0.87	18.18
Inoculation	0.0	2.98	0.29	0.75	18.48
	2.5	3.15	0.32	0.95	19.53
	5.0	3.50	0.39	1.25	21.70
Means		3.21	0.33	0.98	19.89
L.S.D at 0.05	Inoculation	0.11	0.018	0.08	0.62
	compost	0.20	0.030	0.16	0.53
	Interaction	0.25	0.035	0.19	0.95

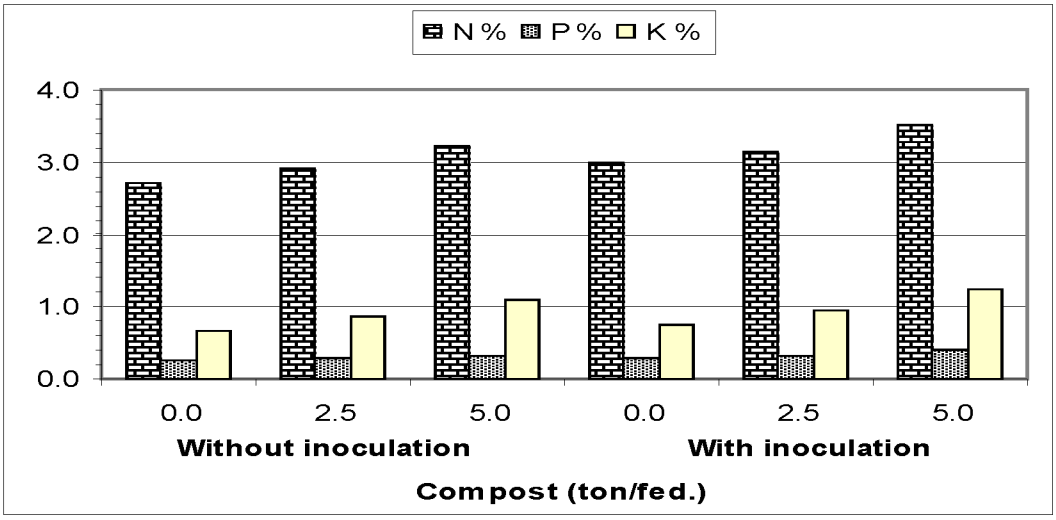

Fig. 2 a: Effect of Rizobium inoculation and compost addition on NPK content of chickpea grains

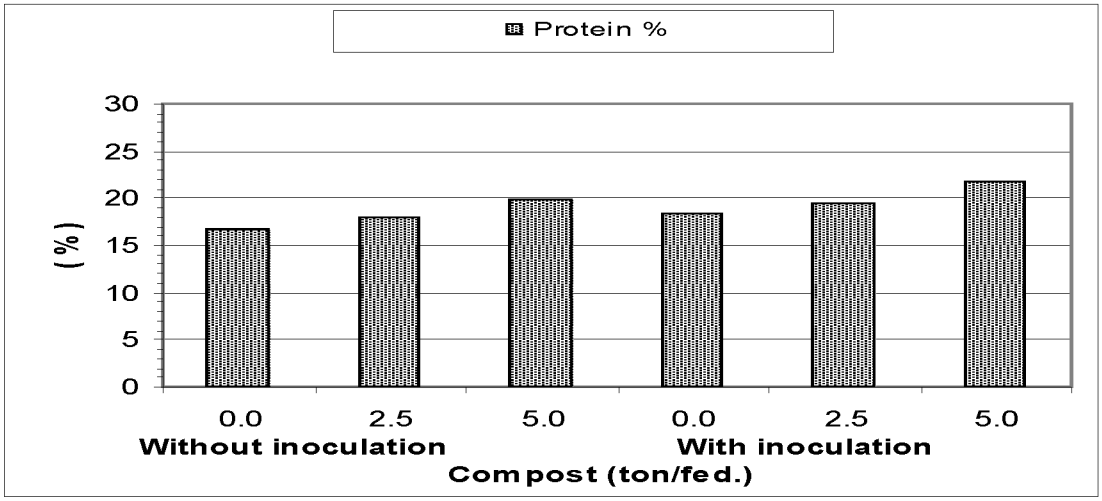

Fig. 2 b: Effect of Rizobium inoculation and compost addition on protein % of Chickpea grains

The results in Table (4) showed that both Rizobium inoculation and compost addition had significant effect on grain P content. The percentage of increase in P contents reached 13.79, 11.1 and 33.3% with respect to control due to rizobium inoculation and addition of 2.5 and 5.0 ton compost respectively. The highest P content obtained from rizobium inoculation with compost addition (0.39%). Increasing effect of combined application of compost and Rizobium on soil enzyme activity such as phosphates increase P availability for plant (Mohammadi *et al.,* 2010).

Addition of compost had significant effect on grain potassium content, but Rizobium inoculation alone or compost had effect on grain K content in Table (4) Abdel-Wahab *et al.,* (2007), and Singh and Sharma (2011) pointed out that, the application of organic manure alone or in combination with Rizobium significantly improved the yield, crude protein content and N, P, K uptake by chickpea.

Soil content of available N, P and K after harvesting

The application of compost enriched soil with organic forms of macronutrients which slowly released in the mineral forms through mineralization process by micro organisms. It is clear from the data available N and P in soil after harvesting due to, in Table (5) that available N and P in soil after harvesting increased due to Rizobium inoculation or compost addition. These increases were magnified by compost addition with Rizobium inoculation and increasing the compost rates. The data are in agreement with those obtained by Wong *et al.,* (1999) who indicated that soluble NH_4, NO_3 and PO^-_4 increased significantly according to compost application rates due to the a abundant of macronutrients in the compost Ouédraoge *et al.*, (2001) mentioned that at harvest, the nutrient content increased in all plots amended with compost particularly those received the large rate of compost application.

Table (5): Effect of Rizobium inoculation and compost addition on the content of Available N, P and K of soil after harvesting.

Rizobium inoculation	Compost ton/fed	N mg/kg	P mg/kg	K mg/kg
Without inoculation	0.0	25.00	6.80	30.2
	2.5	30.00	8.2	32.3
	5.0	36.00	10.5	33.1
Mean		30.3	8.5	31.86
Inoculation	0.0	32.10	7.5	31.0
	2.5	36.20	9.3	33.1
	5.0	42.1	11.8	33.8
Mean		36.8	9.53	32.63
L.S.D at 0.05	Inoculation	3.220	1.25	n.s
	Compost	2.900	1.20	n.s
	Interaction	3.200	1.40	n.s

REFERENCES

Abdel-Wahab, A.F.M., F. Sh. Badawi, C.A.A. Mekhimer and W.M.E. Farghal (2007). Effect of enriched compost tea and rizabacteina on nodulation, growth and yield of chickpea. Minufia J. Agric. Res. 30: 297-321.

Beck, D.P. (1992). Yield and nitrogen fixation of chickpea cultivars in response to maculation with selected residual strains. Agron. J. 84: 510-516.

Beck, D.P., J. Wery and M.C. Saxena (1991). Dinitrogen fixation and nitrogen balance in coal season food legumes. Agro. J. 83: 334-341.

Black, C.C.A. (ed) (1965). Methods at Soil Analysis .Parts1and 2. Am Soc Agron. Madison, Wisconsin USA.

Catroux, G., A. Harmann and C. Revellin (2001). Thends in Rizobial inoculation production and use. Plant and Soil, 230: 21-30.

Husiman, J. and A.F. Vander Poel (1994). Aspect of the nutritional quality and use of cool season food legumes in animal feed. Expanding the production and use of cool season food legume. Dordrehi Kuwer Academic Publisher. pp. 53-76.

Jackson, M.L. (1973). Soil Chemical Analysis Prentice Hall of India Private Limited New Delhi.

Mohammadi, K., A. Chalovand and M. Agaalikhani (2010). World Academy of Science Engineering and Technology, 68: 1114-11120.

Nlssen, O. (1983). Mstat –C " Amicro-computer program for the design, management, and analysis of Agronomic Research Experiments, Mstat development Team. Michigan State University, USA

Ouedreogo, E., A. Mandob and N.P. Zombre (2001). Use of compost to improve soil properties and crop productivity under low input agricultural system in West Africa. Agriculture, Eco systems and Environment. 84: 259-266.

Page, A.L. (ed), (1982). Methods soil Analysis Part-2: Chemical and Mineralogical properties. Amer. Soc. Agron., Madison Wisconsin, U.S.A.

Ravindra, K.C., K. Venkatesen and T. Balasubrmanism (2007). Effect of halophytic compost along with farmyard manure and phosphor bacteria on growth characteristics of A rachis hypogeal, Linn Science of Environment, 384: 33-440.

Rymne, F.G., A.R. Gelenn and M.J. Dilworth (1994). Effect of mutations in aromatizes catabdish on persistence and competitiveness of Rizobium legumiosarum by Trifalu. Soil and Biol. Bioch. 26: 703-710.

Singh, Y.P. and A. Sharma (2011). Effect of sources of phosphorous and microbial inoculation on productivity nutrient availability and productivity nutrient availability in soil and uptake of nutrients by chickpea grown in sandy soil.

Wong, J.W.C., K.K. Ma, K.M. Fang and C. Cheung (1999). Utilization of manure compost for organic farming in Hong Kong. Biresource Technology. 67: 43-46.

Zahran, H.H. (1999). Rizobium legume symbiosis and nitrogen fixation under sever condition and climate. Microbial Molecular Bio, 63: 968-89.

تأثير التلقيح بالريزوبيوم وإضافة الكمبوست على نمو نبات الحمص فى الأراضى الرملية

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الملخص العربي

اقيمت تجربة حقلية خلال شتاء ٢٠٠٧/ ٢٠٠٨ بالمحطة البحثية بالاسماعيلية لدراسة تأثير التسميد الحيوى وإضافة الكمبوست على إنتاجية وخواص محصول الحمص بالأراضى الرملية . وكان تصميم التجربة فى قطع منشقة كاملة العشوائية مع ثلاث مكررات . التلقيح بالريزوبيوم وبدون تلقيح كان القطع الرئيسية ، وإضافات الكمبوست (صفر ، ٢.٥ ، ٥ طن/ف) تحت القطع الرئيسية واضيف الكمبوست قبل الزراعة وقلب جيداً بالطبقة السطحية (٠ . ٢٠سم) ، وتم تلقيح بذور الحمص بالريزوبيا قبل الزراعة مباشرة .

وقد أوضحت النتائج المتحصل عليها ما يلى :

كان تأثير إضافة الكمبوست مع أو التلقيح الميكروبى إيجابيا على خواص التربة الرملية حيث ان إضافة الكمبوست يؤدى الى تحسين خواص الأراضى الرملية وإمدادها بالعناصر الغذائية التى يحتاجها النبات ، كما أن

التسميد الحيوى يزيد من اعداد بكتريا الريزوبيوم مما يزيد من عمليات تثبيت النيتروجين الجوى . وكان لتأثيركل من الكمبوست والتلقيح بالريزوبيوم تحسين فى خواص الأراضى الغذائية .

أن التسميد الحيوى مع/ أو الكمبوست أدى الى زيادة إنتاجية الحبوب مقارنة بالكنترول حيث زادت إنتاجية الحبوب ٩.١% للتلقيح الحيوى ٢٨.٨،٦٠% لإضافة الكمبوست ٢.٥ ، ٥ طن/ف ، وكان أعظم إنتاجية إضافة ٥ طن كمبوست ، مع التلقيح الحيوى حيث اعطت ٧٣٤ كجم /فدان حبوب وان الـ ١٠٠ حبة اعطت ٣٣.٣ جم / ١٠٠ حبة . وبالنسبة للبروتين زادت نسبته بـ ٢١.٧% .

التلقيح مع أو الكمبوست له تأثير معنوى على محتوى الحبوب من النيتروجين ، حيث يزيد النسبة المئوية للنيتروجين ١٨.٣١% نتيجة التلقيح ، ١٥.٤٤ ، ٢٧.٤١% لإضافة ٢.٥ ، ٥ طن/ف كمبوست . وكان أعلى قيمة لمحتوى النيتروجين هو التلقيح مع إضافة كمبوست ٥ طن/ف .

أما بالنسبة لمحتوى الحبوب من الفوسفور فإن هناك معنوية للتلقيح مع /أو الكمبوست حيث تزيد النسبة المئوية للفوسفور ١٣.٧٩ ، ١١.١١ ، ٣٣.٣٣% على الترتيب ، وكان أعلى محتوى لعنصر الفوسفور فى حبوب الحمص التلقيح مع ٥ طن كمبوست حيث بلغ ٣٩% ويرجع ذلك لتأثير انزيم الفوسفور إضافة للتحلل البطئ للكمبوست معطيا أحماض عضوية تزيد من ذوبان الفسفور. أما بالنسبة لعنصر البوتاسيوم فإن إضافة الكمبوست له تأثير معنوى على محتواه بالحبوب منفرداً أو مع التلقيح .

هناك زيادة معنوية فى تيسر NP فى التلقيح منفرداً أو مع الكمبوست أو للتأثير المشترك حيث أن إضافة الكمبوست ينتج عنه مركبات عضوية أثناء انحلاله ببطء بواسطة الكائنات الدقيقة خلال عملية المعدبة mineralization ، وأقصى زيادة فى تيسر NP يكون بالتلقيح مع الكمبوست حيث يزداد ذوبان NO_3, NH_4, PO_4 . أما البوتاسيوم فالزيادة غير معنوية ، أى أن المحتوى الغذائى يزداد فى كل القطع المحسنة بالكمبوست .