Effect of Soil Conditioner and Local Compost on The Growth and Yield of Three Cultivars of Pea (*Pissum sativum* L.)*

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Abstract

The influences of two composts treatment on three pea (Pisum sativum L.) cultivars were studied. The experiments were conducted in the plastic house at the agriculture research center, Ministry of Agriculture in Iraqi Kurdistan region. This study was performed during 14-11-2011 till 29-3- 2012. Two types of composts were studied; the local compost and soil conditioner Latvia compost. Three cultivars of pea (Lincoln, Rondo and Sonata) were treated with various levels of the two mentioned composts (12 parts silt soil, 8 parts of silt soil: 4 parts of the compost and 4 parts silt soil: 8 parts of compost. In the local compost and Latvia compost experiments the highest levels of shoot length, dry weight of shoots and 100 seeds were obtained in Rondo cultivar, and number of branches and seeds/ plant and number of seeds/ pod were recorded from Sonata cultivar. However, the highest levels of most field parameters were obtained in the level 8:4 in both composts, with no significant effects of soil conditioner on shoot length and dry weight of 100 seed. In both experiments the interaction between Rondo cultivar and silt soil gave highest shoot length, and highest dry weight of shoots and 100 seed were obtained in the interaction of Rondo cultivar and the level 8:4. While the highest number of branches/ plant, number of pods/ plant and number of seeds/ pod were recorded from the interaction between Sonata cultivar and the level 4:8 of local compost, and the effects of local compost were more than soil conditioner in different interactions. However, in local compost experiment the highest value of potassium% in the dry seeds was obtained from the interaction between Sonata cultivar and silt soil. However the highest value of the phosphorus% and potassium% were evaluated from the interaction of Sonata cultivar with the level 4:8 and silt soil respectively in the Latvia compost experiment.

Key ward: Pea cultivars, composts, growth, yield, seed content.

Introduction

Peas *(Pisium sativum* L.) are commonly growth and are a popular food in the temperate and to a lesser extent in the subtropical regions of the world (Wien; (1999)). Pea is an annual plant, with a life cycle of less than one year.

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It is a cool season crop, planting can take place from winter to early summer depending on location (Wikipedia; (2012)).

The pea is a legume with great nutritional potential due to their high content of protein (27.8%), carbohydrates (42.62%), vitamins, minerals, dietary fiber and antioxidant compounds (Urbano, et al.; (2003) , Urbano, et al.; (2005)).

Legume grain crops growing under field conditions are supplied exclusively with nitrogen, phosphorus, potassium and sulfur until the legumes have reached a growth and seed yields (Hanway and Ramon; (2009)). Certain nutrients deficiencies may result in poor seed quality, reduced a pod formation and reduce nitrogen fixation by the root nodules, and overall reduction in plants growth and yield. Nitrogen, phosphorus and potassium accumulate in large quantities in peas and a crop of 1000 kg of dry seed may contain up to 43 kg nitrogen, 43 kg phosphorus and 9.2 potassium (Wien; (1999)). Pea cultivars are widespread in area having a mild and warm climate, because relatively high or low temperature is the most important factors limiting pea cultivars (Bozoglu, et al.; (2007)).

Recently, production of large quantities of composts has made possible using compost commercially in vegetable crop production system (Roe, et al.; (1997)). Interests in organic production methods for vegetable continues to increase production of vegetables have a large history (Murray and Anderson. ; (2004)). Composts are the final product of controlled degradation of organic wastes, has been revealed to improve soil physical and chemical properties (Mastouri, et al.; (2005)), that suppresses certain plant diseases, improves moisture retention and cation exchange capacity, provides micronutrients, slow release nitrogen, and organic matter (Stoffella and Kahn; (2001)). In addition other important characteristics of composts used as a media culture include maturity or stability, salinity, pH, particle size (Coopeband; (2000)). Composting is the transformations of new organic materials into biologically stable, humic substances suitable for a variety of soils and plant uses. Essentially, composting is controlled decomposition, the natural breakdown process that occurs when organic residue comes in contact with soil (Coopeband; (2000)). Compost is general term describing all organic matter that has undergone a long thermophilic, aerobic stabilization process. Composts may vary with raw material used, duration and of the composting process. The combination of these factores results in a wide range of characteristics and qualities of the end –product of plant yield (Raviv; (2005)). The chemical fertilizers used in conventional agriculture contain gust a few minerals, which dissolve quickly in damp soil and give the plants large doses of minerals (Masarirambi, et al.; (2010)), and the effect of many types of fertilizers were studied on the growth and yield of several pea cultivars (El – shaikh, et al.; (2010) , Lehotai, et al.; (2011)). Organic fertilizer can there- fore be used to reduce the amount of toxic compounds (such as nitrates) produced by conventional fertilizers in vegetables, hence improving the quality of these vegetables produced as well as human health increased consumer awareness of food safety issues. Thus, it may be possible to lessen the escalating effects of diseases such as cancer and boots immunity of humans (Masarirambi, et al. (2010)).

The general objective of this research is to comparison the effect of local compost and soil conditioner (Latvia compost) on the growth and yield of three pea cultivars in North of Iraq conditions.

Materials and Methods

The experiments were conducted in the plastic house at the agriculture research center, Ministry of Agriculture in Iraqi Kurdistan region. This study was performed during 14-11-2011 till 29-3-2012. The climatologically data of temperature and humidity during the experiment period are shown in the table (1).

Table (1): Maximum and minimum air temperatures and humidity throughout the experiments period.

Year	Month	Air temperature (^oC)		Relative humidity(%)	
		maximum	minimum	maximum	minimum
2010	November	25.50	13.00	56.00	33.70
	December	18.30	8.60	71.50	45.90
2011	January	12.40	5.40	87.90	57.30

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	February	13.80	6.30	87.90	57.3
	March	18.90	9.00	80.20	52.50
	April	23.90	14.90	73.60	46.00

Composts and growing media

The organic matter of local compost were brought from chicken manure and wheat straw, and prepared in the agricultural research center, ministry of agriculture in Iraqi kurdistan region, which contain 1.25% nitrogen, 0.42% phos- phorus and 0.55% potassium, 50% moisture, the pH is 8.3 and electric conductivity is 2.03 $dS.m^{-1}$. However, the organic matter of soil conditioner (Latvia compost) is peat and natural algae which contain approximately 1% nitrogen, 0.02% phosphorus, 0.03% potassium, 60% moisture, the pH is 4 and electrical conductivity is 0.25 $dS.m^{-1}$.

The growing media of both experiments (local compost and soil conditioner) were prepared in same proportions of silt soil and composts as follows:
12 parts of silt soil: 0 part of the compost,
8 parts of silt soil: 4 parts of the compost,
4 parts of silt soil: 8 parts of the compost.

The growing media were putted in the pots (22.5 x 24cm) placed in the plastic house prepared by the agricultural research center.

2-Plant material

The seed of three cultivars of pea *(Pisum sativum L.)* were used in this study (Lincoln, Rondo and Sonata). Four seeds were sown in each pot, and then the plants were thinned to two.

3-Experimental design and statistical analysis

In each experiment nine treatments were used in factorial completely randomize design with three replicates, each include one pot with two plants. Comparisons between means were made by using least significant differences test (LSD) at 5% probability for field parameters, and 1% for chemical analysis (Al – Rawi and Khalaf – Allah; (1980)). Static graph for windows system was used for all statistical analysis (Staticgraphic version 4.0 1999).

4-Experimental parameters

4-1- Field parameters

The parameters were measured from all plants including; shoot length, number of branches / plant, dry weight of shoots, number of pods / plant, number of seeds / pod and dry weight of 100 seeds (Mohammed – Amin; (2008)).

4-2- Chemical analysis of the seeds

Three hundred milligram of dried seed samples powder were digested as described by Ryan et al.; (2001)), then from these digested samples the following contents were determined:

4-2-1- Total nitrogen content (%)

The total nitrogen content was determined as Kjeldahl method (Allen et al.; (1974)).

4-2-2- Total phosphorus content (%)

Total phosphorus content was determined by using spectrophotometer as described by Rayan et al.; (2001).

4-2-3- Total potassium content (%)

Flame photometer was used for determination of potassium content (Allen et al.; (1974)).

4-2-4- Total protein content (%)

Total protein content was calculated by multiplying the values of total nitrogen by 6.25 (Dalaly and Al-Hakim; (1974)).

Results and Discussion

1- Field experiments

1-1- Local compost experiment

The effect of *Pisium sativum* L. cultivars on vegetative growth and yield characteristics were mentioned in table (2). Results indicated significant differences on shoot length, number of branches/ plant, dry weight of shoots, number of pods/ plant, number of seeds/ pod and dry weight of 100 seed. The highest values of shoot length, dry weight of shoots and 100 seed (71.92cm, 38.35gm and 25.18gm respectively) were recorded from Rondo cultivar. While the highest number of branches/ plant, number of pods/ plant and number of seeds/ pod (3.70, 24.11 and 6.04 respectively) were counted from Sonata cultivar.

Table (2): Effect of *Pisum sativum L.* cultivars on vegetative growth and yield characteristics. (depending on local compost)

Cultivars	Shoot length (cm)	Number of branches/ plant	Dry Wt. of shoots (gm)	Number of pods/ plant	Number of seeds/ pod	Dry Wt.of 100 seed (gm)
Lincoln	68.03	2.92	32.19	15.55	4.86	22.57
Rondo	71.92	2.85	38.35	18.37	3.92	25.18
Sonata	63.48	3.70	33.58	24.11	6.04	14.1
L.S.D.<0.05	4.21	0.31	1.97	2.55	0.61	3.01

Table (3) shows significant differences of local compost levels on all vegetative growth and yield characteristics. The highest shoot length (69.59 cm) was recorded from silt soil. However, the highest level of number of branches, dry weight of shoots, number of pods/ plant and dry weight of 100 seed (3.61, 36.81gm, 21.89 and 22.08 gm respectively) were obtained in the level 8:4 treatment, but the highest number of seeds/ pod (5.77) was counted from the level 4:8 treatment.

Table (3): Effect of the local compost on vegetative growth and yield characteristics.

Local compost levels*	Shoot length (cm)	Number of branches/ plant	Dry Wt.of shoots (gm)	Number of pods/ plant	Number of seeds/ pod	Dry Wt.of 100 seed (gm)
12:0	69.59	2.51	31.74	16.37	3.88	22.02
8:4	65.28	3.61	36.81	21.89	5.17	22.08
4:8	68.57	3.35	35.58	19.77	5.77	17.75
L.S.D.<0.05	4.21	0.31	1.97	2.55	0.61	3.01

* 12:0 = only silt soil,
8:4 = 8 is silt soil and 4 is local compost,
4:8 = 4 is silt soil and 8 is local compost.

The interaction of cultivars and local compost affected significantly on vegetative growth and yield characteristics (table 4). The longest shoot (75.55 cm) was observed in the interaction of Rondo cultivar and silt soil, but the greatest number of branches/ plant, number of pods/ plant and number of seeds/ pod (4.22, 28.11 and 6.73 respectively) were recorded from the interaction of Sonata cultivar and 4:8 level of local compost. However, the highest dry weight values of shoots and 100 seed (40.69gm and 28.71gm respectively) were observed in the interaction of Rondo cultivar and the level 8:4.

Similar results were obtained with vegetative growth of *Lactuce sativa* L. (Masarirambi et at.; (2010)), when they used chicken manure fertilizer, and this could be attributed to the nutrient content of the fertilizer which used, such as the large quantities of available phosphorus and potassium contained in chicken manure.

Table (4): Interaction effects of *Pisum sativum* L. cultivars and the local compost on vegetative growth and yield characteristics.

Cultivars	Local compost levels	Shoot length (cm)	Number of branches/ plant	Dry Wt. of shoots (gm)	Number of pods/ plant	Number of seeds/ pod	Dry Wt.of 100 seed (gm)
Lincoln	12:0	72.88	1.99	29.50	12.11	3.27	26.67
	8:4	68.11	3.66	36.57	19.55	5.91	23.95
	4:8	63.11	3.11	29.13	14.99	5.40	17.14
Rondo	12:0	75.55	2.44	35.74	18.44	2.63	26.64
	8:4	66.94	3.39	40.69	20.44	3.94	28.71
	4:8	73.28	2.72	33.99	16.22	5.19	20.18
Sonata	12:0	60.33	3.11	31.33	18.55	5.75	12.81
	8:4	60.77	3.77	37.79	25.66	5.66	13.57
	4:8	69.33	4.22	37.62	28.11	6.73	15.92
L.S.D.<0.05		7.28	0.53	4.42	4.41	1.06	5.22

1-2- Soil conditioner Latvia compost experiment

Table (5) show significant effects of *Pisum sativum* L. cultivars on all vegetative and yield characteristics. The highest values of shoot length, dry weight of shoots and dry weight of 100 seed (72.39cm, 35.96gm and 28.44gm respectively) were obtained from Rondo cultivar. However, the highest number of branches/ plant, number of pods/ plant and number of seeds/ pod (3.70, 23.37 and 5.28 respectively) were obtained from Sonata cultivar. The variation between cultivars may be related with genetic formation and their response to the type of compost and to environmental conditions.

Table (5): Effect of *Pisum sativum* L. cultivars on vegetative growth and yield characteristics. (depending on soil conditioner Latvia compost)

Cultivars	Shoot length (cm)	Number of branches/ plant	Dry Wt. of shoots (gm)	Number of pods/ plant	Number of seeds/ pod	Dry Wt.of 100 seed (gm)
Lincoln	70.41	2.74	32.56	15.74	5.02	19.47
Rondo	72.39	2.44	35.96	15.87	3.57	28.44
Sonata	62.96	3.70	29.93	23.37	5.28	15.84
L.S.D.<0.05	3.60	0.32	1.61	3.21	1.05	4.59

Soil conditioner caused significant differences in number of branches/ plant, dry weight of shoots, number of pods/ plant and number of seeds/ pod (table 6). The highest values of the first three parameters (3.42, 35.18gm and 19.64 respectively) were recorded from the level 8:4 treatment, while the number of seeds/ pod (5.33) was counted from the level 4:8 treatment.

Table (6): Effect of the soil conditioner on vegetative growth and yield characteristics.

Latvia compost levels*	Shoot length (cm)	Number of branches/ plant	Dry Wt.of shoots (gm)	Number of pods/ plant	Number of seeds/ pod	Dry Wt.of 100 seed (gm)
12:0	69.59	2.51	31.74	16.37	3.88	22.02
8:4	66.96	3.42	35.18	19.64	4.65	22.11
4:8	69.20	2.94	31.53	18.96	5.33	19.62
L.S.D.<0.05	N.S.	0.32	1.61	3.21	1.05	N.S.

*12:0 = only silt soil,
8:4 = 8 is silt soil and 4 is soil conditioner,
4:8 = 4 is silt soil and 8 is soil conditioner.

The interaction effect of different cultivars and soil conditioner was shown in table (7), the interactions were significant for the vegetative growth and yield characteristics. The highest level of the shoot length (75.61cm) was observed in Rondo cultivar treated with the level 4:8 of Latvia compost. However, the greatest number of the branches/ plant (4.21) was recorded in Sonata cultivar when was treated with the level 8:4. The highest values of the dry weight of shoots and the dry weight of 100 seed (37.90gm and 33.94gm respectively) were founded in Rondo cultivar when was treated with the level 8:4. While the highest number of pods/ plant (27.66) was recorded from Sonata cultivar when was treating with the level 4:8.The highest number of seeds/ pod (6.09) was resulted from the interaction between Lincoln cultivar and the level 4:8 of soil conditioner.

Table (7): Interaction effects of *Pisum sativum* L. cultivars and the soil conditioner on vegetative growth and yield characteristics.

Cultivars	Latvia compost levels	Shoot length (cm)	Number of branches/ plant	Dry Wt.of shoots (gm)	Number of pods/ plant	Number of seeds/ pod	Dry Wt.of 100 seed (gm)
Lincoln	12:0	72.89	1.99	29.50	12.11	3.27	26.62
	8:4	71.33	3.55	34.58	18.55	5.59	16.27
	4:8	67.00	2.66	33.59	16.55	6.09	15.53
Rondo	12:0	75.55	2.44	36.59	18.44	2.63	26.64
	8:4	66.00	2.5	37.90	16.50	2.78	33.94
	4:8	75.61	2.39	33.38	12.66	5.30	24.75
Sonata	12:0	60.33	3.11	29.13	18.55	5.75	12.81
	8:4	63.55	4.21	33.06	23.88	5.49	16.12
	4:8	65.00	3.77	27.61	27.66	4.60	18.58
L.S.D.<0.05		6.23	0.55	2.79	5.56	1.81	7.97

High values were obtained from Latvia compost treatments, that may be due to that it was improving physical properties of the soil and ease of mineralization of nitrogen and phosphorus, this agree with (Adegbidi and Briggs; (2003)) they indicated that the higher organic levels and the ease of mineralization of minerals in peat responsible for better response in relation of many vegetative indexes when compared to other treatments in the green house and as we mentioned before that the peat is one of the soil conditioner components.

2- Chemical analysis

2-1- Local compost experiment

Table (8) show that the cultivars not affected significantly on total nitrogen, phosphorus, potassium, protein content of dry seeds.

Table (8): Effect of *Pisum sativum* L. cultivars on some chemical charac- teristics of the seed. (depending on local compost)

	Nitrogen	Phosphorus	Potassium	Protein

Cultivars	contennt (%)	contennt (%)	contennt (%)	contennt (%)
Lincoln	4.28	0.27	1.61	10.04
Rondo	4.39	0.27	1.56	9.74
Sonata	4.59	0.25	1.64	10.27
L.S.D.<0.01	N.S.	N.S.	N.S.	N.S.

Table (9) show the effect of local compost on total nitrogen, phosphorus, potassium, protein content of dry seeds. The local compost affect significantly on potassium content, the highest level (1.65%) was recorded from the silt soil.

Table (9): Effect of the local compost on some chemical characteristics of the seed.

Local compost levels	Nitrogen contennt (%)	Phosphorus contennt (%)	Potassium contennt (%)	Protein contennt (%)
12:0	4.22	0.30	1.65	10.31
8:4	4.55	0.24	1.63	10.16
4:8	4.50	0.26	1.53	9.58
L.S.D.<0.01	N.S.	N.S.	0.12	N.S.

Table (10) show the interaction effects between cultivars and local compost on total nitrogen, phosphorus, potassium, protein content of dry seeds. It is demonstrated that the interaction treatments affected significantly only on the potassium content and the highest value (1.73%) was measured from the interaction between Sonata cultivar and silt soil, and it had no significant differences with the two other cultivars in the same sowing me- dium.

Table (10): Interaction effects of *Pisum sativum* L. cultivars and the local compost on some chemical characteristics of the seed.

Cultivars	Local compost levels	Nitrogen contennt (%)	Phosphorus contennt (%)	Potassium contennt (%)	Protein contennt (%)
Lincoln	12:0	3.63	0.30	1.59	9.94
	8:4	4.23	0.25	1.68	10.5
	4:8	5.00	0.28	1.55	9.69
Rondo	12:0	4.11	0.31	1.64	10.22
	8:4	4.70	0.30	1.61	10.04
	4:8	4.37	0.21	1.44	8.97
Sonata	12:0	4.92	0.29	1.73	10.78
	8:4	4.73	0.19	1.59	9.94
	4:8	4.14	0.29	1.62	10.10
L.S.D.<0.01		N.S.	N.S.	0.22	N.S.

The method of application and the quality of organic fertilizers have effects on crop yield and nutrient uptake (Masarirambi et al.; (2010)), and the composts are the major sources of nutrients supplied to crops in organic vegetable production system (Chin-hun et al.; (2005)). Potassium is more or less fixed on soil particles according to the soil type. Uptake of potassium by plants and its transport is enhanced by sufficient nitrate supply (Gaudisova; (1983)).

2-2- Soil conditioner (Latvia compost) experiment

There were no significant differences among cultivars in total nitrogen, potassium, protein content of dry seeds, but the cultivars affected significantly on total phosphorus content (table 11). The highest value of total phosphorus (0.33%) was measured from Sonata cultivar.

Table (11): Effect of *Pisum sativum* L. cultivars on some chemical chara- cteristics of the seed. (depending on soil conditioner)

Cultivars	Nitrogen contennt (%)	Phosphorus contennt (%)	Potassium contennt (%)	Protein contennt (%)
Lincoln	4.25	0.22	1.62	26.54
Rondo	4.52	0.25	1.57	28.26
Sonata	4.25	0.33	1.65	26.56
L.S.D.<0.01	N.S.	0.11	N.S.	N.S.

The effect of soil conditioner levels were shown in the table (12). It was shown significant effect on potassium content, the highest level (1.66%) was recorded from the level 8:4 treatment. Soil conditioner not affected signif- icantly on nitrogen, phosphorus and protein content in dry seeds, but we can observe that the level of 4:8 treatment was the best for nitrogen and protein content.

Table (12): Effect of soil conditioner on some chemical characteristics of the seed.

Latvia compost levels	Nitrogen contennt (%)	Phosphorus contennt (%)	Potassium contennt (%)	Protein contennt (%)
12:0	4.21	0.30	1.65	26.34
8:4	3.91	0.26	1.66	24.43
4:8	4.90	0.24	1.55	30.60
L.S.D.<0.01	N.S.	N.S.	0.09	N.S.

The interaction effects of cultivars and soil conditioner on total nitrogen, phosphorus, potassium, protein content of dry seeds were shown in the table (13). There were significant differences among interaction treatments in phosphorus and potassium content. The highest value of the phosphorus content (0.36%) was observed in the interaction between Sonata cultivar and the level 4:8 of soil conditioner, while the highest value of the potassium content (1.73%) was measured from the interaction between the same cultivar and the silt soil. Organic fertilizers can therefore be used to reduce the amount of toxic compounds (such as nitrates) produced by conventional fertilizers in vegetables (Masarirambi et al.; (2010)).

Table (13): Interaction effects of *Pisum sativum* L. cultivars and soil conditioner on some chemical characteristics of the seed.

Cultivars	Latvia compost levels	Nitrogen contennt (%)	Phosphorus contennt (%)	Potassium contennt (%)	Protein contennt (%)
Lincoln	12:0	3.63	0.30	1.59	22.61
	8:4	3.81	0.19	1.68	23.81
	4:8	5.31	0.17	1.59	33.16
Rondo	12:0	4.11	0.31	1.66	25.66
	8:4	3.99	0.26	1.60	24.91
	4:8	5.48	0.19	1.51	34.22
Sonata	12:0	4.90	0.29	1.73	30.72
	8:4	3.93	0.34	1.70	24.66
	4:8	3.91	0.36	1.55	24.41

L.S.D.<0.01	N.S.	0.19	0.15	N.S.

Generally composts could be used in horticulture and agronomic crop production and land reclamation and vegetation establishment (Manning and Tripepi; (1995)). Composts and cultivars have shown to enhance plant growth in several occasions and these growth enhancements have been attributed to improvement of physical, chemical properties of the growing substances, and the types of genetic information of cultivars. In this study there were considerable low variations in the field parameters and chemical content of dry seeds between the two studied composts.

Conclusion

From our results it can be deduced that there are no big differences between these two composts, when they were used as soil amendment and their suitability for use as horticultural substrates and improves plant growth as our results confirmed. So we can replace the local compost with soil conditioner (Latvia compost) in horticulture applications.

Lincoln, Rondo and Sonata cultivars of pea can be grown successfully in Kurdistan region of Iraq by using the local compost as organic fertilizer.

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تاثير محسن التربة و الكومبوست المحلي في نمو و حاصل ثلاثة اصناف من البزاليا
(*Pisum sativum* L.)

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الخلاصة

تم دراسة تاثير نوعين من الاسمدة العضوية (المحلي و محسن التربة اللاتيفي) في ثلاثة اصناف من البزاليا (*Pisum sativum* L.) وهي Lincoln و Rondo و Sonata، تم اجراء التجربة في البيت البلاستيكي التابع لمركز البحوث الزراعية في وزارة الزراعة لاقليم كوردستان العراق للفترة مابين ١٤- ١١-٢٠١١ و ٢٩-٣-٢٠١٢. حيث استخدمت مستويات مختلفة من السماد العضوي وهي ١٢ جزء تربة مزيجية و ٨ جزء مزيج: ٤ جزء من السماد العضوي و٤ جزء مزيج: ٨ جزء من السماد العضوي. في كلتا التجربتين اعلى معدلات طول الساق و الوزن الجاف للسيقان و الوزن الجاف لـ ١٠٠ بذرة تم الحصول عليها في الصنف Rondo و اكبر عدد للافرع و البذور/ نبات و اكبر عدد للبذور/ قرنة تم الحصول عليها في الصنف Sonata. اعلى القيم لاكثر القياسات الحقلية تم الحصول عليها في المستوى ٨: ٤ في كلا النوعين من الاسمدة العضوية ولكن لم يلاحظ اية تاثيرات معنوية لمحسن التربة في طول الساق و الوزن الجاف لمئة بذرة. في كلا التجربتين التداخل بين الصنف Rondo و التربة اظهرت اعلى المعدلات بالنسبة لطول الساق، كما ان التداخل بين الصنف Rondo و المستوى ٨: ٤ اعطى اعلى المعدلات بالنسبة للوزن الجاف للسيقان و لـ١٠٠ بذرة. بينما اكبر عدد للافرع / نبات و اكبر عدد للقرنات / نبات وكذلك اكبر عدد للبذور / قرنة تم الحصول عليها بتداخل الصنف Sonata و المستوى٤ :٨ من السماد العضوي المحلي ويعد اعلى مما تم الحصول عليه في تجربة محسن التربة في تداخلات مختلفة. اعلى مستوى للبوتاسيوم تم الحصول عليه بتداخل الصنف Sonata مع التربة في تجربة السماد العضوي المحلي، مع ان اعلى مستوى للفسفور و البوتاسيوم في تجربة محسن التربة تم الحصول عليهما بتداخل الصنفSonata مع المستوى ٤: ٨ و التربة على التوالي.