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INFLUENCE OF TILLAGE AND SOME ORGANIC AMENDMENTS ON SOYBEAN YIELD

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ABSTRACT

Field experiment was conducted in seasons 2006 and 2007 to evaluate the response of soybean to different organic amendments under different tillage practices. Organic amendments were, composted amendments Katamya plant residue compost (Kp), katamya city refused compost (Kc) and Kaha plant and cattle mixture compost (Km)) and animal manure (cattle (Cm), poultry (Pm) and goat (Gm)) and control (Control). The tillage treatments were, moldboard plow (MP); chisel plow (CT), and no-tillage (NT). Tillage treatments significantly increased soybean yield compared to the control. In growing seasons, soybean plant growth, yield components and the yield increased under CT followed by MP and NT compared to control. Amended CT and MP increased average yield in both season over NT by 23.0 and 19.0%, respectively. No significant difference in soybean yield was found between CT and MP under both amended and non-amended treatments. However, a significant difference between NT and both CT and MP was found. Across all the tillage treatments, compost amendments increased soybean growth, yield and yield components compared to animal manure. Among compost amendments, amended treatments with Kc produced the highest plant growth, yield components and yield followed by Kp and Km, respectively. While, among animal manure, Cm and Pm treatments significantly increased plant growth, yield components and seed yield as compared to Gm treatments. The results also show that, protein percentage increased with amended treatments by both compost and animal manure. Alternatively, oil content % increased with non-amended treatments. The average of seed protein obtained under CT, MP and NT with compost amendments, increased by 7.0%, 8.0% and 3.0% while, the increase with animal manure was 3.0%, 4.0% and 2.0%, respectively over the control. A significant difference in seed content of N and K was found between composted and animal manure treatments under CT and MP systems. Under NT the difference in NPK between composted and animal manure treatments was not significant. The applied organic amendments influenced growth, seed yield and its components, seed protein and oil content of soybean.

Keywords: Chisel plow, moldboard plow, no-tillage, seed nutrients content, organic amendments, plant growth, soybean yield, yield components.

INTRODUCTION

Organic matter is of a primary importance for maintaining soil productivity and soil sustainability. The need to produce more food for the growing human population is one of man·s greatest challenges. The interest in using organic amendments for crop production is becoming stronger due to its benefits to soil health and the environment, and to its important in reducing the requirements for synthetic fertilizer. Application of organic waste materials to land must, however, take into account both crop needs and the soil potential. Clark *et al.,* (1998) indicated that manure application resulted in beneficial biological, physical and chemical changes in soil properties, such as increased organic matter and available nutrients. Organic materials contain

nutrients needed for crop growth and improving soil tilth, water holding capacity, lessen wind and water erosion, improve aeration, and promote soil biological activity (Lal, 1986). Khater *et al.,* (2004) reported that the effect of organic amendments is depending on its nature, especially its chemical composition and C/N ratio, along with its applied rate or the initial state in soil. Wallace and Terry, (1988), Craul, (1999) indicated that the performance of soil conditioners varies with material type, application rate, climate, soil texture and soil mineralogy. Nyakatawa *et al.,* (2001) and Grandy *et al.,* (2002) found that poultry litter applications improve soil quality compared to chemical fertilizers. Sims, (1987) also found that poultry manure application resulted in significantly greater corn grain yield for a conventional than a no-till system. He also added that the application of organic waste material is a desirable disposal alternative for facing excessive chemical fertilizers application and the costs are usually lower relative to the chemical fertilizers. Nutrients should not be applied in quantities that exceed the amount needed for optimum plant nutrition.

Availability of nitrogen in organic waste depends both on the method of application and days to incorporation into the soil. McAndrews *et al.,* (2006) reported an increase of 0.2-0.5 Mg ha-1 of soybean grain yield in manure-treated plots compared to control (no manure applied). Freeborn *et al.,*(2001) and Schmitt *et al.,* (2001) found that the increase in soybean yield with compost could be attributable to more favorable plant N status from N mineralization because recent studies have presented inconsistent soybean yield responses from in-season N application. De Costa *et al.,* (1997) reported that one of the most influential technical factors on the crop yield is the tillage method since it changes both the physical properties and moisture content of the soil. Kurle *et al.,* (2001) stated that agricultural management practices may significantly influence the organic matter and the plant response to organic amendments often varies and may interact with tillage. The aim of the present study was to evaluate the effects of different organic amendments and three tillage practices on soybean growth, yield components, yield and seed NPK content.

MATERIALS AND METHODS

A Field experiment was conducted at the Agriculture Experimental Station, Faculty of Agricultural, Cairo University in 2006 and 2007 seasons. The experimental design was a randomized complete block in a split-plot arrangement of treatments with three replications. Soil samples were collected from the top 0-30 cm to determine some soil properties Table (1). These properties were determined according to Black *et al.,* (1965). The tillage main plots (3.5 m wide by 50 m long) were consisting of moldboard (MP); chisel plow (CT), and no-tillage (NT). Subplots (3.5 m x 3 m) consisted of applications of composted amendments and animal manure. The composted treatments were, (Katameya plant residue compost (Kp), Katameya city refused compost (Kc) and Kaha plant and cattle mixture compost (Km)), the animal manure were, (cattle manure (Cm), poultry wastes (Pm) and goat wastes (Gm)) and control (no addition). Organic amendments

properties analyses are listed in Table (2). The moldboard and chisel plow operations were conducted after organic amendments application to the soil surface in two blocks while, the third had the no-tillage. In the no-tillage system, organic amendments were applied on the soil surface. The applied rate of the organic amendments under all the tillage treatments was 4.0 ton /feddan. No chemical fertilizers were applied. Soybean *Glycine max* (L.), Merr. v.c. Giza 35 was planted in 20th and 25 th May of 2006 and 2007 seasons, respectively. Seeds were sown in hills at 20 cm distance. Soybean seeds were inoculated with an effective strain of *Bradyrizobium japonicum* immediately before sowing. The following characteristics were studied:

Table (1): Some soil properties of the studied experimental site.

Soil depth (cm)	Particle size distribution (%)			Texture class	pH	ECe $dS.m^{-1}$	OM %	Total (%) of		
	Sand	Silt	Clay					N	P	K
0-15	45.6	31.7	22.7	Loam	7.87	1.47	1.84	0.17	0.13	0.18
15-30	41.9	25.3	32.8	C.loam	7.82	0.89	1.74	0.13	0.12	0.16

2.1. Growth characters

Weight of shoot (gm/plant), weight of root (gm/plant) and stem length (cm).

2.2. Yield and yield components

Soybean was harvested in mid September, three interior soybean rows from each plot were taken to determine seed yield. The following parameters were studied:

Seed yield (ton/fed.), number of pods/plant and weight of 100 seed (gm).

2.3. Oil content (%): Seed oil content % was determined using Soxhlet continuous extraction apparatusas according to the method described by Association of Official Analytical Chemists (A.O.A.C. methods 1990).

Table (2): Chemical analysis of the organic amendments.

properties	Organic amendments					
	Kc	Kp	Km	Cm	Pm	Gm
pH (1:10)	8.30	6.60	7.76	7.47	7.82	7.97
EC (1:10) (dS/m)	5.40	1.60	1.80	2.78	4.15	4.90
OM%	32.85	42.84	47.51	72.48	58.00	52.84
Total						
N%	1.25	1.40	1.32	2.15	2.00	0.83
P%	0.35	0.60	1.50	0.45	0.70	0.21
K%	0.69	0.79	1.50	1.23	0.90	0.67
Fe ppm	1959.0	630.0	770.0	840.0	500.0	603.0
Mn ppm	257.0	157.0	260.0	411.0	130.0	106.0
Zn ppm	382.0	40.0	150.0	160.0	140.0	38.0
Cu ppm	30.0	30.0	67.0	98.0	120.0	56.0
C/N	15.46	18.00	21.17	19.83	17.06	37.45

2.4. Nutrients analysis and protein content %

Seed content of NPK was determined as follows: N% was estimated by using micro Kjeldahl method, as described by A.O.A.C. (1990). The protein

content (%) in seeds was calculated by multiplying total nitrogen % by a factor of 6.25, P % was determined according to A.O.A.C. (1990) and K % was determined by using Flame Photometer.

Statistical analysis:

The data were analyzed using the analysis of variance (ANOVA) according to Gomez and Gomez (1984). The treatments means were compared using least significant difference (L.S.D).

RESULTS AND DISCUSSION

1. Effect of tillage and organic amendments on

1.1. Plant growth characters

Data presented in Table (3) show that tillage practices affect soybean growth in both growing seasons. The highest shoot weight, root weight and stems length was obtained under CT followed by MP and NT as compared to Control in both seasons. Raji *et al.,* (1999) stated that soybean plants grown with no-tillage often appear smaller than those grown with conventional tillage. The amended treatments produced higher shoot and root weight and stem length compared to control (non-amended treatments) in both growing seasons.

Table (3): Some growth characters of soybean plants as affected by tillage and organic amendments.

Organic amendments	Tillage treatments					
	(2006)			(2007)		
	Shoot weight (gm/plant)	Root weight (gm/plant)	Stem Length (cm)	Shoot weight (gm)	Root Weight (gm)	Stem Length (cm)
	(CT)					
Kc	21.63	12.02	115.30	21.49	13.25	112.0
Kp	16.90	8.70	97.30	17.45	10.21	96.20
Km	14.35	7.18	93.00	14.19	8.65	91.40
Cm	17.37	7.83	86.50	16.87	6.86	85.30
Pm	16.62	6.97	84.60	17.04	6.65	81.60
Gm	13.89	5.37	75.70	13.68	5.24	77.40
Control	11.48	5.72	78.20	10.76	5.86	76.50
	(MT)					
Kc	20.17	10.51	105.20	19.84	9.62	102.00
Kp	14.31	7.79	95.40	15.63	8.27	91.00
Km	11.36	5.62	91.20	10.81	5.41	86.50
Cm	16.85	6.88	83.60	17.16	7.19	79.00
Pm	16.49	5.92	81.20	16.22	6.57	78.20
Gm	12.74	4.86	72.50	13.72	5.63	68.40
Control	10.61	5.46	68.3	10.35	5.18	67.20
	(NT)					
Kc	13.37	7.15	81.30	14.29	8.24	84.60
Kp	11.15	5.22	77.20	11.29	5.72	75.70
Km	8.28	4.18	70.40	9.31	4.54	71.60
Cm	10.28	5.27	76.40	10.93	6.14	78.21
Pm	9.3٧	5.21	74.50	9.٩٥	5.48	76.83
Gm	8.36	4.26	69.72	7.62	4.59	73.42
Control	7.25	3.27	57.60	7.49	3.48	58.70
L.S.D. 0.05	**2.157**	**0.984**	**5.839**	**1.819**	**1.026**	**4.260**

The highest shoot and root weight and stems length were recorded with (Kc) while, the lowest shoot, root and stems length were recorded with Gm. Kc significantly increased all the studied parameters under all the tillage systems, as compared to the other organic amendments in both growing seasons. On the other hand, both Cm and Pm were significantly different than Gm. Under NT treatments, no significant difference between Km and Gm in all the studied parameters was detected.

1.2. Yield components

Data in Table (4) show that the highest and the lowest number of pods, pods weight and 100-seed weight were obtained under CT and NT, respectively as compared to control. Yield components with MP were not significantly different than CT. However, both CT and MP were significantly different than NT. The data show that amended CT, MP and NT with compost amendments produced the highest yield components than the animal manure. The highest number of pods, pods weight and 100-seed weight were obtained with Kc followed by Kp and Km compared to the control. The increase in yield components was less with Cm, Pm and Gm.

Table (4): Effect of tillage and organic amendments on yield components of soybean.

Organic amend-ments	Tillage treatments									
	(2006)					(2007)				
	No. of pods	Pods Weight (gm/ plant)	100-seed weight (gm)	Seed Protein (%)	Oil Content (%)	No. of pods	Pods Weight (gm/ plant)	100-seed weight (gm)	Seed Protein (%)	Oil Content (%)
	(CT)									
Kc	102.0	60.38	23.18	42.81	17.54	107.0	64.29	23.41	42.65	17.27
Kp	87.0	51.56	22.72	42.56	18.42	91.0	53.54	22.93	42.35	18.21
Km	6٩.0	40.79	22.49	39.68	18.93	72.0	42.36	22.61	39.38	18.73
Cm	59.0	38.75	22.53	40.55	19.14	56.0	37.36	22.26	40.42	18.56
Pm	57.0	36.92	22.81	40.36	19.08	58.0	35.94	22.73	40.27	18.75
Gm	51.0	34.79	21.32	39.82	19.53	49.0	31.44	20.42	38.97	19.63
Control	41.0	26.15	20.18	38.81	20.64	36.0	23.49	19.83	38.52	20.58
	(MT)									
Kc	104.0	61.24	22.42	42.17	17.64	109.0	63.35	22.18	42.35	16.59
Kp	86.0	49.81	21.82	41.73	18.17	85.0	49.27	21.76	42.01	17.87
Km	67.0	36.58	20.62	40.05	18.64	70.0	40.54	20.35	38.77	18.72
Cm	56.0	36.64	20.10	39.51	18.84	61.0	39.14	19.48	39.26	18.73
Pm	54.0	34.95	20.36	39.25	18.65	58.0	38.52	20.13	38.61	19.21
Gm	48.0	30.36	19.89	38.81	20.59	49.0	33.91	19.87	37.72	19.58
Control	39.0	24.91	19.64	37.98	20.61	37.0	25.53	18.92	37.42	20.45
	(NT)									
Kc	73.0	41.32	19.83	37.82	18.30	74.0	43.28	20.34	38.71	18.24
Kp	69.0	40.15	19.52	38.20	18.87	71.0	41.52	20.14	38.79	18.90
Km	56.0	31.39	19.47	37.24	19.51	56.0	32.47	19.13	37.12	19.60
Cm	49.0	28.51	19.54	37.69	19.13	51.0	29.51	19.65	38.60	19.32
Pm	52.0	30.32	19.31	37.31	19.46	50.0	29.06	19.53	37.89	19.57
Gm	36.0	21.18	19.18	36.72	19.85	41.0	23.80	19.24	36.38	20.38
Control	33.0	18.56	19.36	36.58	20.13	34.0	18.81	19.49	36.95	20.35
L.S.D. 0.05	**13.301**	**8.948**	**0.452**	**0.993**	**0.747**	**4.790**	**4.059**	**ns**	**1.105**	**0.833**

Regarding seed protein and oil content %, seed protein increased with compost amendments compared to the control. In both seasons, the increase percentages in seed protein with Kc, Kp and Km under CT were 10%, 9% and 2%, under MP were 12.0%, 10% and 3.0%, while under NT, the increase was 3.0%, 4.0% and 2.0 %, respectively over the control. The increase in seed protein with animal manures, under all tillage systems; was lower than those obtained under Kc and Kp. While, no significant difference was found between Km and the studied animal manure under all tillage systems. On the contrary, the maximum oil content % of seeds was obtained under NT while, the minimum oil content % was obtained under CT and MP. The averages of oil content % under composted CT, MP and NT were lower by 11.0%, 12.0% and 6.0%, while the average with animal manure were lower by 7%, 6% and 3.0%, respectively than the control. These data illustrate that the highest reduction in oil content was recorded under both CT and MP while, the lowest reduction was recorded under NT. Also, it is recognized that compost amendments increased seed protein whereas, animal manure increased oil content of the seed.

1.3. Nutrient Uptake

The effect of tillage and the different amendments on macro-nutrients content of soybean seeds are given in Table (5).

Table (5): Seed NPK content % as affected by tillage practice and organic amendments.

Organic amendments	Tillage treatments								
	(2006)								
	(CT)			(MP)			(NT)		
	N	P	K	N	P	K	N	P	K
Kc	6.85	0.71	1.51	6.79	0.70	1.36	6.05	0.66	1.24
Kp	6.81	0.80	1.32	6.68	0.78	1.35	6.11	0.65	1.23
Km	6.35	0.65	1.29	6.57	0.60	1.31	5.96	0.58	1.10
Average	**6.67**	**0.72**	**1.37**	**6.68**	**0.69**	**1.34**	**6.04**	**0.63**	**1.19**
Cm	6.48	0.69	1.35	6.32	0.66	1.31	6.03	0.61	1.22
Pm	6.44	0.70	1.31	6.27	0.67	1.28	5.97	0.65	1.19
Gm	6.26	0.67	1.23	6.21	0.62	1.24	5.86	0.56	1.08
Average	**6.39**	**0.69**	**1.29**	**6.27**	**0.65**	**1.28**	**5.95**	**0.61**	**1.15**
Control	6.21	0.62	1.20	6.06	0.60	1.21	5.74	0.57	1.09
	(2007)								
Kc	6.82	0.67	1.48	6.78	0.69	1.39	6.19	0.64	1.25
Kp	6.78	0.78	1.34	6.72	0.75	1.29	6.21	0.62	1.25
Km	6.30	0.63	1.27	6.39	0.58	1.25	5.94	0.61	1.16
Average	**6.63**	**0.69**	**1.36**	**6.63**	**0.67**	**1.31**	**6.11**	**0.62**	**1.22**
Cm	6.47	0.67	1.34	6.28	0.64	1.32	6.18	0.62	1.23
Pm	6.46	0.68	1.31	6.18	0.64	1.30	6.06	0.61	1.21
Gm	6.21	0.61	1.19	6.04	0.61	1.17	5.82	0.54	1.13
Average	**6.38**	**0.65**	**1.27**	**6.17**	**0.63**	**1.26**	**6.02**	**0.59**	**1.19**
Control	6.19	0.60	1.17	5.94	0.58	1.18	5.91	0.55	1.12
L.S.D. 0.05 (All tillage)	**(2006)**			**(2007)**					
N%	0.256			0.179					
P%	0.075			0.076					
K%	0.050			0.042					

The seed content of NPK were in sufficient range adequate for normal plant growth. Amended soil with compost increased NPK content compared to animal manure. Under CT and MP a significant difference in average of both N and K was found between composted and animal manure. However, no significant difference in P content was found. The NPK under NT, were lower than CT and MP. No significant difference in NPK was detected under NT in both seasons. The lower seed content of NPK may be due to the surface compost application which may not be as efficient as incorporation because of additional N loss or nutrient stratification, Singer *et al.,* (2004). Among compost treatments, the highest seed content of NPK was found in seeds fertilized with Kc followed by Kp. There was no significant difference between Kc and Kp and also, between Cm and Pm in seed content of NPK.

1.4. Grain yield

Soybean yields as affected by tillage practices and the different organic amendments in the two growing seasons are presented in Table (6). Tillage practices significantly increased grain yield of soybean compared to control. The highest seed yield was obtained with amended CT followed by MP while, the lowest seed yield was obtained with NT as compared to Control. The increase in average yield with amended CT and MP over NT was about 23.0 % and 19.0 %, respectively in the first season and 21.0% and 18.0% in the second season. These results are in agreement with Vyn *et al.,* (1998) and Kastsvairo *et al.,* (2002) as they found that yields with no-tillage tended to be lower than the yields with chisel or moldboard systems. Comparing to the control, CT, MP and NT increased seed yield by about 38.0%, and 39.0% and 33.0%, respectively in both growing seasons. Seed yield from composted treatments were greater than those from animal manure treatments. Across the amended treatments under NT system, Kc, Kp, and Km increased yield by about 62.0%, 56.0% and 31.0% while, with animal manure the increase was about 13.0%, 19.0% and 4%, respectively over the control in both seasons.

Table (6): Soybean yield (ton/fed.) as affected by tillage practices and organic amendments.

Organic amendments	Tillage treatments					
	(2006)			(2007)		
	(CT)	(MP)	(NT)	(CT)	(MP)	(NT)
Kc	١,16	1.14	0.84	1.19	1.15	0.86
Kp	0.98	0.95	0.82	1.03	0.97	0.85
Km	0.83	0.81	0.74	0.85	0.86	0.72
Cm	0.77	0.74	0.61	0.75	0.73	0.64
Pm	0.75	0.72	0.64	0.76	0.74	0.67
Gm	0.67	0.64	0.56	0.64	0.62	0.58
Average	**0.86**	**0.83**	**0.70**	**0.87**	**0.85**	**0.72**
Control	0.61	0.58	0.52	0.62	0.59	0.53
L.S.D 0.05	0.032			0.026		

These results indicate that higher soybean yield can be achieved under NT with compost amendments. Also, the difference between no-tillage and conventional tillage can be eliminated by using compost amendments under NT system. No significant difference between CT and MP was found, but both were significantly different than NT under amended and non-amended soil.

CONCLUSION

The mean seed yield from compost and animal manure treatments was greater than the control. Compost amendments however, were more effective in increasing soybean yield, yield components and seed content of NPK nutrients. The effect of both CT and MP were similar on soybean growth, yield and yield components. Both CT and MP significantly increased seed yield compared to NT. The beneficial effect of compost amendments on plant growth can be ordered as follows Kc> Kp> Km while, the animal manure amendments were as follows Cm≥ Pm> Gm. The results suggest that macro-nutrients were not responsible for the yield increase; the improved soil physical, chemical and biological properties that due to the effect of organic amendments led to the increase of the soybean yield. The highest protein content was found in seed fertilized with compost amendments compared to treatments received animal manure amendments. On the contrary, maximum oil contents were found in the control treatments. The study concluded that the response of soybean plants changes with the sources of organic amendments. The best combination of tillage and amendment for higher soybean yield can be determined. Soybean producers can enhance yield and eliminate yield differences between conventional and no-tillage systems by compost application.

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تـأثير بعـض عمليـات الخدمـة الميكانيكيـة و بعـض المـواد العضـوية علـى محصـول فـول الصويا

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أجريت تجربة حقليه بمزرعه محطة البحوث الزراعية جامعة القاهرة خلال الموسمين الصيفيين ١٩٩٦/١٩٩٧ وصممت بنظام القطاعات الكاملة العشوائية (المنفصلة) فى اربع مكررات وقد شملت التجربة ثلاثة انظمة من خدمة التربة وهى الحرث بالمحراث الحفار(CT) والمحراث القلاب(MP) ونظام عدم الخدمة (NT). وكذلك شملت التجربة دراسة تأثير ستة أنواع مختلفة من المادة العضوية تحت أنواع الخدمة المختلفة. والمادة العضوية المضافة هى ثلاثة أنواع من الكمبوست (كمبوست قمامة القطامية (Kc)، كمبوست نباتى القطامية (Kp)، كمبوست قها خليط نباتى و حيوانى (Km) و ثلاثة أنواع من مخلفات حيوانات المزرعة (سماد الماشية،سماد زرق الدواجن،سماد الماعز) و قد تم دراسة تأثيركل من نظم الخدمة المذكورة و الانواع المختلفة من المادة العضوية على نمو نباتات فول الصويا وبعض مكونات المحصول و محصول البذور. و يمكن تلخيص

أهم النتائج المتحصل عليها فى موسمى الزراعة فيما يلى:-

١- أشارت النتلئج الى أن اعلى نمو و اعلى محصول و اعلى القيم لصفات عدد القرون ، وزن القرون ، وزن المائة بذرة كان عند تطبيق نظام الخدمة بالمحراث الحفار يلية نظام الخدمة بالمحراث القلاب. بينما أعطى نظام عدم الخدمة أقل محصول. وفى التربة المسمدة كانت نسبة الزيادة تحت نظام CT,MP هى على الترتيب 23.0% و١٩,٠% وذلك بالمقارنة بنظام غدم الخدمة.

٢- لم يكن هناك فرق معنوى بين نظامى الخدمة CT وMP بينما كان هناك فرق معنوى بينهما و بين نظام عدم الخدمة.

٣- أختلفت أستجابة نمو النباتات و المحصول و مكوناتة بأختلاف نوع المادة العضوية المضافة للتربة فكانت اعلى قيم للنمو و المحصول و كذلك مكوناتة عند أضافة كمبوست قمامة القطامية (Kc) يلية كمبوست القطامية النباتى (Kp) ثم كمبوست قها النباتى و الحيوانى (Km). و عند أستعمال سماد المزرعة كانت أعلى قيم متحصل عليها للصفات المدروسة هو عند أضافة سماد الماشية يلية زرق الدواجن ثم سماد الماعز.

٤- لم يكن هناك فرق معنوى بين Kc و Kp بينما كان هناك فرق بينهما و Km.

٥- أثرت معاملات الخدمة و أضافة المادة العضوية على كل من نسبة البروتين و محتوى البذور من الزيت. فقد سجلت اعلى نسبة بروتين فى المعاملات المسمدة بالكمبوست يليها المعاملات المسمدة بسماد حيوانات المزرعة. أما بالنسبة لمحتوى البذور من الزيت فقد زاد فى معاملة الكنترول بالمقارنة بباقى المعاملات.

٦- زاد محتوى البذورمعنويا من الـ NPK فى المعاملات المسمدة بالكمبوست و ذلك بالمقارنة بالمعاملات المسمدة بسماد حيوانات المزرعة.

٧- يمكن للمزارع أن يقلل الفرق فى محصول فول الصويا بين نظام عدم الخدمة و نظامى الحرث و ذلك بأضافة الكمبوست حيث سجل اعلى قيم للصفات المدروسة و ذلك بالمقارنة بسماد المزرعة.