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The Effects of Different Cattle Manure Levels and Branch Management Methods on Organic Production of *Cucurbita pepo* L.

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Abstract: To study the effects of different cattle manure levels and two branch management methods on organic production of Schneider squash, a field experiment was conducted during years 2005 and 2006. Treatments consisted of four manure levels (10, 15, 20, 25 tons ha^{-1}) and two branch management methods (with and without wood pole), which were allocated to main plots and subplots, respectively. Results showed that branch management method without wood pole was better than branch management method with wood pole. The first year results showed that increase of manure level had significant effect on fruit and seed yields. However, these traits were not significantly affected by manure levels in the second year. For both years, there were no differences in seed numbers due to manure levels. Seed oil content was slightly increased when manure level was increased from 10 to 25 tons ha^{-1}. This study showed that use of 20 tons ha^{-1} cattle manure is a suitable organic production system of Schneider squash which give a suitable yield with high seed oil content, without using chemical fertilizers.

Key words: Schneider squash · Manure · Seed oil · Yield · Organic production

INTRODUCTION

In recent years, safety and health of food has been becoming a major concern due to over use of chemicals for food production and its negative impacts for human health and environment [1, 2]. Furthermore, use of colorant and chemical food additives has caused a serious threat to the aspects of safety in food processing. In this context, use of natural food and plant products from the natural habitats including medicinal plants is gaining important. On the other hands, cultivation of medicinal plants and other food plants with medicinal properties have been expanded [3]. One of such causes is production of oil seed plants with unsaturated fatty acids such as oleic and linoleic acid [4-6]. *Cucurbita pepo* is an important oil seed plant which is used in food and also in cosmetics and health items [7-9]. This species belongs to family cucurbitaceae which includes plants with a prostrate stem. Seeds are coatless with a thousand weight of 200-210 g [6,8]. Active ingredients of the seed are fatty acids, vitamin E and phytosterols (β-sitosterol). Some medicines made from seeds of these plants are Peponen, Graun fink, Prostaliquid, Phosphostrol, Pepostrin and Kurbiskern [4,6,8]. Murkovic *et al.* [9] reported that seeds of some *C. pepo* species contained 39.5-56.5% oil and 21-67.4% linoleic acid in its oil. They also noted that delaying the harvest of fruits and a decrease in a temperature at maturity caused these constituents to be increased. In other studies, Seeyami *et al.* [10] reported that oleic and linoleic acids in the seeds were 75.98-81.84 and 12.1-16.54 %, respectively. They also reported a value of 3.88 percent for myristic acid. Murkovic *et al.* [9] and Younis and Al-Shihry [6] reported that the major components (more than 99%) of *C. pepo* oil are linoleic, oleic, palmitic and stearic acids. Berenyi [3] reported that small fruits are suitable for oil production and large fruits for other purposes including seed production or cattlefeeds.

Due to increasing attention to medicinal plants and their products and lack of enough information about their response to manure application and organic production, the purpose of this experiment was to study the effects of different manure levels and branch management methods on yield, oil and protein content of *C. pepo*.

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MATERIALS AND METHODS

This study was conducted during the two growing seasons of 2005 and 2006 in the Research Farm of Faculty of Agriculture, Ferdowsi University of Mashhad, Iran, located on East latitude of 36°, 15' and North longitude of 59°, 28' with 985 m altitude above sea level. The experiment was designd as split plots based on randomized complete block design with three replications. Plots dimensions were 9×3.5 m. Cattle manure levels were 10, 15, 20, 25 tons ha^{-1} and were applied in the main plots and branch management method (with and without wood pole) were allocated to the subplots. The soil type of the experimental field was sandy clay loam with a pH of 7.5 to 7.8 and 0.25 to 0.30% organic matter (Table 1). Nutrient contents of manure used were 2.11, 0.73 and 1.88% N, P and K, respectively. Planting was carried out on April 20, 2005 on rows 3 m apart with 50 cm between each plant on rows. No chemical fertilizers or biocides were applied and weeds were controlled by hand. Plants were irrigated every 8 days. After plants grown on the plots with wood pole treatment, wood poles were fixed adjacent to each plant and related to each other with cotton rope. In the second year no soil tillage was conducted and seeds were planted on the same place and the same date as the first year. However, based on the results of the first year in which superiority of plants without wood pole was confirmed, this treatment was not continued for the second year of experiment. Therefore, in the second year only the effect of manure was investigated and the experiment was analyzed with levels of manure only. In both years, when the fruits color turned to yellow, there were collected and the necessary measurements were made on fruits and seeds including fruit yield, seed yield, seed oil and protein contents. Data were analysed by analysis of variance (ANOVA) and regression using Minitab software Ver. 13 and means were compared with Duncan's multiple range test at 0.05 probability level.

Table 1: Selected soil properties of the experimental field

	Soil depth (cm)	
Properties	0-15	15-30
Total N (%)	0.077	0.068
Available P (ppm)	45.000	41.000
Available K (ppm)	480.000	465.000
C/N	13.200	12.500
pH (saturation extract)	7.800	7.600
Organic C (%)	0.580	0.520
Water storage capacity (%)	24.300	22.000
Bulk density (g cm^{-3})	1.420	1.540

RESULTS AND DISSCUSION

Results of combined analysis of the experimental data (without respecting of wood pole) are shown in Table 2. The effect of manure application on fresh fruit yield was significant; however, manure application did not affect seed dry weight and seed number.

Yield of fresh fruits for two years and the averages are shown in Fig. 1. With increasing the level of cattle manure up to 25 tons ha^{-1} increase the yield of fresh fruit. However, in the second year application of manure did not affect yield. Application of cattle manure at a rate of 10-20 tons ha^{-1} resulted in a significantly increase in yield of fresh fruit, however no significant differences between 10 and 15 tons ha^{-1} were observed. In general, the effect of cattle manure level was somehow inconsistent and a reduction of yield at 25 tons ha^{-1} seems to be unusual. However, it may be postulated that the effect of cattle manure on this species is achieved up to 20 tons ha^{-1} and further increase may have a detrimental effect possibly due to plants die off. It also could be assumed that higher levels of cattle manure might have caused water to be stored in the root zone and hence spread of root pathogens. Visual investigation showed that more dead plants at the highest manure level (25 tons ha^{-1}) which could have been associated with this effect.

Bombardelli and Morazzoni [8] and Khorrami-Vafa [11] indicated that a well drained soil is suitable for this species. This could be an indication of sensitivity of plants to high level of water in the root zone. On the other

Table 2: Combined analysis of fresh fruit yield, seed yield and seed number of *cucurbita pepo*

		Mean of squares (MS)		
Source of variation	Degree of freedom	Fresh fruit yield	Seed dry weight	Seed number
Year	1	*18.904	975.308**	416925.805**
Replication per year	4	1.705	4.787	3240.112
Manure	3	7.378*	7.054^{ns}	6880.268^{ns}
Manure × Year	3	6.989	8.818^{ns}	3764.737^{ns}
Error	12	2.100	5.933	3253.512
Total	23	-	-	-

ns: non significant, *: significant at $p<0.05$, **: significant at $p<0.01$
Fruit yield

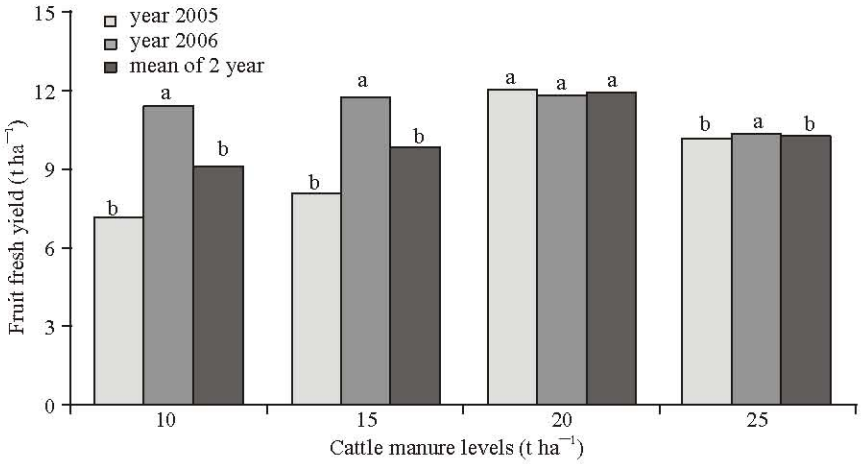

Fig. 1: Effect of cattle manure levels on *C. pepo* fresh fruit yield. Similar letters indicate no significant differences between treatments within a year ($p<0.05$)

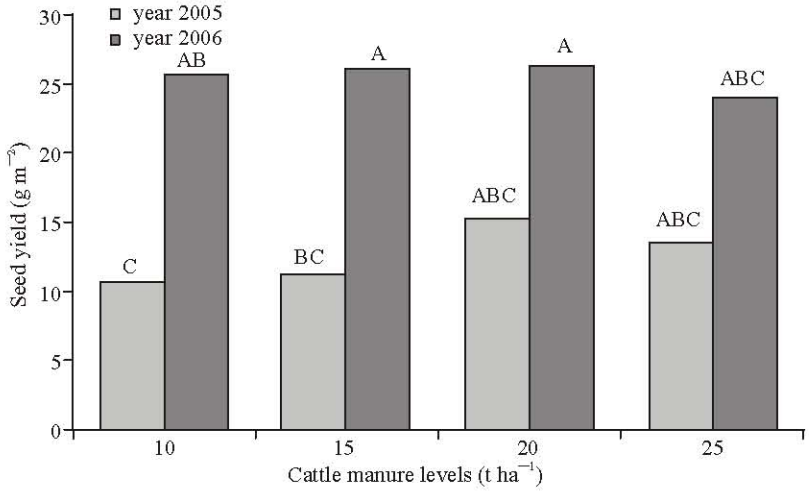

Fig. 2: Interaction between cattle manure levels and year of experiment on *C. pepo* seed yield. Means that followe the same letters do not differ at $p<0.05$

chand, also Aruyi *et al.* [7] reported that application of high level of nitrogen fertilizers have caused fresh vegetative growth and hence low yield of fruit. Therefore, low yield at 25 tons ha^{-1} of cattle manure could be associated with higher water level in the root zone and also availability of more nitrogen which changes the proportion of vegetative to generative growth.

Seed yield: Figure 2 shows that increasing cattle manure level from 10 to 20 tons ha^{-1} in first year, seed yield was increased but there was no further increase by increasing the level of manure to 25 tons ha^{-1}. However, in the second year there was no significant difference between seed yield.

By comparing Fig. 1 and 2 it is appeared that the trends of change in fruit and seed yields are somehow similar. In general, the response of both components to cattle manure was higher in the second year compared to the first year. This is not unusual because more nutrients are released in the second year [12,13]. However, lack of response to fertilizer levels seems unclear. In other words, the reason why there was no difference between fruit or seed yield at 10 tons ha^{-1} and other manure level is unusual.

Number of fruits and seeds: Table 3 shows that the number of healthy fruits per hectare was not affected by manure levels; however, in the second year this was higher at 15 and 20 tons ha^{-1} manure, compared with other levels. As expected this trend was also noticed for fresh fruit yield. Number of seeds per fruit and also thousand seed weight were not

Table 3: Means number of healthy fruits, individual fruit weight, number of seed per fruit and thousand seed weight of *C. pepo*

		Cattle manure levels (tons ha^{-1})				
Year of experiment	Measured traits	10	15	20	25	Means
First year (2005)	Number of healthy fruits per hectare	3333^{A}	3174^{A}	4444^{A}	3809^{A}	3690
	Fruit weight (kg/fruit)	1.6^{A}	1.6^{A}	1.5^{A}	2^{A}	1.67
	Number of seeds per one fruit	268^{A}	301^{A}	293^{A}	291^{A}	288
	1000 seeds weight (g)	121^{A}	116^{A}	117^{A}	122^{A}	119
Second year (2006)	Number of healthy fruits per hectare	3174^{B}	3968^{A}	4285^{A}	3015^{B}	3603
	Fruit weight (kg/fruit)	0.9^{A}	1.4^{A}	1^{A}	1.4^{A}	1.17
	Number of seeds per one fruit	623^{A}	520^{A}	497^{A}	619^{A}	564.7
	1000 seeds weight (g)	127^{A}	125^{A}	121^{A}	128^{A}	125

-Means followed by the same letter, do not differ at $p<0.05$

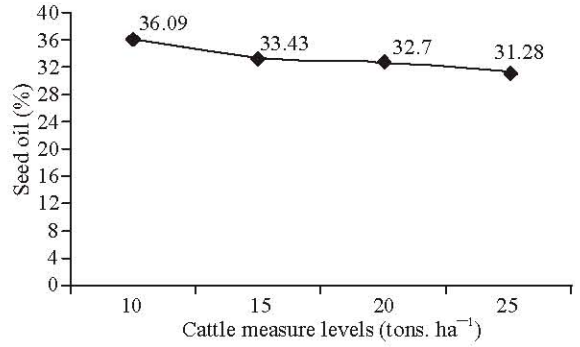

Fig. 4: Effect of cattle manure levels on seed protein content

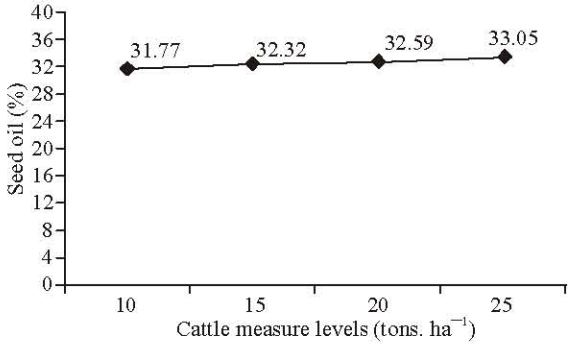

Fig. 3: Effect of cattle manure levels on seed oil content

affected by manure application (Table 3). However, this component was higher in the second year compared to the first year at all levels of manure. Kuepper [12] and Lampkin [13] indicated that in the first year of application, only 50 percent of nutrients for cattle manure are available for the plants. In general, it can be concluded that changes in seed yield associated with manure application was mainly due to number of fruits per hectare rather than other yield components.

Table 4: *Cucurbita pepo* fresh fruit yield (kg.ha^{-1}) within two branch management methods and four cattle manure levels

Branch management method	Cattle manure levels (tons ha^{-1}) 10	15	20	25	Mean
with wood pole	6711^{B}	7587^{B}	10885^{A}	7841^{B}	8256^{B}
without wood pole	7483^{B}	8479^{B}	12879^{A}	12463^{A}	10315^{A}
Mean	7074^{C}	8033^{BC}	11882^{A}	10152^{B}	

-Means followed by the same letter, do not differ at $p<0.05$

Method of branch management: Table 4 shows that fruit yield for branch management without wood pole is higher than the method with wood pole and this seems to be true at all levels of cattle manure. It appears that when a branch of plant is arranged on the pole and ropes between the poles, the hang fruit are more susceptible to wind and therefore poleless plants produced more fruit.

Protein and oil content: Increasing the cattle manure rates resulted in a decrease in oil percent (Fig. 3). Such reduction in oil % estimated by 5 % when cattle manure was applied at rate of 10-25 tons ha^{-1}. Similar results are in agreement with those obtained by Aruyi *et al.* [7].

Also, protein % was increased by increasing the cattle manure rates from 10-25 tons ha^{-1} (Fig. 4), such increase in protein % may be due to the increase of nitrogen fertilization which reported by Khorrami-Vafa [11] and Levitte [14].

CONCLUSION

Effect of cattle manure on fruit and seed yield are almost similar and increasing the rate of cattle manure up to 20 tons ha^{-1} resulted in increase in fruits and seed yield, but further increase in cattle manure either did not change the yield or slight reduction was observed. Therefore, an optimum amount of cattle manure seems to

be 20 tons ha^{-1}. The effect of cattle manure, as expected, was higher in the second year than in the first year and this was more pronounced for seed yield compared to the fresh fruit yield.

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