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Research Article

STUDY OF ORGANIC SUBSTRATE AND PHOSPHATE AND ZINC FERTILIZATIONS ON SOME AGRONOMIC CHARACTERS, SEEDS AND YIELD OF PUMPKIN (*CUCURBITA PEPO* L.)

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ABSTRACT
Understanding the interactions and relationships between fertilizer and minerals help to have optimum fertilization practice with the lowest costs. In a split-split plot field experiment, we studied the effect of some organic substrate (control (soil), spent mushroom substrate (SMS), cow manure and vermicomposts), different levels of phosphorus (at 0, 75, 100 and 125 kg h $^{-1}$) and zinc foliar application (0 and 1000 mgl^{-1}) to investigate the best treatment for some characters of medicinal pumpkin (*Cucurbita pepo* L.) such as: leaf, stem length, fruit weight, dry matter percentage, seed number, phosphorus and protein content of seeds and TSS. For lonely application of organic substrates, phosphorus concentration and zinc foliar application; vermicomposts, 125 P (kg.ha^{-1}) and 1000 Zn (mg l^{-1}) treatments resulted the high improved in pumpkin seeds and qualities. For combining application of organic substrate×P levels, organic substrate×Zn levels, P levels× Zn levels and organic substrate×P levels×Zn levels, reslts showed the maximum of seed number with high quality (protein) were found in cow manure×125P, vermicomposts×1000 Zn, 125P×1000Zn and vermicomposts×100P×1000 Zn, respectively.

Keywords: *Pumpkin (Cucurbita pepo L.), Spent Mushroom Substrate (SMS) and Organic Substrate*

INTRODUCTION
Medicinal Pumpkin (*Cucurbita pepo* L.) is an important annual plant that belongs to the Cucurbitaceae family. It does not grow naturally in Iran, but recently has been planted and has been used as medicine in Iran. The seeds of pumpkin contain medicinal raw materials that are used for producing pharma-ceutical products such as peponen, pepostrin and gronfing to overcome prostatic hypertrophy and urinary tract irrita-tion (Younis *et al.*, 2000). Pumpkin's seed oil is rich in unsaturated fatty acids including linoleic acid, oleic acid, and palmitic acid, phenolic compounds and antioxidant vitamins, such as carotenoids and tocopherol. Due to high omega-3 (6 and 9)-fatty acids, seeds and oil have been claimed to promote HIV/AIDS wellness (Yousefi and Zandi, 2012).
In a constant effort to improve yields and profitability of highly productive cropping system, nutrient management remains a cornerstone practice to assist in this endeavor. Phosphorus (P) is a major nutrient applied by producer and sufficient P supply early in the growing season is necessary maximize crop yields (Grant *et al.*, 2001). Grain crops, especially canola, germination and emergence can be reduced if too much phosphate is placed with the seed (Karamanos *et al.*, 2014). Therefore, producers constantly must ensure that crops have adequate levels of available P. Das *et al.*, (2005) showed that application of phosphorus and zinc in a same time, cauused to have negative effect on Zn availability in soil and decreased the Zn absorption. Also Rehim *et al.*, (2014) reported that application of 80 (Kg ha^{-1}) increased the rice yield but increasing of phosphorus concentration from 80 up to 120 (Kg ha^{-1}) caused to soil toxicity and decreased the yield.
Foliar fertilization is an effective practice for the application of some micronutrients, since it uses low rates and the micronutrient does not directly contact the soil, avoiding losses through fixation. For example, one possible approach to minimize drought-induced crop losses is the foliar application of zinc (Zn), which is an essential trace element for every living organism. About 200 enzymes and transcription factors require Zn as a functional component (Yousefi and Zandi, 2012). Zinc is known to have an important role; either is involved on the activity of enzymes such as chlorophyll biosynthesis, auxin,

protein, carbohydrate and lipid metabolism, nucleic acid and membrane integrity (Yadav, 2010). Sorkhi lalelou *et al.,* (2013) reported that sufficient application of Zn (30 mM) lead to high chlorophyll (a & b) and starch contents in pumpkin leaves (*cucurbita pepo*) but high concentration of Zn (90 up to 180 mM) decreased chlorophyll content and increased soluble sugar and proline concentrations in shoots and roots. Aktas *et al.,* (2006) found that increase of Zn supply (from 0 up to 10 mg kg^{-1}) could increased shoot dry matter from 400 up to over 1200 mg $plant^{-1}$ in pepper plants. Any practice of a nutrient management, which either decreases or increases the supply of another nutrient element or its absorption from the soil by plants or translocation and mobility within the plant, will influence its nutrition and, thereby, the nutrient use efficiency and crop yields. For example, heavy use of P fertilizers may have some adverse or favourable effect on the availability of applied Zn in soils as well as its effect on plants (Das *et al.*, 2005). Hence, the interaction effect between Zn and P is still very much contradictory. Therefore, it is worthwhile to study the interaction effect between P and Zn on their availability in soil in relation to their contents in pumpkin plant.

Utilization of organic fertilizers, such as animal manures and composted materials or organic manure, has been proposed as one of the main pillars of sustainable agriculture. Animal manure is a valuable resource as a soil fertilizer because it provides large amounts of macro- and micronutrients for crop growth and is a low-cost, environmentally friendly alternative to mineral fertilizers (Haghighat *et al.,* 2013). Cow manure contains of 1% N, 0.2% P, and 1% K (Materechera 2010). The effect of organic matter to the sweet corn growth and yield was reported similar to chemical synthetic fertilizer and even better (Efthimiadou *et al.,* 2009; Zahradnik and Petrikova, 2007).

Sarhan *et al.,* (2011) worked on organic manures in tomato crop and reported that organic manures significantly affected tomato plant height, leaf area and fruit number per plant. Abd El-Rahman and Hosny (2001) stated that using organic manure improved the yield and yield components of egg-plant fruits.

The use of organic amendments, such as traditional thermophilic composts, has long been recognized as an effective means of improving soil structure, enhancing soil fertility, increasing microbial diversity and populations, microbial activity, improving the moisture-holding capacity of soils and increasing crop yields (Arancon *et al.,* 2004). Vermicompost contains most nutrients in plant-available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium. Vermicomposts are rich in microbial populations and diversity, particularly fungi, bacteria and actinomycetes. Researchers have shown that vermicomposts consistently promote biological activity which can cause plants to germinate, flower and grow and yield better than in commercial container media, independent of nutrient availability (Atiyeh *et al.,* 2000a, b). Vermicomposts contain plant growth regulators and other plant growth influencing materials produced by microorganisms including humates (Atiyeh *et al.,* 2002). On the other hand, spent mushroom substrate (SMS) is another kind of composts to increase growth factors in plants. SMS are, in general, wastes with a stabilized organic matter, due to the composting or fermentation process carried out in the preparation of the substrates for A. bisporus or P. ostreatus, respectively (Paredes *et al.,* 2009). Nevertheless, few studies about their use as a growing media have been performed (Medina *et al.,* 2009; Segarra *et al.,* 2007).

Therefore, the main objectives of the present work were to study the physical, physico-chemical and chemical properties of pumpkin under single and multiple applications of organic (vermicompost, SMS and cow manure) and chemical (zinc and phosphorus) fertilizer.

MATERIALS AND METHODS

The present study was conducted at Agricultural field of North Khorasan (Iran) in 2014. The experimental units were designed as split-split plots based on randomized complete block design (RCBD) in four replications and thirty two treatment combinations. Organic substrates consisted of 4 substrates (controlled, cow manure (25 T ha^{-1}), SMS (10 T ha^{-1}) and vermicompost (10 T ha^{-1})), which allotted to the main plots. Analysis of each substrate was done before the seed sowing and their results presented in Table 1.

Sub-plots were comprised of different levels of phosphorus application: 0, 75, 100 and 125 (kg ha^{-1}) and foliar application of zinc included of 0 and 1000 mg L^{-1} at 3 times (four leafy, flowering and seed set stage).
Each plot comprised two rows with 1 m spacing between them and each row had 4 plants with 40 cm space between plants. After the land preparation (such as plowing, disking and ridging), sowing was carried out on April 10th in the soil directly.

The plants were thinned to one at 4-6 true leaf stages. Zinc foliar fertilization (0 and 1000 mg L^{-1}) was done at four leafy, flowering and seed set stages. In general, weather condition during all trial period was favorable for the growth and development of pumpkin. At physiological maturity stage, after discarding margins, 4 random samples were harvested from each experimental unit and traits consisting of Leaf number, stem length (cm), fruit weight (kg), dry matter percentage, seed number per fruit, phosphorus content of seed, total solid soluble percentage in fruits (TSS%) and protein content of seeds were measured, and their averages in terms of these traits were considered.

Obviously, when more than 75% of the fruits became yellowish orange in color and stem and leaves began to dry and the seeds became dark green and well rounded, manual harvesting was done. Harvested ripen fruits were weighed (fresh weight).The seeds were manually extracted from the fruits and then naturally dried by sun light until constant weight. The sun-dried seeds were transferred to laboratory. The seed number was obtained by the average number of counted seeds per plot (4 plants). For a determination of P the method described by Murphy and Riley (1962) was employed.

Data on crop growth and yield were analyzed using MSTAT C program and treatments means were compared using Duncan's Multiple Range test at 5% level of probability.

Table 1: chemical properties of experimental substrates before sowing

Substrates	N (ppm)	P (ppm)	K (ppm)
Control (Soil)	0.057	10.8	273
SMS	14530	76.40	19290
Coe manure	14170	6120	19880
Vermicomposts	15970	7120	5090

RESULTS AND DISCUSSION
The organic substrates affected all of traits in pumpkin. Result showed that compare to control treatment, most of traits increased when organic substrates were used (Table 2).

But in compare to four substrates, vermicompost treatment had the greatest effect on improving characters, except phosphorus content of seeds. Leaf number and stem length of plants in plots treated with vermicompost did not differ from those in plots receiving cow manure, whereas there were significant differences between vermicompost and cow manure with SMS and control treatments (Table 3). The highest values of fruit weight (4.109 kg), dry matter percentage (6.67) and protein content (38.21%) were found in vermicompost treatment. There were no significant differences were recorded between vermicompost, cow manure and control treatments for seed number and SMS treatment had lowest seed number.

SMS treatment had the highest values of phosphorus content in seed (0.2109 mg/100g) and the lowest values measured phosphorus content was observed in vermicompost treatment (Table 3).

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Table 2: Analysis variance of measured traits in pumpkin

S.O.V	df	Leaf number	Stem length (Cm)	Fruit weight (Kg)	Dry matter (%)	Seed number	P content (mg/100g)	TSS	Protein content of seed (%)
Rep.	3	9.17*	16337.23**	0.082	0.21*	15262.34*	0.002**	3.720*	1.429**
Organic sub	3	461.05**	138687.45**	3.97**	46.41**	13751.71*	0.001*	8.11**	1618.65**
Error	9	5.55	1398.02	0.527	0.41	3290.96	0	0.736	0.025
P Levels	3	97.44**	40184.44**	2.62**	4.67**	18681.59*	0 ns	3.20*	177.57**
Organic sub× P	9	109.33**	17791.87	1.97**	30.37**	9060.18 ns	0.001**	4.431**	21.37**
Error	36	10.20	1251.13	0.33	0.51	5703.65	0	0.960	0.014
Zn levels	1	903.12**	55986.94	0.67ns	0.77 ns	87623.44**	0.001**	17.925**	0.49**
Organic sub× Zn	3	65.14**	25028.48	0.43 ns	3.68**	2402.02ns	0.001**	12.633**	0.48**
P×Zn	3	100.16**	7708.46 ns	2.62**	3.23**	1606.90 ns	0 ns	18.181 ns	2.97**
Organic sub× P×Zn	9	479.99**	23932.31**	0.66**	5.60**	10375.68 ns	0 ns	1.548 ns	0.52**
Error	48	12.68	3784.65	0.28	0.43	5251.25	0	0.998	0.018
CV%		7.48	15.31	14.88	11.29	19.78	2.85	18.86	0.4

*Notes. * – P < 0.05, ** – P < 0.01, ns – P > 0.05; S.O.V– Source of variance, df – degrees of freedom; Rep – Replication, Organic sub–Organic substrate, P – Phosphorus, Zn –Zinc, Organic sub×P, Organic sub× Zn, P×Zn and Organic sub× P×Zn – represent interaction terms between the treatment factors*

Table 3: Effect of organic substrate, phosphorus and zinc application on measured traits in pumpkin

Treatments		Leaf number	Stem length (Cm)	Fruit weight (Kg)	Dry matter (%)	Seed number	P content (mg/100g)	TSS	Protein content of seed (%)
Organic Substrate	vermicomost	50.91 a	a 465.9	4.109 a	6.677 a	364.8 ab	0.1964 d	5.659 a	38.21 a
	Cow manure	50.84 a	448.9 a	3.539 b	6.177 b	387.4 a	0.2074 b	4.753 b	36.71 b
	SMS	44.88 b	330.1 c	3.288 b	6.396 ab	338.6 b	0.2109 a	5.784 a	22.67 d
	Control (soil)	43.81 b	362.6 b	3.490 b	4.043 c	374.7 ab	0.2040 c	4.988 b	35.05 c
Phosphorus levels (kg ha^{-1})	125	45.53 c	358.0 c	3.558 b	5.426 c	383.8 a	0.2054 b	5.094 b	29.96 d
	100	47.34 b	406.0 b	3.858 a	5.885 b	355.7 ab	0.2039 c	5.662 a	33.00 c
	75	49.78 a	444.5 a	3.223 c	5.659 bc	337.4 b	0.2068 a	5.450 ab	34.21 b
	Control (0)	47.78 b	399.0 b	3.788 ab	6.323 a	388.6 a	0.2027 d	4.978 b	35.46 a
Zinc levels (mL^{-1})	1000	50.27a	422.8 a	3.67 a	5.90 a	392.5 a	0.206 a	5.67 a	33.22 a
	Control (0)	44.59 b	381.0 b	3.53 a	5.74 a	340.2 b	0.202 b	4.92 b	33.10 b

Mean values in columns followed by the same letter do not differ significantly (P < 0.05) between the groups of residues

Table 4: Effect of combine application of organic substrate× P levels, organic substrate× Zn levels and P levels × Zn levels on measured traits in pumpkin.

Organic substrates	P (kg ha^{-1})	Leaf number	Stem length (Cm)	Fruit weight (Kg)	Dry matter (%)	Seed number	P content (mg/100g)	TSS	Protein content of seed (%)
vermicomosts	**0**	49.75 bc	392.0 de	4.537 a	6.762 c	433.1 a	0.2013 h	5.825 abc	37.71 e
	75	55.50 a	496.4 a	4.140 abc	8.012 b	364.3 abcde	0.1842 l	6.363 ab	37.13 f
	100	51.13 b	505.9 a	3.995 abc	5.435 de	322.6 de	0.1946 i	5.750 abcd	39.21 b
	125	47.25 bcde	469.3 abc	3.765 bcd	6.500 c	339.3 cde	0.2056 g	4.700 cdef	38.78 c
Cow manure	**0**	50.00 bc	426.1 bcd	3.156 ef	6.093 cd	406.9 abcde	0.2167 c	3.750 f	31.27 i
	75	47.88 bcde	507.3 a	3.801 bcd	4.425 f	384.4 abcde	0.2062 fg	4.613 def	37.62 e
	100	56.13 a	481.4 ab	3.131 ef	4.766 ef	348.1 abcde	0.2005 h	4.813 cdef	38.58 d
	125	49.38 bc	381.0 def	4.069 abc	9.425 a	410.4 abc	0.2062 fg	5.838 abc	39.37 a
SMS	**0**	45.00 def	286.9 g	2.912 fg	3.763 g	319.9 e	0.1899 j	5.838 abc	19.78 n
	75	41.63 f	333.4 efg	3.150 ef	6.264 c	345.8 bcde	0.2178 b	6.637 a	22.80 m
	100	44.38 ef	378.5 def	3.318 def	8.863 a	312.1 e	0.2223 a	5.438 bcd	23.75 l
	125	48.50 bcd	321.8 fg	3.773 bcd	6.694 c	376.5 abcde	0.2134 d	5.225 bcde	24.35 k
Control	**0**	37.38 g	327.1 efg	3.625 cde	5.088 ef	375.4 abcde	0.2137 d	4.963 cde	31.09 j

	75	44.38 ef	287.0 g	4.342 ab	4.838 ef	328.3 cde	0.2072 f	5.037 cde	34.46 h
	100	47.50 bcde	412.4 cd	2.447 g	3.572 g	366.9 abcde	0.2097 e	5.800 abc	35.30 g
	125	46.00 cde	423.9 bcd	3.546 cde	2.675 h	428.4 ab	0.1854 k	4.150 ef	39.36 a
Organic Substrates	**Zn (m L^{-1})**								
vermicomosts	**1000**	52.06 ab	514.5 a	4.349 a	6.815 a	398.4 abc	0.2040 de	6.794 a	38.46 a
	Control	49.75 bc	417.3 b	3.869 b	6.540 a	331.3 d	0.1889 g	4.525 d	37.96 b
Cow manure	**1000**	52.56 a	446.9 b	3.538 bc	6.496 a	413.6 a	0.2031 f	4.375 d	36.71 c
	Control	49.13 c	451.0 b	3.541 bc	5.858 b	361.3 abcd	0.2117 b	5.131 cd	36.71 c
SMS	**1000**	48.81 c	325.9 c	3.354 c	5.977 b	352.6 bcd	0.2165 a	6.012 b	22.66 e
	Control	40.94 d	334.4 c	3.222 c	6.814 a	324.6 d	0.2053 c	5.556 bc	22.68 e
Control	**1000**	47.63 c	403.9 b	3.476 bc	4.315 c	405.6 ab	0.2035 ef	5.500 bc	35.06 d
	Control	40.00 d	321.3 c	3.505 bc	3.771 d	343.8 cd	0.2045 d	4.475 d	35.04 d
P (kg ha^{-1})	**Zn (m L^{-1})**								
0	**1000**	46.00 c	377.9 cd	3.371 c	5.469 bc	419.6 a	0.2055 c	5.569 abc	30.13 g
	Control	45.06 c	338.1 d	3.744 bc	5.384 c	348.1 cd	0.2053 c	4.619 d	29.75 h
75	**1000**	51.44 ab	436.5 ab	3.707 bc	6.381 a	382.9 abc	0.2075 b	6.256 a	33.13 e
	Control	43.25 c	375.5 cd	4.010 ab	5.388 c	328.4 cd	0.2002 d	5.069 bcd	32.88 f
100	**1000**	53.88 a	478.4 a	3.461 c	5.382 c	359.0 bcd	0.2088 a	5.688 ab	34.54 c
	Control	45.69 c	410.7 bc	2.985 d	5.936 ab	315.9 d	0.2047 c	5.213 bcd	33.88 d
125	**1000**	49.75 b	398.4 bc	4.179 a	6.371 a	408.8 ab	0.2052 c	5.169 bcd	35.09 b
	Control	45.81 c	399.6 bc	3.398 c	6.276 a	368.5 abcd	0.2001 d	4.787 cd	35.84 a

Mean values in columns followed by the same letter do not differ significantly ($P < 0.05$) between the groups of residues.

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Table 5: Effect of combine application of organic substrate× P levels × Zn levels on measured traits in pumpkin.

Organic substrate	P (kg ha^{-1})	Zn (m L^{-1})	Leaf number	Stem length (Cm)	Fruit weight (Kg)	Dry matter (%)	Seed number	P content (mg/100g)	TSS	Protein content of seed (%)
Vermicomposts	0	1000	52.75 def	465. bcd	4.82 a	7.10 efg	423.5 abcd	0.1892 o	6.30 bcdef	37.84 e
		Control	46.75ghij	318.8 fghi	4.250 abcd	6.42 fghijk	442.8 ab	0.2135 f	5.35 cdefghijk	37.58 fg
	75	1000	61.50 ab	526.0 ab	4.03 abcdefg	8.97 bc	392.5 abcdefg	0.2109 gh	8.12 a	37.35 h
		Control	49.50efgh	466.8 bcd	4.25 abcd	7.05 efg	336.0 abcdefgh	0.1576 r	4.60 fghijklm	36.91 i
	100	1000	46.25ghij	568.0 a	4.34 abc	3.76 opq	396.5 abcdefg	0.2125 f	6.950 abc	39.86 a
		Control	56.00bcd	443.8 bcde	3.65 cdefghij	7.11 efg	248.8 h	0.1767 p	4.55 ghijklm	38.57 d
	125	1000	47.75 fghi	498.8 abc	4.20 abcde	7.42 ef	381.0 abcdefg	0.2033 j	5.80 bcdefghi	38.78 bc
		Control	46.75 ghij	439.8 bcde	3.32 efghijk	5.57 ijklm	297.5 defgh	0.2078 i	3.600 lm	38.79 bc
Cow manure	0	1000	40.50 klm	318.0 fghi	2.58 kl	6.56 fghi	453.3 a	0.2123 fg	3.450 m	31.84 n
		Control	59.50 abc	534.3 ab	3.72 bcdefghi	5.62 ijklm	360.5 abcdefgh	0.2212 c	4.05 jklm	30.71 q
	75	1000	61.00 ab	597.0 a	3.63 cdefghij	5.05 lmn	387.5 abcdefg	0.1987 m	4.27 ijklm	37.49 gh
		Control	34.75 m	417.5 cdef	3.97 abcdefgh	3.80 opq	381.3 abcdefg	0.2137 f	4.95 efghijklm	37.75 ef
	100	1000	64.50 a	526.0 ab	3.32 efghijk	5.77 hijklm	382.0 abcdefg	0.2012 kl	4.32 hijklm	38.64 cd
		Control	47.75 fghi	436.8 bcde	2.94 ijk	3.75 opq	314.3 cdefgh	0.1997 m	5.30 cdefghijklm	38.51 d
	125	1000	44.25 hijk	346.5 efghi	4.615 ab	8.60 cd	431.8 abc	0.2001 lm	5.45 cdefghijk	38.87 b

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SMS		**Control**	54.50 cde	415.5 cdef	3.52 cdefghij	10.25 a	389.0 abcdefg	0.2123 fg	6.22 bcdefg	39.86 a
	0	**1000**	51.75 defg	318.5 fghi	3.095 hijk	3.40 pqr	344.5 abcdefgh	0.2034 j	6.77 abcd	19.91 w
		Control	38.25 lm	255.3 i	2.730 jkl	4.12 nop	295.3 efgh	0.1764 p	4.90 efghijklm	19.65 x
	75	**1000**	34.75 m	324.3 fghi	3.05 hijk	6.02 ghijkl	371.8 abcdefgh	0.2187 d	7.22 ab	22.88 v
		Control	48.50 fgh	342.5 efghi	3.24 fghijk	6.50 fghij	319.8 bcdefgh	0.2170 e	6.05 bcdefgh	22.73 v
	100	**1000**	51.50 defg	379.0 defgh	3.29 efghijk	7.87 de	287.5 fgh	0.2277 a	5.12 defghijklm	24.13 s
		Control	37.25 lm	378.0 defgh	3.34 defghijk	9.85 ab	336.8 abcdefgh	0.2170 e	5.75 bcdefghij	23.36 u
	125	**1000**	57.25 bcd	281.8 ghi	3.97 abcdefgh	6.61 fghi	406.5 abcdef	0.2162 e	4.92 efghijklm	23.73 t
		Control	39.75 klm	361.8 defgh	3.57 cdefghij	6.77 fgh	346.5 abcdefgh	0.2107 h	5.52 cdefghijk	24.97 r
Control (Soil)	**0**	**1000**	39.00 klm	410.0 cdef	2.97 ijk	4.81 mno	457.0 a	0.2171e	5.75 bcdefghij	30.96 p
		Control	35.75 m	244.3 i	4.27 abc	5.36 klm	293.8 efgh	0.2103 h	4.17 ijklm	31.23 o
	75	**1000**	48.50 fgh	298.8 ghi	4.113 abcdef	5.47 jklm	379.8 abcdefg	0.2017 k	5.40 cdefghijk	34.81 l
		Control	40.25 klm	275.3 hi	4.57 ab	4.20 nop	276.8 gh	0.2127 f	4.675 efghijklm	34.11 m
	100	**1000**	53.25 def	440.5 bcde	2.88 ijk	4.12 nop	370.0 abcdefgh	0.1937 n	6.35 bcde	35.5 j
		Control	41.75 jkl	384.3 defg	2.007 l	3.02 qr	363.8 abcdefgh	0.2256 n	5.25 cdefghijkl	35.08 k
	125	**1000**	49.75 efgh	466.5 bcd	3.92 abcdefgh	2.85 qr	415.8 abcde	0.2014 kl	4.50 ghijklm	38.98 b
		Control	42.25 ijkl	381.3 defg	3.16 ghijk	2.50 r	441.0 ab	0.1694 q	3.80 klm	39.7 a

Mean values in columns followed by the same letter do not differ significantly ($P < 0.05$) between the groups of residues.

This fact was also found by other authors that organic substrate caused to increase the growth factors (leaf number, stem and root length, sub shrub number, etc) and reproductive traits (female flower number, yield, fruit weight, etc.) in crops (Arancon *et al,* 2004; Fallahi *et al.*, 2009; Lakhdar *et al.*, 2009; Azeez *et al.*, 2010; Frutos *et al,* 2010; Jahan *et al.*, 2013).

Because of superiority of vermicompost contains such as nitrates, phosphates, and exchangeable calcium and soluble potassium, microbial populations and diversity, particularly fungi, bacteria and actinomycetes (Arancon *et al*., 2004), it has effective role on growth factor compare to composts, cow and sheep manure (Said Nejad and Rezvani Moghaddam, 2010) and can consistently promote biological activity which can cause plants to germinate, flower and grow and yield better than in commercial container media, independent of nutrient availability (Atiyeh *et al.*, 2000a, b). Vermicomposts contain plant growth regulators and other plant growth influencing materials produced by microorganisms (Arancon *et al*., 2004) including humates (Atiyeh *et al*., 2002).

The effect of P levels (phosphorus levels) on quantitative and qualitative yield might be due to its additive effect on vegetative growth of the crop ultimately affecting the yield (Tables 3). The morphological traits especially leaf number and stem length were improved by the 100 (kg.ha $^{-1}$) P levels. The highest values of fruit weight (3.788 kg), dry matter percentage (6.323 %) and protein content of seed (35.46 %) were recorded in 125 (kg.ha $^{-1}$) P levels. There were no significant differences in any of the P levels for seed number, but the lowest value (337.4) was recorded in 100 (kg.ha $^{-1}$) P level. The highest and lowest values (0.206 and 0.202 mg/100g) of phosphorus content of seed were found in 100 and 125 (kg.ha $^{-1}$) P levels, respectively. For TSS trait, the 75 and 100 P (kg.ha $^{-1}$) treatments gave the highest values (5.66 and 5.45) and they were significantly not different from each other.

Phosphorus fertilizer can have a varied effect on crop responses, depending on the crop and environmental conditions. P application increased root development, early flowering, fruit set and fruit ripening, seed-formation and yield (Imran and Gurmani, 2011). Increasing of P caused to nitrogen availability and resulted to increase growth factors and yield. But high value of P may have antagonistic effects on nutrition availability in soil and decrease nutrition absorption (Das *et al.*, 2005; Karamanos *et al.*, 2008) and caused to decrease morphological and biological factors in plants (Rehim *et al.*, 2014; Boroomand and Hosseini Grouh, 2012; Imran and Gurmani, 2011; Ronan, 2007; Das *et al*., 2005; Sawan *et al.*, 2001).

According to presented data in Table 3, foliar zinc application has positive effects on most of the traits, except fruit weight and dry matter percentage. Leaf number, stem length, seed number, phosphorus and protein content of seed and TSS were improved by zinc foliar application compared to control treatments. The mentioned results are in agreement with those of other researchers on agricultural crop by zinc foliar application (Sorkhi *et al.*, 2013; Yousefiand, 2012; Aktas *et al*., 2006; Sawan *et al.*, 2001).

Interactions of organic and chemical fertilizers have positive and negative effects on growth and yield components (Table 4). In combine application of organic substrate and P levels, the highest values for leaf number, stem length, seed number, TSS with not significant differences were observed in vermicompost×75 P (kg.ha $^{-1}$) and cow manure×100 P (kg.ha $^{-1}$). Plants grown in plots treated with cow manure×125 P (kg.ha $^{-1}$) had significantly more dry matter percentage than plants in plots grown in plots receiving with other organic and chemical substrates. The greatest increases in phosphorus concentration of seed were found at the SMS×100 P (kg.ha $^{-1}$) treatment. There were not significant differences between cow manure×125 P (kg.ha $^{-1}$) and control×125 P(kg.ha $^{-1}$) for protein content of seed and the highest values (39.37 and 39.36 %) were found in those treatments, respectively.

In combine application of organic substrates and zinc foliar application, vermicompost with 1000 Zn (mg l^{-1}) caused to improve most of traits such as leaf number, stem length, fruit weight, TSS and protein content of seed compared to other treatments. The highest value of phosphorus content was recorded in SMS with 1000 Zn (mg l^{-1}) application. The SMS with and withought zinc foliar applications had the lowest fruit weight with not significant differences (Table 4).

Application of P and Zn at different concentrations affected pumpkin traits. Results showed that applications of 100 P (kg.ha $^{-1}$) with 1000 Zn (mg l^{-1}) significantly increased leaf number and stem length.

There were no significant differences between 125 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}) and 75 P (kg.ha $^{-1}$) × control (0 Zn mg l^{-1})) for fruit weight, 125 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}), 125 P (kg.ha $^{-1}$) × control (0 Zn mg l^{-1})), 100 P (kg.ha $^{-1}$) × control (0 Zn mg l^{-1})) and 75 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}) for dry matter percentage, control (0 P kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}), 75 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}), 125 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}), 125 P (kg.ha $^{-1}$) × control (0 Zn mg l^{-1})) for seed number, 75 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}), 100 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}) and the highest values were found in those treatments. Maximum of phosphorus content of seed was recorded in 100 P (kg.ha $^{-1}$) × 1000 Zn (mg l^{-1}) treatment. The 125 P (kg.ha $^{-1}$) × control (0 Zn mg l^{-1})) treatment has the highest values for protein content of seed.

The results showed significant differences in combine application of organic substrates, P levels and Zn foliar applications (Table 5). The influence of cow manure×100 P×1000 Zn, cow manure×75 P×1000 Zn¸ vermicomposts×75 P×1000 Zn and cow manure×control (0P)× control (0Zn) have the highest leaf number per plant in pumpkin, respectively. According to data presented in Table 5, the maximum of stem length were found in vermicomposts×100 P×1000 Zn, cow manure×75 P×1000 Zn, cow manure×100 P×1000 Zn, cow manure×control (0P)× control (0Zn), cow manure×100 P×1000 Zn and vermicomposts×125 P×1000 Zn treatments. The influence of vermicomposts× control (0P)×1000 Zn application produced the highest value (4.82 kg) of fruit weight. The highest dry matter percentage were observed in cow manure×125 P×control (0Zn) and SMS×100 P×control (0Zn), respectively. The seed number trait was influenced by all of treatments but the lowest values were found in vermicomposts×100 P×control (0Zn). The highest phosphorus content of seed was recorded in SMS×100 P×1000 Zn application and the lowest value was found in control (soil)×125 P×control (0Zn). The highest and lowest TSS content were found in vermicomposts×75 P×1000 Zn and cow manure×control (0P)×1000 Zn, respectively.

The interaction between organic substrate, P levels and Zn foliar application on protein content showed that the highest value was found in vermicomposts×100 P×1000 Zn, cow manure×125 P× control (0Zn) and control (soil)×125 P×control (0Zn). The SMS× control (0P)×control (0Zn)

Because of variety of micro and macro elements in organic substrates and elements availability or solubility in the presence of different phosphorus and zinc levels, combine application of organic substrates, phosphorus and zinc with different concentraition affected quality and quantity of properties in pumpkin plants.

Conclusion

The most aim charachers in pumpkin production concerned to seeds and seed components which have greatest role in pharmaceutical products. So, according to data presented in this paper, we can suggest some fertilizer to gain the maximum seed yield with high quality and quantity. For lonely application of organic substrates, phosphorus concentration and zinc foliar application; vermicomposts, 125 P (kg.ha^{-1}) and 1000 Zn (mg l^{-1}) treatments resulted the high improved in pumpkin seeds and qualities (protein %). For combining application of organic substrate×P levels, organic substrate×Zn levels, P levels× Zn levels and organic substrate×P levels×Zn levels, reslts showed the maximum of seed number with high quality (protein%) were found in cow manure×125P, vermicomposts×1000 Zn, 125P×1000Zn and vermicomposts×100P×1000 Zn, respectively.

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