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Research Article

IMPROVING WHEAT YIELD USING SPENT MUSHROOM COMPOST COMBINED WITH CHEMICAL FERTILIZERS

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ABSTRACT
A factorial experiment base on complete block design with four replications carried out to investigate the effect of chemical and organic on wheat yield. Falat variety of wheat was planted during 2012-2013 growing season at Neyshabour. Chemical fertilizer applied in three levels: control (0,0), intermediate (140 kg/ha urea and 60 kg/ha potash) and complete level (240 kg/ha urea and 120 kg/ha potash).Organic manure applied in six levels: fresh mushroom compost aged mushroom compost (at least for 6 month), rinsed compost (50%) plus cow manure (50 %), aged compost (50 %) plus cow manure (50 %), rinsed compost andbarnyard manure. All organic manures applied in 40 ton/ha amount. Measured traits were spick length, plant height, kernel number per spick, kernel weight in spick, thousand kernel weight and kernel yield. Kernel yield significantly affected by applying treatments. The highest kernel yield (6225 kg/ha) obtained using intermediate chemical fertilizer level combined with aged mushroom compost. The lowest kernel yield (4682 kg/ha) belonged to applying control level of chemical fertilizer plus with barnyard manure. Results showed that applying spent mushroom compost combined withintermediate level of chemical fertilizers produced the highest wheat yield.

Keywords: *Wheat, Spent Mushroom Compost, Yield*

INTRODUCTION
Wheat is the most important crop in the world and applying fertilizers is an important aspect in its production (Rasouli and Maftoon, 2011). Applying chemical fertilizers is a quick way of nutrient supply in crops. Enhancing production costs, soil and water pollution and decreasing agricultural production quality limit applying chemical fertilizers (Malekuti, 1997). Investigations showed that chemical fertilizers successfully could replace by organic manures. Organic manures enhances oil physical and chemical characteristics, add organic matters to soil, increases activity of micro-organisms and improve soil structure (Toohidlu, 2002).
Spent mushroom compost (SMC) is the composted organic materials remaining after a mushroom crop harvest. SMC could pollute environment as other waste residuals but humification could change it to a valuable nutrient substance for crops. SMC is a useful source of major and minor nutrients. It has not microbial infections because it is pasteurized (Salimi, 2011). Seiedi *et al.,* (2012), studied the effect of SMC and several nitrogen fertilizers on wheat yield, yield components and nitrogen efficiency. Results showed that dry weight, plant height, kernel number per plant, kernel weight per plant and 1000 kernel weight increased by applying higher amount of SMC.
Webster *et al.,* (2007), use SMC as a soil enhancement material. They declared that grape vines well established in SMC combined soils. Polat *et al.,* (2009) investigated the effects of spent mushroom compost on quality and productivity of cucumber in green houses condition. 20, 40 and 80 ton/ha SMC applied to the soil. They reported that fruit yield and quality and total soluble solids enhanced using 40 ton/ha SMC. Tomato, peas, potato, ginger, garlic, wheat, rice and corn yield improved applying SMC in south India (Sagar *et al.*, 2009).
The aim of the present experiment was to determine the effect of organic manure and chemical fertilizers on wheat yield and yield component and finding the best combination of chemicals and organic manures for wheat production.

MATERIALS AND METHODS

A factorial experiment base on randomized complete blocks design with four replications carried out at Neyshabour during 2012-2013. Experimental treatments include three levels of chemical fertilizers (CF) and six levels of organic manures (OM). CF contains: control (0,0), intermediate (140 kg/ha urea and 60 kg/ha potash) and complete level (240 kg/ha urea and 120 kg/ha potash) and OM contains: OM1: fresh mushroom compost, OM2: aged mushroom compost (at least for 6 month), OM3: rinsed compost (50%) plus cow manure (50 %), OM4: aged compost (50 %) plus cow manure (50 %), OM5: rinsed compost and OM6: barnyard manure. All organic manures applied in 40 ton/ha amount. Falat variety of wheat planted in 2*5 plots with 20 cm row distance. Fertilizers combined with soil a few days before planting. Plots harvested at physiological maturity time when spikes grew yellow by late May. Spike length, plant height, kernel per spike, kernel weight per spike, 1000 kernel weight and kernel yield measured in each treatment. Data analyzed using SAS software ver 8. Comparison between means was conducted using Duncan's multiple range test at 0.01 significant levels.

RESULTS AND DISCUSSION

Analysis of variance showed that spike length, plant height and kernel number per spike significantly affected by organic manure and chemical fertilizers ($p<0.01$). Kernel weight per spike enhanced by applying OM ($p<0.01$). Thousand kernel weight affected by OM and interaction between OM and CF ($p<0.01$). Kernel yield significantly affected by OM, CF and interaction between them ($p<0.01$) (table 1).

Table 1: Analysis of variance of different fertilizer and manure levels

		Mean of squares (MS)					
source of variation	**df**	**Spike length**	**Plant height**	**Kernel no/spike**	**kernel weight/spike**	**1000 kernel weight**	**Kernel yield**
rep	3	0.24	108	0.6	0.005	2.27	109512
Organic manure (OM)	5	4.07**	463**	1.6**	0.004**	70.95**	1536951**
Chemical fertilizer (CF)	2	2.73**	400**	0.72**	0.001ns	1.7ns	185779**
OM * CF	10	0.16ns	10.5ns	0.14ns	0.002ns	2.38**	130356**
CV%	-	4.9	9.7	11.93	13.26	12.40	12.69

**, ** and n.s significant at 5 and 1 level and no significant*

Spike Length

Spike length significantly affected by CF levels (table 1). The largest (6 cm) and smallest spike length belonged to complete CF and control treatment respectively (figure 1).

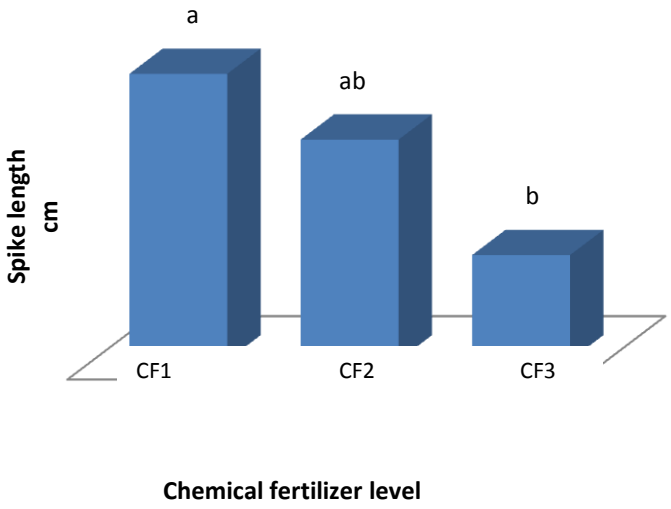

Figure 1: Spike length affected by chemical fertilizers
CF1, CF2 and CF3 refers to complete, intermediate and control level of chemical fertilizer

Effect of OM on spike length was significant too (table 1). The largest (7.6 cm) and smallest spikes produced by OM2 and OM6 respectively (figure 2). Results were in agreement with Seiedi *et al.*, (2012) which reported spike enlargement by applying SMC.

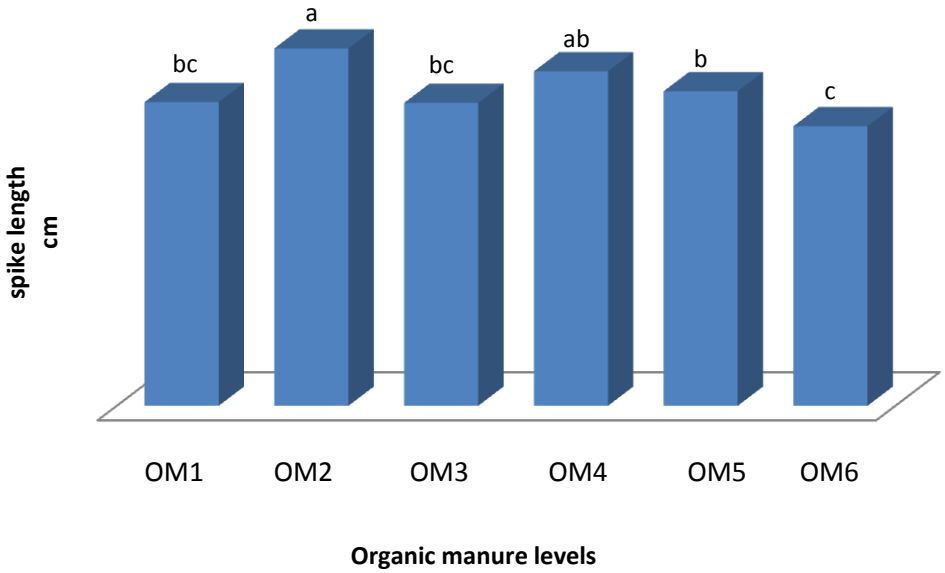

Figure 2: Spike length affected by organic manures
OM1-OM6 refers to fresh mushroom compost, aged mushroom compost, rinsed compost plus cow manure, aged compost, plus cow manure, rinsed compost and barnyard manure

Plant Height

Plant height significantly affected by applying CF ($p<0.01$) and OM ($p<0.01$) (table 1). The highest plant height (62 cm) obtained by complete level of CF (figure 3). Hossein *et al.*, (2006) declared that nitrogen fertilizers results in higher wheat height.

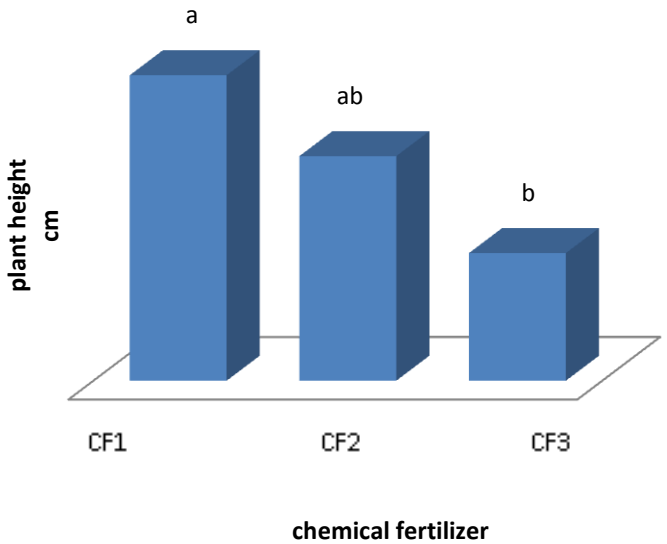

Figure 3: Plant height affected by chemical fertilizers
CF1, CF2 and CF3 refers to complete, intermediate and control level of chemical fertilizer

Between OM treatments, the highest plant height belonged to OM2 by 68 cm. The shortest plant height (51 cm) belonged to OM1 and OM6 (figure 4). Singh and Agarwal (2001) stated that cow manure is a proper factor for enhancing wheat height.

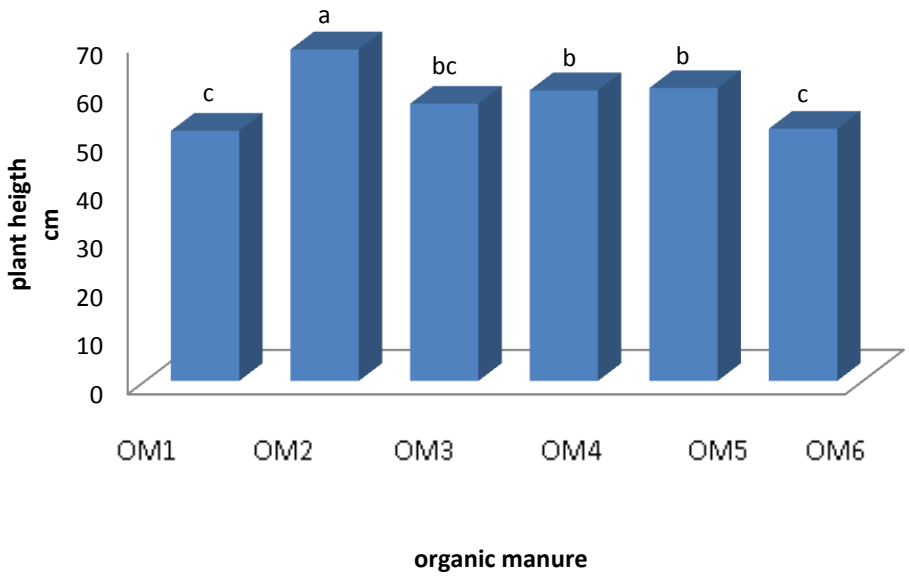

Figure 4: Plant height affected by organic manure
OM1-OM6 refers to fresh mushroom compost, aged mushroom compost, rinsed compost plus cow manure, aged compost, plus cow manure, rinsed compost and barnyard manure

Kernel Number per Spike
There was no significant difference between CF levels in respect of kernel number per spike (table 1). The highest and lowest kernel number obtained by applying intermediate and control level of CF respectively (figure 5).

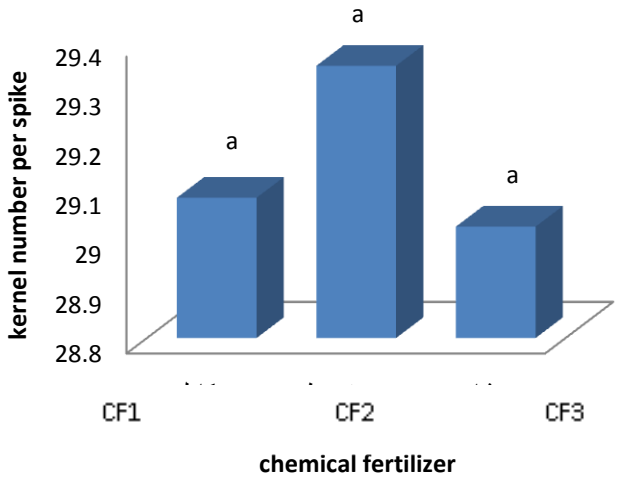

Figure 5: Kernel number per spike affected by chemical fertilizers
CF1, CF2 and CF3 refers to complete, intermediate and control level of chemical fertilizer

Kernel numbers perspike significantly affected by OM levels. The highest (30) and lowest (28) spike number belonged to OM1 and OM6 respectively (figure 6). Seiedi *et al.*, (2012) reported that higher kernel number gained using higher amount of aged spent mushroom compost. JafariMoghadam *et al.*, (2011) reported that there was no significant difference between chemical fertilizers and poultry manure is respect of kernel number per spike.

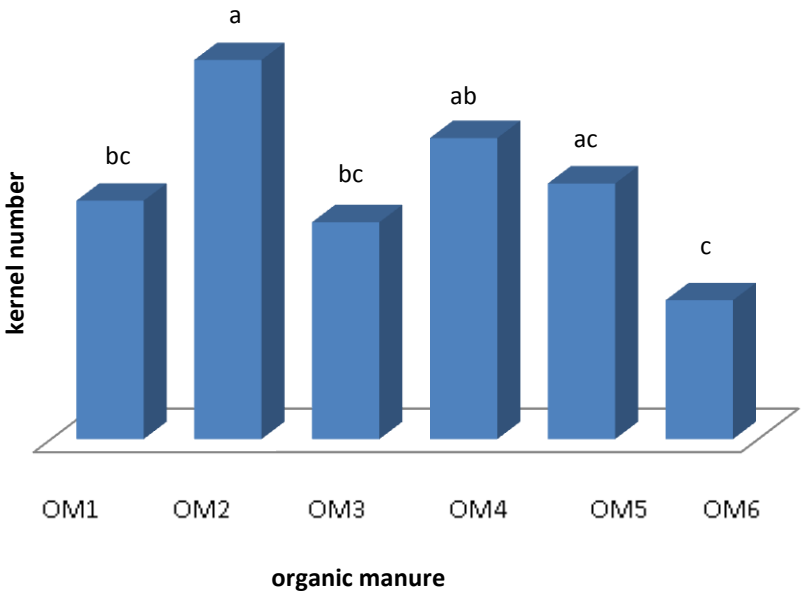

Figure 6: Kernel number affected by organic manure
OM1-OM6 refers to fresh mushroom compost, aged mushroom compost, rinsed compost plus cow manure, aged compost, plus cow manure, rinsed compost and barnyard manure

Kernel Weight per Spike
Kernel weight significantly affected using different OM levels (table 1). The highest kernel weight (0.99 gr) belonged to OM4. There was no significant difference between other OM levels in respect of kernel weight (figure 7).

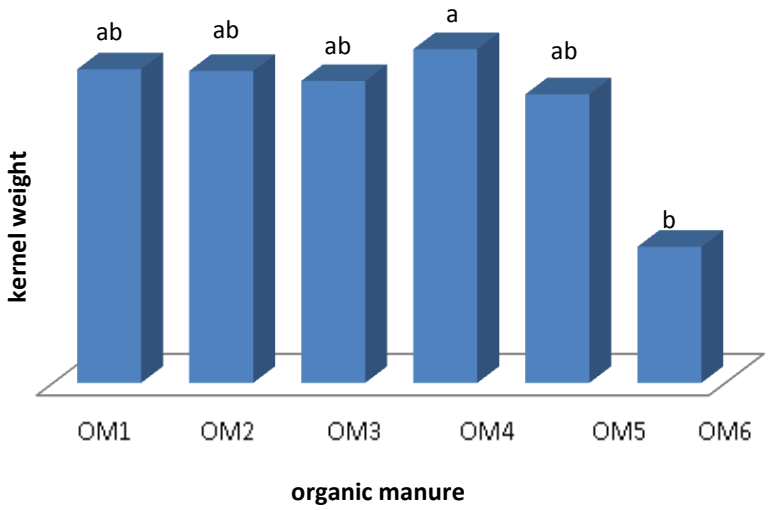

Figure 7: Kernel weight affected by organic manure
OM1-OM6 refers to fresh mushroom compost, aged mushroom compost, rinsed compost plus cow manure, aged compost, plus cow manure, rinsed compost and barnyard manure

Thousand Kernel Weight

Thousand kernel weight (TKW) significantly affected by OM and interaction between CF and OM (table 1). The highest (48 gr) and lowest (41 gr) TKW gained by OM2 and OM6respectively.

Interaction between treatment showed that the highest TKW (48 gr) obtained by control level of CF and OM2. The lowest TKW (40 gr) belonged to control level of CF and OM6. There was no significant difference between control level×OM2 and complete level×OM2 in respect of TKW (figure 8).

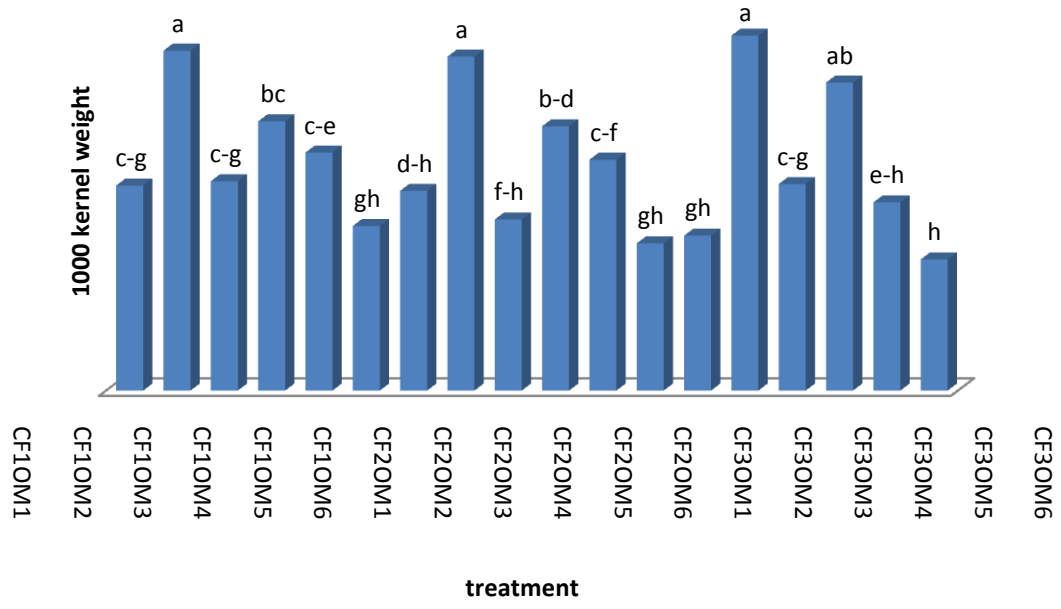

Figure 8: Thousand kernel weight affected by interaction between chemical fertilizers and organic manures
CF and OM refers to chemical fertilizer and organic manure respectively

Seiedi *et al.*, (2012) reported that 1000 kernel weight enhanced using spent mushroom compost. Hosseini *et al.*, (2012) showed that 1000 kernel weight of pearl millet enhanced by applying organic manure.

Kernel Yield

Kernel yield affected by interaction between CF and OM (table 1). The highest yield (6225 kg/ha) belonged to intermediate level of CF and OM2. The lowest yield (4682 kg/ha) obtained by control level of CF and OM6 (figure 9). Rezvani Moghadam *et al.*, (2012) showed that saffron yield enhanced using spent mushroom compost. Nezhad Hossein *et al.*, (2012) reported that pearl millet yield enhances by applying organic manure.

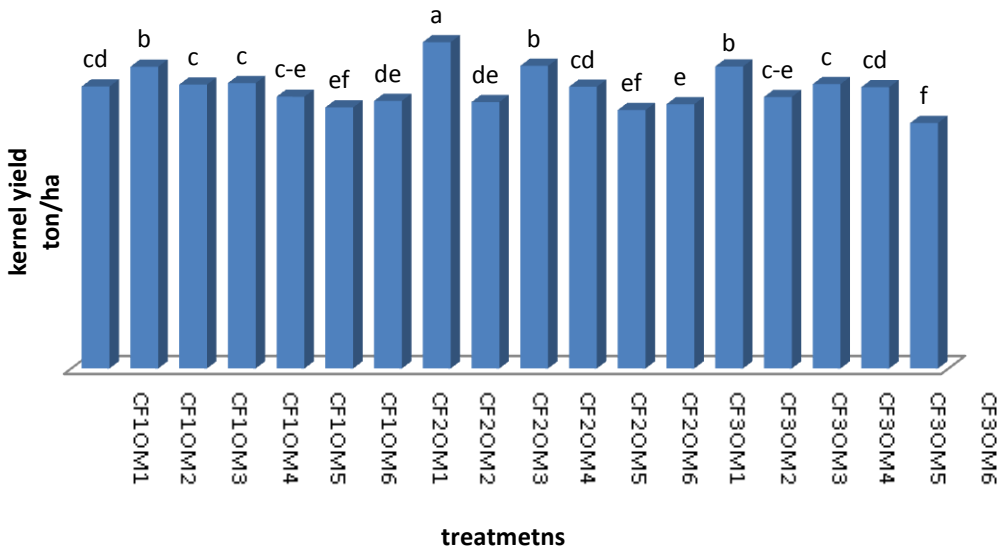

Figure 9: Kernel yield affected by interaction between chemical fertilizers and organic manures CF and OM refers to chemical fertilizer and organic manure respectively

Table 2: Interactions slicing between chemical fertilizer and different rates of the application of organic manure for means of square of B levels (different rates of organic manure) per each level of A(chemical fertilizer)

Chemical (A level)	ddf	1000 kernel weight	Kernel yield
control	5	17.64**	274365 **
intermediate	5	21.56 **	982492 **
complete	5	36.70 **	540801 **

**, ** and n.s significant at 5 and 1 level and no significant*

Thousand kernel weight and kernel yield significantly affected by interaction between treatments (table 1). Thus slicing analysis carried out to compare the levels of organic manure for each level of the chemical fertilizer.

Results showed that in each CF level applying organic manures had a significant effect on TKW and kernel yield (table 2).

Conclusion

Spent mushroom compost potentially could enhance soil characteristics but more investigations need to diminish its salinity. The results of the present study showed that applying aged spent mushroom compost with 140 kg/ha urea and 60 kh/ha potash is a proper combination in wheat production.

Thus integrated use of chemical and organic matters is advisable for higher yield approach in wheat.

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