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Investigating the Effect of Urea Chemical Fertilizer on Wheat (*Triticum aestivum* L.) Production Affected Sugarcane Compost under Warm and Climate Condition

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RESEARCH ARTICLE

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ABSTRACT

BACKGROUND: To alleviate the negative effect of fertilizers, integrated plant nutrient management is an option as it utilizes available organic and inorganic nutrients to build ecologically sound and economically viable farming system. Research has suggested that integrated nutrient management strategies involving chemical fertilizers and bio-fertilizers enhance the sustainability of crop production.

OBJECTIVES: Current research was conducted to investigate the effect of urea chemical fertilizer and sugarcane compost on wheat crop production and growth indices.

METHODS: This study was done according split plots experiment based on randomized complete block design with three replications. The treatments included different amounts of sugarcane compost at three levels of zero, 15 and 30 $t.ha^{-1}$ as the main factor and nitrogen fertilizer from the urea source at three levels of 80, 160 and 240 $kg.ha^{-1}$ pure nitrogen belonged to secondary factor.

RESULT: The results showed that the difference between the levels of sugarcane compost on the leaf area index, total dry matter plant and seed yield was significant. The difference between nitrogen fertilizer levels was statistically significant in all measured traits. The interaction effect of nitrogen fertilizer and sugarcane compost on the measured traits was not statistically significant. The highest seed yield in 30 $t.ha^{-1}$ of sugarcane compost and 240 $kg.ha^{-1}$ of pure nitrogen was 6446 and 6421 $kg.ha^{-1}$, respectively, and the lowest seed yield in conditions without sugarcane compost and 80 $kg.ha^{-1}$ was 5166 and 5304 $kg.ha^{-1}$, respectively.

CONCLUSION: The results of the current study showed that the consumption of sugarcane compost and nitrogen led to an increase in the yield of corn seeds through the improvement of growth characteristics. The highest quantitative yield was obtained under the conditions of application of 30 $t.ha^{-1}$ of sugarcane compost and 240 kg per hectare of nitrogen fertilizer, which can be considered and suggested by farmers and researchers.

KEYWORDS: *Dry matter, Integrated nutrition management, Nitrogen, Phenology, Yield.*

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1. BACKGROUND

Considering the destructive environmental effects of conventional agriculture caused by the excessive use of chemical inputs such as chemical fertilizers and pesticides, the importance of sustainable agriculture is increasing day by day. Conventional farming systems have shown that although high yields can be achieved with the help of chemical fertilizers and pesticides in the short term, the sustainability of soil fertility and environmental health in these systems is questionable. These systems are often accompanied by problems such as leaching of nitrates and as a result of groundwater pollution, N_2O release caused by excessive use of nitrogen fertilizers into the atmosphere, and as a result, loss and destruction of stracture and reduction of soil permeability (Kochaki and Khalghani, 2000). Among the macro nutrients essential for crop growth, nitrogen (N) is a very mobile element in the soil, due to its susceptibility to leaching, de nitrification, and volati-lization losses. Excessive use of N fertilizer can lead to pollution of water bodies and may lead to soil acidification. Balanced and efficient use of applied N is of paramount importance in the overall nutrient management system than any other plant nutrient in order to reduce its negative impact on the environment. Besides, even under the best management practices, 30%-50% of the applied nitrogen is lost through different routes and hence more fertilizer needs to be applied than actually needed by the crop to com-pensate for the loss. The transitory loss of N not only causes loss to the farmer but also causes irreversible damage to the environment. High rates of chemical fertilizer cause environmental pollution (Shamme *et al*., 2016). Currently, farmers tend to return to organic farming to restore and improve soil composition. Bagasse is a by-product of the sugar factory and adding it to the soil can improve soil fertility. In the southern region of Khuzestan, due to the cultivation of sugarcane by the Company for the development of sugarcane and related industries, a large amount of bagasse is produced every year, which is considered as a by product and most of it is lost as waste (Ahmadi and Panahpour, 2018). Sugarcane compost is a peat-like organic material that softens soil texture and increases ventilation, moisture absorption and water retention capacity. Organic carbon in compost releases nutrients slowly and uniformly in the plant growth system and enables the plant to absorb them (Alikhani and Savabeghi, 2006). The use of compost in sustainable agriculture, in addition to increasing the support and activity of beneficial soil microorganisms, provides nutrients needed by plants, such as nitrogen, phosphorus, and soluble potassium, and improves growth and yield of crop (Arancon *et al*., 2004). Haji Sharfi *et al*. (2014) investigated the quality yield of sugarcane affected sugarcane bagasse compost and stated the greatest reduction occurred in treatment of fibrous bagasse and the least reduction in treatment of 20 $t.ha^{-1}$ of bagasse. Mirzashahi and Saadat (2011) increased seed yield and components of rapeseed yield, as well as increased organic carbon and decreased specific mass of the soil as a result of using 5 $t.ha^{-1}$ of sheep manure compost or sugarcane bagasse compost combined with optimal use of nitrogen, phosphorus and chemical fertilizers.

2. OBJECTIVES

Regarding the production of sugarcane compost in some sugarcane production companies in Khuzestan region and the need to use these products as organic fertilizers in order to reduce the consumption of chemical fertilizers, this experiment is to investigate the effect of the use of urea chemical fertilizer in wheat fields under the conditions of using sugarcane compost. It was designed and implemented.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was conducted in the farm of Ahvaz Islamic Azad University. The geological characteristics of the research area are presented in table 1. Experiment design was a split plots in a randomized complete block design with three replications.The experimental treatments include sugarcane compost at three levels of zero (control), 15 and 30 $t.ha^{-1}$ as the main plot and nitrogen fertilizer from the source of urea at three levels of 80, 160 and 240 (control) $kg.ha^{-1}$ pure nitrogen per as sub plot. Each sub-plot had 5 planting lines with a distance of 0.75 meters and a length of 6 meters.

3.2. *Farm Management*

Sugarcane compost was mixed with the soil with the help of a disc after obtaining it from Karun Agriculture Company according to the type of treatment at the time of land preparation. According to the type of treatment, nitrogen fertilizer was used in two stages as base and after greening in the six-leaf stage and phosphorus fertilizer based on 90 $kg.ha^{-1}$ pure phosphorus from the source of triple superphosphate was used completely as base. S.C. 704 seed was used in this experiment. Seed cultivation was done manually by placing three seeds in each spot and after sprouting, additional plants were thinned.

Table 1. The results of soil analysis of the experimental field

Texture	Clay	Silt	Sand	pH	EC ($ds.m^{-1}$)	K (ppm)	P (ppm)	N (%)	OC (%)	Soil depth
Silty clay loam	32	49	19	7.15	6	196	18.5	0.04	0.51	0-30

3.3. Measured Traits

In order to determine the leaf area index (LAI) and total dry weight (TDW), sampling was done in 3 stages, including the appearance of tassel, the appearance of silk, and the middle of the seed filling stage, so that 5 plants were randomly selected from each plot. and the area of the leaves was determined by drawing method and after drying in the oven for 48 hours at 72 degrees, the total dry weight was determined. Seed yield was determined after weighing the whole plants and then threshing the cobs in two middle lines with an area of 3 square meters in each experimental plot.

3.4. Statistical Analysis

In this research, the data was analyzed by Minitab 17 software and the average data was compared by Duncan's multi-range test at the 5% level.

4. RESULT AND DISCUSSION

4.1. *Total dry matter* (*TDM*)

The results showed that the effect of sugarcane compost and urea fertilizer on total dry matter in different stages of growth was significant, but the interaction effect of sugarcane compost and urea was not statistically significant (Table 2). The highest effect of sugarcane compost was related to the consumption of 30 t.ha^{-1}, so that it was recognized as the best treatment, and the lowest amount belonged to the conditions without the use of sugarcane compost (Table 3). In this regard, Monjazi *et al*. (2015) also stated that by increasing the use of sugarcane cake filter, the total dry weight of rapeseed increased by 16.5%. The positive effects of compost fertilizers may be due to the increase of organic matter in the soil as well as the balanced provision of a set of high-use and low-use elements in the soil, which can directly affect vegetative and reproductive growth (Rezvani Moghaddam *et al*., 2003). Marashi *et al*. (2005) reported that the highest corn dry matter in the stage of tassel emergence stage and seed filling stage was obtained in the treatment of 240 kg.ha^{-1} and the lowest in the treatment of 120 kg.ha^{-1}, and the increase in nitrogen consumption from 120 to 240 kg.ha^{-1} increased. The dry matter of corn was 8.1% and 9.7% in the stages of tassel emergence stage and seed filling stage, respectively. It can be said that nitrogen plays a great role in photosynthesis activities, so making carbohydrates and chlorophyll and leads to increased vegetative growth and accumulation of dry matter in the plant, with its increase, the total dry weight increased in different stages and it also seems the reduction of leaf surface index in the treatment of 80 kg.ha^{-1}, parallel to the reduction of photosynthetic activity, is a reason for the reduction of dry matter accumulation in this treatment.

Table 2. The results of analysis of variance of leaf area index, total dry matter and wheat seed yield in the conditions of application of sugarcane compost and urea chemical fertilizer

S.O.V	df	TDM (Total dry matter)			LAI (Leaf area index)			Seed yield
		Tassel emergence stage	Silk emergence stage	Seed filling stage	Tassel emergence stage	Silk emergence stage	Seed filling stage	
Sugarcane compost (SC)	2	49919*	63203**	64683**	0.269381**	0.06431**	0.040015*	37240.7**
Error a	4	4512	2041	2315	0.014204	0.00243	0.003343	359.7
Urea fertilizer (UF)	2	32818**	39549**	37983**	0.193848**	0.02923*	0.029626**	28180.5**
SC× UF	4	760^{ns}	1044^{ns}	1056^{ns}	0.008343^{ns}	0.00861^{ns}	0.000170^{ns}	41.2^{ns}
Error b	12	937	684	638	0.002744	0.01063	0.000500	225.6
CV(%)	-	12.5	11.5	11.9	11.2	13.15	11.1	12.6

^{ns}, *, and ** respectively indicate a non-significant and significant difference at the level of 5% and 1%, respectively.

The application of nitrogen fertilizer can increase the dry matter of the whole plant with the development of vegetative growth and more durability of leaf and stem surface, and these results were consistent with the results of Sadeghi *et al*. (2009).

4.2. Leaf area index (LAI)

The results showed that the effect of sugarcane compost fertilizer was significant in tassel emergence, silk emergence and seed filling stage (Table 2). The highest effect of sugarcane compost in different stages was related to the consumption of 30 $t.ha^{-1}$, and the lowest effect belonged to the treatment without the use of sugarcane compost (Table 3). Saadatian *et al*. (2014) stated that the presence of wheat residues in the soil caused a significant increase in the leaf area of corn cultivars compared to conditions without plant residues (control), during the growth period. According to the results of this experiment, it seems that the reason for the increase in leaf area due to 30 $t.ha^{-1}$ of compost is due to the richness of sugarcane compost in essential elements such as nitrogen, phosphorus and potassium and micronutrients such as iron and zinc. The results also showed that the effect of nitrogen consumption in the seed filling stage was significant at the probability level of 1%, but there was no statistically significant difference in the silk emergence stage (Table 2). In this experiment, the effect of 240 $kg.ha^{-1}$ of pure nitrogen had the greatest effect on the leaf area index, so that it was recognized as the superior treatment at tassel emergence stage with 4.3 and at the stage of seed filling with 2.28 (Table 3).

Table 3. Comparison of average index of leaf area, total dry matter and seed yield in the conditions of application of sugarcane compost and urea chemical fertilizer

Sugarcane compost	TDW (Total dry matter, $gr.m^{-2}.day^{-1}$)			LAI (Leaf area index)			Seed yield ($Kg.ha^{-1}$)
	Tassel emergence stage	Silk emergence stage	Seed filling stage	Tassel emergence stage	Silk emergence stage	Seed filling stage	
Control	1129.4*^{c}	1576.7^{c}	1503.2^{c}	3.97^{c}	3.19^{c}	2.16^{c}	5166.6^{c}
15 $t.ha^{-1}$	1223.0^{b}	1680.2^{b}	1606.0^{b}	4.18^{b}	3.27^{b}	2.23^{b}	5921.1^{b}
30 $t.ha^{-1}$	1276.5^{a}	1742.7^{a}	1671.4^{a}	4.32^{a}	3.36^{a}	2.29^{a}	6446.3^{a}
Urea fertilizer							
80 $Kg.ha^{-1}$	1148.2^{c}	1596.2^{c}	1524.5^{c}	4.00^{c}	3.24^{a}	2.17^{c}	5304.1^{c}
160 $Kg.ha^{-1}$	1211.9^{b}	1675.5^{b}	1602.6^{b}	4.17^{b}	3.25^{a}	2.23^{b}	5808.5^{b}
240 $Kg.ha^{-1}$	1268.9^{a}	1727.9^{a}	1653.5^{a}	4.30^{a}	3.34^{a}	2.28^{a}	64215^{a}

*The mean of treatments with the same letters were not statistically significant with respect to the Duncan multidimensional test at 5% level.

The lowest effect belonged to the treatment of 80 kg.ha^{-1} of pure nitrogen, which was recognized as the lowest effect at the stage of emergence of male flowers with 4, at the tassel emergence stage stage of emergence of silk with 3.24 and at the stage of seed filling with 2.17 (Table 3). Marashi *et al*. (2005) reported that the highest corn dry matter in the stage of tassel emergence stage and seed filling was obtained in the treatment of 240 kg.ha^{-1} and the lowest in the treatment of 120 kg.ha^{-1}, and the increase in nitrogen consumption from 120 to 240 kg.ha^{-1} increased the dry matter of corn was 8.1% and 9.7% in the stages of tassel and seed filling, respectively. It can be said that nitrogen plays a great role in photosynthesis activities, making carbohydrates and chlorophyll and leads to increased vegetative growth and accumulation of dry matter in the plant, with its increase, the total dry weight increased in different stages and it also seems the reduction of leaf surface index in the treatment of 80 kg.ha^{-1}, parallel to the reduction of photosynthetic activity, is a reason for the reduction of dry matter accumulation in this treatment. The application of nitrogen fertilizer can increase the dry matter of the whole plant with the development of vegetative growth and more durability of leaf and stem surface, and these results were consistent with the results of Sadeghi *et al*. (2009).

4.3. Seed yield

The results showed that the effect of sugarcane compost and nitrogen on seed yield was significant, but their interaction did not show a significant difference (Table 2). The highest seed yield was given to the treatment of 30 t.ha^{-1} of sugarcane compost with an average of 6446 kg per hectare and the lowest seed yield with an average of 5166 kg per hectare was assigned to the treatment of no use of sugarcane compost (Table 3). It can be said that sugarcane compost has improved the yield components such as the number of rows in the cob, the number of seeds in the row, the weight of 1000 seeds and finally the increase in seed yield due to its nutritional elements and its effect on improving the soil structure. Jalali *et al*. (2012) also attributed the increase in seed yield in the conditions of compost consumption to the amount and incease of access of nutrients. Nejad *et al*. (2010) in reviewing their results stated that the superiority of seed yield in the conditions of application of organic materials is due to their positive role in increasing soil moisture storage, reducing water losses and maintaining soil moisture for a longer period. Also, Qasr al-Dashti *et al*. (2013) stated in their experiment that compost directly through the release of macro and micro elements and indirectly through improving the physical properties of the soil such as reducing the apparent density of the soil and increasing the water holding capacity in the increase the yield is effective. The results of this experiment were consistent with the findings of Monjazi *et al*. (2015) regarding the increase of seed yield in the conditions of using sugarcane residues in sesame cultivation. Sugarcane residues were compatible with sesame cultivation. The results also showed that the seed yield was significantly affected by nitrogen fertilizer (Table 2). The highest seed yield was obtained in the treatment of 240 kg.ha^{-1} of nitrogen with 6421 kg.ha^{-1} and the lowest seed yield was obtained in the treatment of 80 $kg.ha^{-1}$ with 5304 $kg.ha^{-1}$ (Table 3). It seems that the reason for the increase in seed yield under the conditions of application of organic and nitrogen fertilizers is the lengthening of the seed filling period and the increase in the absorption of soil nutrients due to the increase in the total volume of corn roots (Karimi *et al*., 2012). The results of this experiment were consistent with the findings of Haghjo and Bahrani (2015) regarding the increase of corn seed yield up to the level of 250 $kg.ha^{-1}$ of nitrogen. Some researchers believe that nitrogen consumption leads to an increase in seed yield due to an increase in the efficiency of photosynthesis per unit area (Cheema *et al*., 2001). Bagheri *et al*. (2013) stated that at high levels of nitrogen, seed yield increased due to proper nutrition and reduced intensity of competition and flower abortion in the stage of determining the number of ovules. It has also been stated that the presence of nitrogen causes the continuity of the leaf surface, increases the duration and rate of leaf photosynthesis and ultimately causes more dry matter production (Zebarth *et al*., 1992).

5. CONCLUSION

The results of the experiment showed that the consumption of sugarcane compost and nitrogen led to an increase in the yield of corn seeds through the improvement of growth characteristics. The highest quantitative yield was obtained under the conditions of application of 30 $t.ha^{-1}$ of sugarcane compost and 240 kg per hectare of nitrogen fertilizer, which can be considered and suggested by farmers and researchers.

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FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

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