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Assessment of corn grain yield and yield components in double cropping with winter crops affected by vermicompost application

Ramin Khoda Moradi*, Davod Sheykhlar* and Fateme Ahmadi*
**Department of Agronomy and Plant Breeding,*
College of Agriculture, Karaj Branch, Islamic Azad University, Alborz, Iran

(Corresponding author: Ramin Khoda Moradi)
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ABSTRACT: Amplification of corn acreage in previous years, increasing of compacted cultural system for this plant along with higher corn nutrients requirement have resulted excessive use of chemical inputs, increased production costs, increasing environmental risk. Using of appropriate double cropping system can be an effective method to overcome these problems. During this study a randomized complete block design was conducted to study three different rotation systems (1- barley-corn 2- wheat-corn, 3-wheat-corn + vermicompost fertilizer) in 2013 crop year. Results have showed that maximum highest dry and fresh yields were obtained in barley-corn rotation, with 75250 and 30375 kg respectively.

Keywords: corn, crop rotation, barley, vermicompost.

INTRODUCTION

Alternative cropping systems are using to increase the efficiency of crop production, improvement of soil fertility and environmental protection (Kiminami *et al.* 2010) Crop rotation is one of the best ways to increase dry matter production plant for industrial purposes or for livestock feed. Sustainable development of agriculture needs urgent structural changes in the existing farming systems on arable soils which in order to balance the processes of mineralization and humification of soil organic matter (Boincean, 2010). Developments of farming systems provide a balance between production and agro-ecosystems (Fales *et al*., 2007). Traditionally, the cropping system involved growing cereals (barley and wheat) in rotation with fallow to conserve moisture; sheep and goats were an integral part of the low-input system (Ryan and Sommer, 2010). Crop rotation is an efficient and economical weapon for controlling plant diseases (Hake *et al*., 1991). A developed double cropping system is a pathway to increase plant dry matter productions which make numerous benefits (Karpenstein Machan, 2001; Arshad *et al*., 2007; Wrather *et al*., 2008). In such a system, two crops are cultured sequentially in the same growing year which includes harvesting a psychrophilic crop (mainly cover plants) in spring and immediately cultivating a thermophilic crop in the summer (Snap *et al*., 2005).

Double cropping led to soil conservation by reducing soil erosion, because the crop on a farm to grow longer each year in comparison with single cropping. Also the cycles of pests and diseases life can disrupt due to existence of different plants in a year. (Kinoshita *et al*., 2008) This system result to less risk of damage production and it is more adaptable to existing agricultural conditions which increase economic benefits for farmers (Seddiqi *et al*., 2013). Double cropping could increase the profitability of agriculture through increasing efficiency of land, labor, water of irrigation, capital and equipment (Kiminami *et al*., 2010). During the past few decades rising of the area under maize cultivation intensify cropping systems which require high corn plant with the addition of nutrients and it caused excessive use of chemical fertilizers and increased production costs and environmental risks (Biari *et al*., 2008). Therefore use of double cropping system is suitable method to overcome these problems.

About 70 percent of the corn in Iran harvest after of wheat, barley and canola. Planting corn in summer is important for using of empty capacities (Zabihi, 2002). In the central and southern areas of Tehran province, which has a temperate climate and warm, after canola, barley or winter wheat can attempt to summer planting corn that this is economically can useful for farmers to maximum use of summer duration.

The destructive environmental impacts of conventional farming because of uncontrolled using of chemical inputs such as fertilizers and pesticides emphasize the importance of sustainable agriculture methods. It is clear that although conventional agricultural systems with using of chemical fertilizer and pesticides result to high performance in short term but Actual performance will be reduced in the long term. These systems are often associated with problems such as nitrate leaching and, groundwater pollution, N2O emissions in the atmosphere because of uncontrolled using of nitrogen fertilizers which is resulting in the destruction of the ozone layer, Phosphorus and potassium leaching which is resulting destruction of the soil structure and reduction of soil permeability (Kochaki and Khalghani., 1998).

Recently farmers have tended to biological agriculture for the restoration and improvement of soil compositions. For maintenance high production output l it is necessary to provide organic fertilizer for agricultural. Also using of vermicompost organic fertilizers can improve soil structure, increase soil organic carbon, increase microbial activity, decreases nutrient leaching. Several options have been proposed to reduce nitrate loadings including increased use of wetlands and cover crops and better nutrient management and crop rotations (Christianson *et al*., 2010).

Vermicompost, or Vcompost, is a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and pure vermicast produced during the course of normal vermiculture operations (Maleki Farahani *et al*., 2011). Vermicompost causes more smooth structure for soil and increase process of aeration and the capacity of moisture and water holding of soil. Vermicompost include organic carbon nutrients which release slowly and steady and plant is able to absorb them in growth process (Alikhani and Savabeghi., 2006). Using of vermicompost is effective to support sustainable agriculture and activity of beneficial microorganisms in the soil and also help to provide important nutrients element needed such as N, P, K and improve the plant growth process and crop yield (Arancon *et al*., 2004) Kumawat *et al*. (2006) reports that using of vermicompost increased the plant's environmental performance of barley. Maleki Farahani *et al*. (2011) in their report concluded which Integrated fertilizing systems, including vermicompost and biofertilizer along with chemical fertilizers have the capacity to provide enough food in sustainable agricultural systems in Iran. The aim of this study was to study the impact of common winter crops which cultivating in the region on performance and characteristics of maize due to the different effects on soil fertility, soil characteristics and previous culture.

MATERIALS AND METHODS

This study was conducted using a randomized complete block design in 2013 in Tehran, Iran. Treatments consisted of three crop rotation system was 1- barley - corn, 2-wheat- corn, , 3-wheat-corn + vermicompost fertilizer.

The plot size for each experiment was 100 m × 100 m (one hectare) which was two meters away from other plot. Amount and Date of fertilizers application was planning for each of crops base of crops, soil analysis and scientific recommendations. At flowering phase, plant height (from ground level to the male inflorescence nodes) was calculated (Khajeh pour *et al*., 1998). For calculating the yield crops in middle rows of each plot was harvested with considering margin of each plot. In this regard the grain weight for each of samples was calculated separately. Depending on conducted experimental design, Data was analyzed by statistical SAS software statistical version 9.1, analysis and analysis of comparison was done by Duncan's test at 5% level.

RESULTS AND DISCUSSION

The total performance of different studied rotation culture provided in Table 1. The results of variance analysis showed significant differences ($P \leq 0.01$) between studied traits include fresh and dry biomass, maize yield and 1000 seed weight. Results of mean Comparison for fresh and dry biomass have shown in form of graphs in Fig. 1 and Fig. 2 respectively. Results showed that barley-corn rotation system resulted highest fresh and dry biomass with the amount of 75250 and 30375 kg respectively. Also the highest grain yield (Fig. 3) and seed weight (Fig. 4) was observed on barley-corn rotation system, with 14750 kg and 155 kg, respectively. There was no significant difference between rotation systems for plant height. The results of this study showed the highest yield of corn cultivation was in on barley-corn rotation culture system. The wheat-corn rotation systems along with using vermicompost did not recognize as the best rotation culture system in this region. This research indicated barley has positive effects on plant traits such as dry weight and grain weight. The barley-corn rotation culture system showed better economic performance rather than other double cropping system. As result this study suggest barley-corn rotation culture in order to offer the best yield, quality of grain and forage in areas with similar climatic. Mallarino (2006) reported that Comparison of yield of corn after corn and other corn crops indicated a clear rotation effect resulting in higher yield levels after legumes. This yield difference ranged from 10 to 14% for the various rotations. Kratochvi *et al*. (2006) studied evaluation of double crop corn production in Virginia.

Table 1: Analysis of variance of parameters measured in corn.

	D.F	Fresh biomass	Dry biomass	Maize yield	Plant height	TKV	Seed yield	Cob ear yield
Rep	3	94000000	1076388.9	3744075.20	0.0011	394.75	253444.44	915555.556
Treatment	2	14083333.3**	92645833.3**	35228158.33**	0.001^{ns}	1263.25**	2015833.33**	330833.33^{ns}
Error	6	25750000	8034722.2	4077825	0.0019	65.91	226944.44	20305
CV%	-	7.65	11.09	17.21	1.59	5.93	5.362704	5.55 15.71

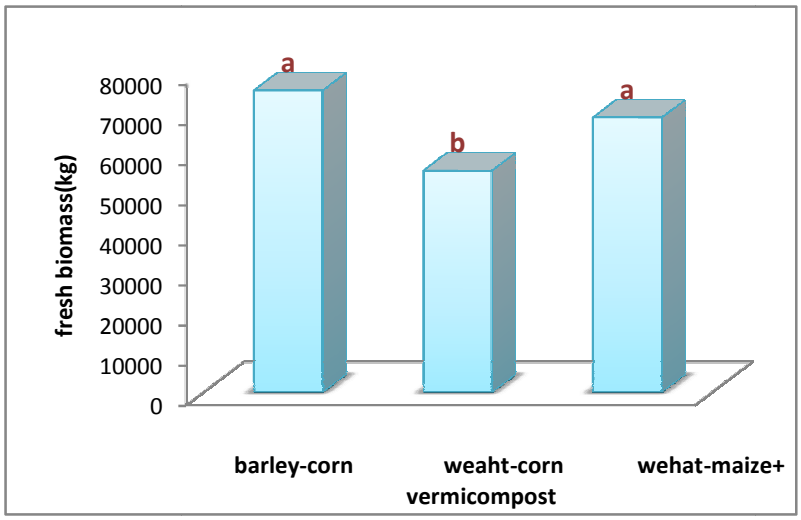

Fig. 1. Mean Comparison of different rotation culture on fresh biomass of corn.

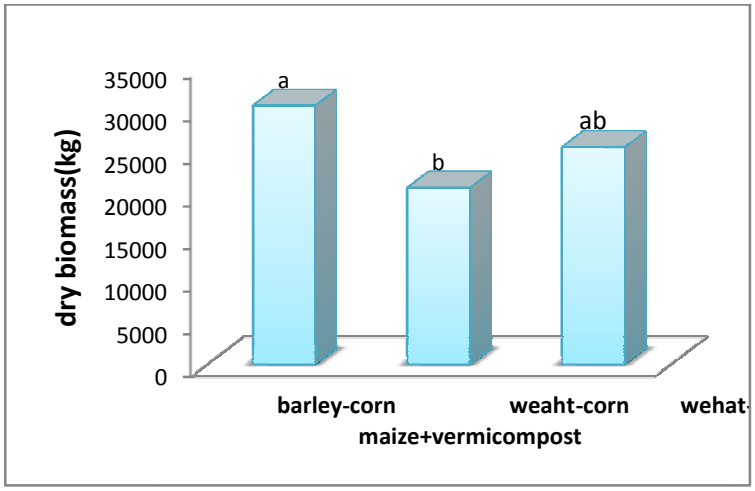

Fig. 2. Mean Comparison of different rotation culture on dry biomass of corn.

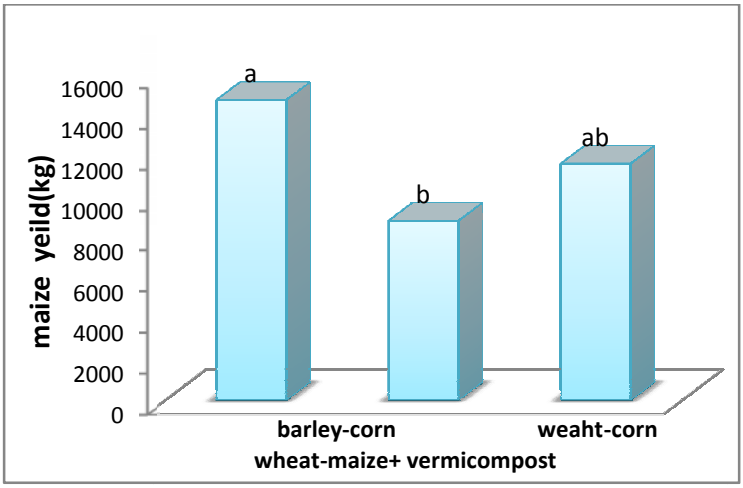

Fig. 3. Mean Comparison of different rotation culture on corn yield.

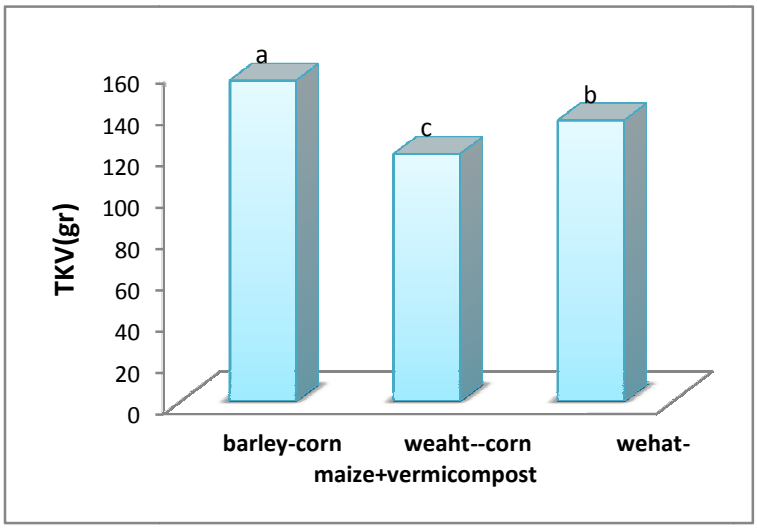

Fig. 4. Mean Comparison of different rotation culture of corn seed weight.

Their reports indicated double crop production of corn following barley had potential and can be successfully incorporated as a cropping system option for the region provided it is planted timely. They recommended which double crop production of corn appears to have agronomic potential when the growing season precipitation level is suitable and if soil moisture holding capacity is suitable. Also In one of important study results obtained in long-term experiments with different crop rotations and permanent crops at the Research Center "Selectia" Republic of Moldova have proved a high "effect of rotation" and the irreplaceable role of soil fertility on yield formation for the majority of crops (Boincean, 2010). Allen *et al*. (2010) applied management strategies to improve yield and nitrogen with using of spring wheat and field pea in the semi-arid Northern Great Plains USA and their results from the transition phase of long-term study suggest that increased level of rotation diversification in wheat and pea and ecological management in pea improve yield, in part through improved N use efficiency.

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