The effect of pre-sowing treatments and nitrogen rates on yield of silage maize 
(Zea mays L.) SC 704
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Abstract
In order to determine the best pre-sowing treatment and nitrogen rate in silage corn, a field experiment was conducted in a split plots based on randomized complete block design (RCBD) with four replications during 2013 - 2014 growing season in Karaj. Main plots consisted of four pre-sowing treatments (Fallow, manure, Perko and Buko) and sub-plots included three rates of nitrogen (120, 240 and 360 kg ha⁻¹). Variation analysis results showed that pre-sowing treatments have a significant effect (P ≤0.01) on dry matter and yield of forage, dry matter and yield of grain and biological yield. The maximum forage yield (78.23 ton ha⁻¹) obtained from Perko pre-planting and the minimum forage yield (63.72 ton ha⁻¹) obtained from manure pre-sowing. The highest grain yield (7.76 ton ha⁻¹) obtained from Perko pre-sowing and the lowest grain yield (5.11 ton ha⁻¹) obtained from manure pre-sowing. The effect of nitrogen rate on forage yield, dry matter and yield of grain and biological yield was significant. The maximum forage yield (76.42 ton ha⁻¹) obtained from 240 kg ha⁻¹ nitrogen rate. Interaction of pre-sowing treatment and nitrogen rate on grain yield was significant (P ≤0.05). Correlation analysis showed that forage yield had a significant (P ≤0.01) and a positive correlation with grain yield, biological yield and grain dry matter. Among the traits, the grain dry matter had the highest correlation with grain yield (r=0.950 **) and biological yield (r=0.931 **).
Keywords : Buko, Fallow, manure, forage and Perko,
fertilizers and also reducing soil organic compounds in the last three decades has attracted the attention of experts to other resources of nitrogen. Among them, organic sources of nitrogen can be pointed out that in addition to supply the amount of nutrients for the plants can play an important role in maintaining soil organic compounds and plant health (Ochiai et al., 2008; Ajvanzadeh, 2005; Kamkar and Mahdavi damghani, 2008). Todays, the role of cover crops in improving soil structure and quality and preventing soil erosion and the growth of weeds, pests and diseases is determined as well. But what is superior over the other benefits in these plants refers to the enhancement of soil organic matter and consequently less consumption of chemical fertilizers and preventing environmental pollution (Hashemi et al., 2010). Therefore, today presowing can be cultivated to special purposes such as preserving and adding nitrogen and carbon in agricultural systems, improving C/N ratio and the Soil Erosion Control. Three major groups of plants, including grasses, legumes and Brassica used as green manure. Brassica in many cases are suitable replacement for legumes and grasses to cultivate and in addition to the effect of green manure can significantly increase soil organic carbon and soil porosity (Collins et al., 2007). In Europe and parts of North American hybrid varieties of Brassica species are used as an inter-crop forage crop. These varieties are the result of crosses between crop plants of the Brassica family, Preko hybrids resulted from the confluence between (Brassica napus L.var.napus) and (Brassica rapa subsp. Chinensis L.) and Buko plant is a new amphiploid which is the result of confluence between tetraploid winter rapeseed (Brassica napus L. var napus) and Chinese cabbage and forage turnips, which in many ways is superior than its parents. The hybrids are used as livestock feed due to the well-being favor, and because of rapid growth and cover on the soil surface can and also high performance of shoots can be used in organic and sustainable farms and as cover crops and green manure (Mihailovic et al., 2008; Saito, 1998). Another interesting capability of cover plants refers to fixing the moving nitrogen so that convert nitrogen to nitrate nitrogen and then to protein inside the plant and in this way they timely prevent the waste of nitrogen through leaching or denitrification (Pink et al., 1948). In addition, by cultivation of these plants the conserve and save of nitrogen or soil nitrogen deficiency is improved (Cambardella and Elliott, 1992). Zadabdollah et al. (2013) studied the effect of pre-sowing plants Preko and Buko and different amounts of nitrogen on corn and reported that these plants increase forage yield by improving soil fertility. Kaveh et al. (2013) noted that cultivating Perko and oilseed radish will increase the quantitative and qualitative performance of the 640 single cross type of corn. Holderbaum et al. (1990) studied the harvest, management of cover crop (Trifolium incarnatum L.) and reported the increasing of the corn yield by adding the nitrogen fertilizer. Nasri (2014) during the two-year study on the climatic conditions of Ilam stated that pre-sowing of the Buko and Perko will increase the wheat yield through the improvement of the soil organic compounds.

In recent years, continuous operation and lack of observing crop rotation destroy the organic compounds so that the organic compound in arid and semi-arid regions of the countries will have the minimal compounds. Therefore, this research is carried out to investigate the integrated management of feeding corn silage and increasing the soil organic compounds through the cultivating the pre-sowing plants in Karaj.

**Materials and Methods**

This research was performed in the 2013-2014 crop year at the Agricultural Research Station of Islamic Azad University of Karaj (Mehrshahr). The
location of the experiment was conducted in geographical position of (35° 45˝N, 51° 56˝E; 1313 m above the sea level). The experiments were conducted as a split plot in a randomized complete block design and four replications. Main factors include pre-sowing treatments in 4 levels (Perko, Buko, manure and fallow) and sub factors also included nitrogen manure levels (120 and 240 and 360 kg ha\(^{-1}\)). Before conducting the experiment, composite samples of soil were prepared and physicochemical characteristics were measured. Physical and chemical analysis of the soil and manure was provided in (Tables 1 and 2).

Land preparation, including plowing, disc plow and leveling was conducted in March 2013. Cultivating the pre-sowing plants was done in March 2013. For cultivating the pre-sowing plants, Seeds of these plants were considered linearly at the depth of 0.5 up to 1 cm and spacing of 15 cm. At the end of June and the end of the growth period of Buko and Perko, pre-sowing plant returns to the soil in conducted. First, the plants floor action was done and then return operation was conducted by the crop rotator.

Preparation of silage corn was made on 10 June 20. Based on the recommendations of soil tests, 36 kg ha\(^{-1}\) phosphorus of triple superphosphate and 70 kg ha\(^{-1}\) of potash of potassium sulfate resources were added to the soil before conducting the experiments.

Also for applying the treatment of animal manure in portrait the amount of 7 ton ha\(^{-1}\) was given to the soil before the cultivation. Corn cultivation was done by pneumatic devices in July 5 in a mechanization way. Thus, in order to eliminate the effects of solar radiation and reduce marginal effects and leakage of nitrogen. All the cultivated land areas were tested in agricultural farms natural conditions. The lines spaced by 65 cm and a density of 12 plants m\(^{-2}\) and dimensions of 22 m\(^{2}\) for cultivating are used. During the growing season for weed control, weeding was done by hand. Also, nitrogen fertilizer is used in three steps by 10% in 5 and 6 leaves, 70% in the rise of the male tassel and 20% in grain filling stage of urea resources. The irrigation was done by stacked barley and based on crop needs and environmental conditions every seven days in the early period of growth and every 10 days in the last period of growth. On 30 October 2014, when the moisture content of corn achieved to the 55-60%, the amount of 4 m\(^{2}\) were taken from each port subject to the marginal effect, Some characteristics such as forage yield, biological yield, grain yield, dry compounds seeds and dry compounds forage we were assessed. The order of forage yield is the aboveground organs when the plant has 45% dry compounds. But the order of biological yield is the total dry weight of the aboveground organs when the samples are in the temperature of 65°C and

### Table - 1. Physical and chemical properties of the soil of the experiment site

<table>
<thead>
<tr>
<th>Soil depth (Cm)</th>
<th>Soil Texture</th>
<th>pH CaCl(_2)</th>
<th>EC (dS.m(^{-1}))</th>
<th>C(_{org}) (%)</th>
<th>N(_t) (%)</th>
<th>P (mg.kg(^{-1}))</th>
<th>K (mg.kg(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 30</td>
<td>Sandy-Clay</td>
<td>7.8</td>
<td>2.83</td>
<td>0.81</td>
<td>0.08</td>
<td>11.8</td>
<td>342</td>
</tr>
<tr>
<td>30 - 60</td>
<td>Sandy-Clay</td>
<td>7.6</td>
<td>3.7</td>
<td>0.63</td>
<td>0.06</td>
<td>9.8</td>
<td>298</td>
</tr>
</tbody>
</table>

C\(_{org}\) – organic carbon; N\(_t\) – total N

### Table - 2. Properties of the manure

<table>
<thead>
<tr>
<th>K</th>
<th>P</th>
<th>DM (%)</th>
<th>C(_{org})</th>
<th>N(_t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25</td>
<td>1.07</td>
<td>91.74</td>
<td>21.12</td>
<td>1.11</td>
</tr>
</tbody>
</table>

C\(_{org}\) – organic carbon; N\(_t\) – total N
the humidity of the 14%. Data analysis was done using SAS (Version 9.1) statistical software and the means were compared using Duncan test in 5% level.

Results and discussion

Grain yield

The result of variance analysis showed that the interaction between nitrogen and pre-sowing treatments on grain yield of corn at probability level of 5% was significant (Table - 3). Means comparison between the levels of nitrogen and pre-sowing treatments showed that highest grain yield of corn was affected by nitrogen consumption of 240 kg ha\(^{-1}\) and pre-sowing of Perko was 9.1 ton ha\(^{-1}\). On the other hands, the lowest grain yield of corn was related to nitrogen treatments of 120 and 360 kg ha\(^{-1}\) as well as treatments with manure to rates 4.85 and 4.8 ton ha\(^{-1}\) (Fig.-1).

Grain yield at probability level of 1% with percent of dry compound of rain, biological yield and forage yield has positive and significant correlation. These results are corresponding to Daneshian (2000) report (Table - 4). Zadabdoallah (2013) described the interactions of pre-sowing plants and nitrogen on grain yield at the level of 5% was significant. Nasri et al. (2014) stated that pre-sowing plants had a significant effect on wheat grain yield so that in the first year pre-sowing of Buko and in the second year pre-sowing of Perko were the best treatments for increasing grain yield. He reported the cause of increase in grain yield in pre-sowings due to increase in soil organic compounds and nitrogen fixation in the soil deep by extended roots of Perko and Buko and restore nitrogen to the soil surface by shoots.

Biological yield

The result of variance analysis showed that the effect of nitrogen and pre-sowing treatments on corn biological yield at probability level of 1% and 5% was significant, but the interaction between nitrogen and pre-sowing was not significant (Table - 3). Means comparison showed that the higher biologic yield of corn after Perko planting was 25.73 ton ha\(^{-1}\) and the lowest biological yield of corn was related to fallow treatments with manure and without manure that were 17.47 and 19.03 respectively (Fig.- 2). The results of means comparison showed that treatment of fertilizer consumption 240 kg ha\(^{-1}\), at 22.5 ton ha\(^{-1}\) and treatment of fertilizer consumption 120 kg ha\(^{-1}\), at 19.68
ton ha\(^{-1}\) had the highest and the lowest biological yield of corn respectively (Fig.-3). Zad abdoallah (2013) reported that the effect of pre-sowing plants and nitrogen consumption on biological yield of corn at level of 1% was significant so that the highest biological yield of corn was obtained due to pre-planting treatment of Perko and consuming 240 kg N. Kaveh (2011) described the interactions of pre-sowing plants and nitrogen on biological yield at the level of 5% was significant. It seems that the cause of increase in biological yield in pre-sowing treatments comparing with manure is due to increase in soil organic compounds and nitrogen fixation in the soil deep by extended roots of Perko and Buko and restore nitrogen to the soil surface by shoots. Imam et al., (2009) stated that nitrogen as a key element in plant nutrition plays an important role in increasing qualitative and quantitative yield of crops and also can increase the power of plant to dramatically help to cope with environmental stress conditions. Adesoji et al. (2013) stated that the green manure cover crops in the first year of control experiments had not significant effect compared to witness (without a green manure cover crop) on corn biomass, but had significant effects in the second and third years.

**Corn Forage Yield**

The result of variance analysis showed that the effect of nitrogen and pre-sowing treatments on corn forage yield at probability level of 1% was significant (Table – 3). The result of means comparison showed that highest corn forage yield after Perko planting was 78.23 ton ha\(^{-1}\) and the lowest corn forage yield was related to fallow treatments with manure was 63.72 ton ha\(^{-1}\) (Fig.- 4). The treatment of fertilizer consumption 240 and 360 kg ha\(^{-1}\) was 74.3 and 76.42 ton ha\(^{-1}\) respectively, and treatment of fertilizer consumption 120 kg ha\(^{-1}\) had 62.9 ton ha\(^{-1}\) of corn forage yield (Fig.-5). Zad abdoallah (2013) reported that pre-sowing plants had significant effect on corn forage yield and this increasing yield is due to increase in nitrogen of soil by shoots that pre-sowing restore to the soil and the rapid decay of Perko and Buku shoots because of the low C/N ratio at 15 range. He also reported that consumption of fertilizer nitrogen at probability level of 1% was significant. Kwaw-Mensah and Al-kasri (2006) reported that reaction of corn biomass for nitrogen levels was significant and the highest grain yield was obtained with 389 kg N ha\(^{-1}\). Generally, planting cover crops through different ways improves soil conditions and use of nutrients for plants. Steenwerth...
Table - 4. Regression coefficient for experimental characters

<table>
<thead>
<tr>
<th>Characters</th>
<th>Forage dry matter</th>
<th>Forage yield</th>
<th>Grain dry matter</th>
<th>Biological yield</th>
<th>Grain yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forage dry matter</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage yield</td>
<td>0.71**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain dry matter</td>
<td>0.46**</td>
<td>0.85**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biological yield</td>
<td>0.64**</td>
<td>0.83**</td>
<td>0.93**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Grain yield</td>
<td>0.48**</td>
<td>0.81**</td>
<td>0.95**</td>
<td>0.89**</td>
<td>1</td>
</tr>
</tbody>
</table>

n.s: not significant. *, **: Statistically significant at P < 0.05, 0.01, respectively.

Fig. - 3. The effect of nitrogen on biological yield
Means followed by different letters are significantly different using Duncan’s multiple range test (P < 0.05)

Fig. - 4. The effect of pre-sowing treatment on Forage yield
Means followed by different letters are significantly different using Duncan’s multiple range test (P < 0.05).

Fig. - 5. The effect of nitrogen on forage yield
Means followed by different letters are significantly different using Duncan’s multiple range test (P < 0.05)

Fig. - 6. The effect of pre-sowing treatment on Forage dry matter
Means followed by different letters are significantly different using Duncan’s multiple range test (P < 0.05).

Fig. - 7. The effect of pre-sowing treatment on grain dry matter
Means followed by different letters are significantly different using Duncan’s multiple range test (P < 0.05)

Fig. - 8. The effect of nitrogen on grain dry matter
Means followed by different letters are significantly different using Duncan’s multiple range test (P < 0.05).
and Belina (2008) stated that cover crops reduce nitrogen leaching from the soil up to 70%. At a probability level of 1%, forage yield has positive and significant correlation with percentage of grain dry matter, biological yield and grain yield (Table - 4). In general, it can be concluded that the modification of yield characteristics can be taken a step to increase yield indirectly.

**Forage Dry Matter**

The result of variance analysis showed that the effect of pre-sowing treatments on percentage of forage dry matter at level of 1% was significant (Table – 3). The highest percentage of forage dry matter was after cultivating Perko and Buko that were 15.08 and 14.28 respectively, and the lowest percentage was in fallow treatment with manure and without manure that were 12.55% and 12.65% respectively (Fig.-6). The percentage of forage dry matter had positive correlation with biological yield at 5% level r=0.64ns** (Table – 4).

**Grain Dry Matter**

The result of variance analysis showed that the effect of nitrogen and pre-sowing treatments on percentage of grain dry matter at probability level of 1% and 5% was significant, respectively but the interaction between nitrogen and pre-sowing was not significant (Table – 3). Means comparison between the levels of nitrogen and pre-sowing treatments showed that the highest percentage of the grain dry matter was affected by pre-sowing of Perko 22.16 kg ha\(^{-1}\) and the lowest percentage of the grain dry matter was related to fallow treatments with manure to rate 16.5% (Fig. – 7). The results of means comparison showed that the highest percentage of the grain dry matter was affected by consumption nitrogen 240 and 360 kg ha\(^{-1}\) 19.77 and 19.09% respectively and the lowest percentage of grain dry matter was related to nitrogen treatments 120 kg ha\(^{-1}\) that was 17.07% (Fig.- 8). Among all the traits, percentage of grain dry matter had the highest correlation with grain yield \(r = 0.950**\) and biological yield \(r = 0.931**\) (Table - 4). Akhlaghdoost (2010) reported the effect of nitrogen fertilizer on corn grain dry matter was significant at the level of 5%.

**Conclusion**

There was no significant difference among the pre-sowing treatment in term of forage dry matter, forage yield, percentage of grain dry matter, grain yield and biological yield. The highest rate of forage yield, biological yield, percentage of grain dry matter and percentage of forage dry matter was observed in pre-sowing treatment of Perko. The effect of nitrogen consumption on traits of forage yield, percentage of grain dry matter and biological was significant. The highest forage yield was related to 360 kg N h\(^{-1}\), however, there were no significant differences between the use of 240 and 360 kg of nitrogen. The highest biological yield and grain dry matter was related to consumption, nitrogen of 240 kg ha\(^{-1}\). Interaction between pre-sowing treatments and nitrogen levels on grain yield was significant and the highest grain yield in pre-sowing treatment of Perko for 240 kg N h\(^{-1}\) was observed. Finally, the pre-sowing treatment of Perko and Buko was due to high economic performance of appropriate and recommendable pre-panting in the area.

**References**


submitted to University of Zanjan, Iran. pp. 30 - 37.

Akhalgdoost, M., Kashani, A. and Tohidloo, G.h. 2010. The effect of different levels of density, chemical fertilizer and urban waste compost on quantitative and qualitative characteristics of corn silage KSC. Master thesis, Islamic Azad University of Karaj, Iran. pp. 87-96.


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