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Effect of pre-sowing and nitrogen application on forage quality of silage corn

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Abstract. In order to determine the best pre-sowing treatments and nitrogen rates on forage quality traits in silage corn (SC 704), a field experiment was conducted in a split plot based on a randomized complete block design (RCBD), with four replications during 2013–14 growing season in Karaj. Main plots consisted of four pre-sowing treatments (Black fallow, Farmyard manure and 2 green manure treatments including pre-sowing treatment of perko PVH and pre-sowing treatment of buko) and sub-plots included three rates of nitrogen (120, 240 and 360 kg ha^{-1}, utilized urea source). Results showed that the effect of pre-sowing treatments on DMD, NDF and forage yield was significant ($P \leq 0.01$), so that in all traits, perko PVH and buko treatments were the best ones to compare with black fallow and farmyard manure. Moreover, different nitrogen levels had significant ($P \leq 0.01$) effect on dry matter digestibility (DMD), neutrals detergent fiber (NDF) and forage yield, so that with the increasing rate of nitrogen, these traits increased. The interaction effect of pre-sowing treatments and nitrogen levels on water soluble carbohydrates (WSC), crude protein (CP), acid detergent fiber (ADF) and total ash was significant ($P \leq 0.01$). In general, results showed that the suitable component is perko PVH treatment by using 240 kg ha^{-1} nitrogen fertilizer.

Key words: Crude protein, Dry matter digestibility, Green manure, Water soluble carbohydrates.

Abbreviations: ADF: Acid Detergent Fiber; CP: Crude Protein; DMD: Dry Matter Digestibility; NDF: Neutrals Detergent Fiber; WSC: Water Soluble Carbohydrates.

INTRODUCTION

One of the most important factors limiting the development of animal husbandry and livestock production is to provide fodder to feed the country's livestock. Thus, the need for forage production is increasing every day (Armstrong & Albrecht, 2008). Forage crops have an undeniable role in providing nutrient requirements of the ruminants. In modern animal husbandry, the silo which is made from corn allocates an important part of the daily diet of ruminants (Kmicikewycz et al., 2015). Forage quality represents nutritional value and the amount of energy that is available for livestock. In other words, it is the amount of nutrients that animals obtain in the shortest possible time from the feed (Buxton, 1996). Using good quality forage in animal breeding, reproduction, meat, dairy, leather and wool is very useful and effective. So that nutrient in the diets of livestock, forage quality and the amount of that is very important (Suyama et al., 2007). An important factor in the production and management of forage plants is the quality of the forage and improving forage quality results in feed efficiency (Catanese et al., 2016).

Corn is widely cultivated due to many features including multiple use cases in many countries (Al-Kaisi & Yin, 2003). In addition to being very good forage for livestock; this plant is also suitable for livestock in terms of power supply. Because of having sugars, starch and high forage yield, corn is one of the most important crops for the production of green forage, silage and grain (Gholamhoseini et al., 2013). Silage corn yield in most of the arid and semi-arid areas of the country is low due to low organic matter of the soil and nitrogen deficiency (Ferreira et al., 2014). Although the use of chemical fertilizer significantly increases the performance of many products; however, some adverse environmental impacts and lack of response to the excessive use of fertilizers because of their indiscriminate use, food production in the coming decades will face difficulties (Villegas & Fortin, 2002). Black fallow as a traditional practice has been defined as farming perform wherein no crop is grown and all plant growth is controlled by cultivation or chemicals during a season when a crop might normally be grown (Haas et al., 1974). Unfortunately, soil loss under black fallow management due to water and wind erosion can be significant. A study involving the use of the revised universal soil loss equation (RUSLE; Renard et al., 1991) indicated the use of seeded fallow (green fallow) in central Spain would cut the area estimated to have greater than 6 t ha^{-1} soil loss to one-third the area under that risk when in unseeded or black fallow (Boellstorff & Benito, 2005). In central Croatia, Basic et al. (2004) measured a 5-yr average soil loss of 87 t ha^{-1} from standard black fallow USLE protocol plots (Wischmeier & Smith, 1978) on a 9% slope.

Recently, different cropping systems, including crop rotation, delayed planting and annual intercropping planting with legumes are introduced to increase production in agriculture (Carruthers et al., 2000). Today, for this purpose and instead of black fallow, pre-sowing (or green manure) can be cultivated for 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 recently brassica family are cultivated as green manure. Brassica family are planted in many cases as a substitute for legumes and grasses which in addition to the properties of green manure, can significantly increase soil organic carbon and soil porosity (Collins et al., 2007). Nowadays, in Europe and parts of North America hybrid varieties of brassica species such as perko PVH and buko are planted as intercropping forage. Perko PVH plant is the hybrid between *Brassica napus* L. var. napus and *Brassica campestris* L. var. sensulato. Also, buko is the result of crosses between tetraploid rapeseed (*Brassica napus* L. var napus) and Chinese cabbage (*Brassica campestris* L. var. sensulato) and forage turnips (*Brassica campestris* L. var. rapa), which are in many ways superior to their parents. These hybrids also are used in livestock feed due to be palatable, according to grow and create quick cover on the soil surface and also high performance of aerial organs can be used as cover crop and green manure in organic and sustainable farms (Mihailovic et al., 2008).

Clark et al. (1997) reported that quantitative and quality of corn forage is very significant under the influence of cover crops. In another study, Holderbaum et al. (1990) have been reported increased corn yield with increasing nitrogen by studying lucky clover cover crop harvest management, which was 30–65% of increased performance compared to control corn yield using 90 kg N ha^{-1}. In the study of single and double cropping of sorghum, has been reported that by increasing the amount of nitrogen fertilizer, sorghum protein content has increased and also the protein content of sorghum was looking for rye cover crop cultivation was more than sorghum which was continuously growing (Buxton et al., 1999). Ranells & Wegger (1996) attributed the main reason for increasing in yield after planting cover crops to the release of nitrogen from crop residues. Gholamhoseini et al. (2013) reported that by increasing levels of nitrogen fertilizer protein percentage of corn forage is significantly increased. Increasing the amount of nitrogen will lead to the increased crude protein, total carbohydrates and total sorghum ash (Reiad et al., 1995). A significant increase in protein percentage and digestibility of corn by increasing the levels of nitrogen has been reported by other researchers (Lawrence et al., 2008; Gheysari et al., 2009). Most studies on corn silage were based on monoculture and single cultivation and report on the plants before cultivation is unavailable. Therefore, knowing the effect of organic fertilizers on forage quality and performance of silage corn requires lots of study and research. This study aimed to evaluate the effect of pre-sowing forage quality and nitrogen levels were implemented.

MATERIALS AND METHODS

Field experiment was conducted at the Faculty of Agriculture, Agricultural Research Station of Islamic Azad University, Karaj, Iran (35° 45' N and, 51° 56' E, altitude 1,313 m), during the 2013 and 2014 years. The region is characterized as semi-arid, with mean annual precipitation of 207 mm, which mostly falls during the autumn and winter months. The annual mean temperature is 16 °C. The average precipitation and temperature in 2013 and 2014 were similar to the long-term meteorological data trend. Prior to the beginning of the experiment, a composite soil sample was collected at depths of 0–30 cm, air-dried, crushed and tested for various physical and chemical properties. Physical and chemical analysis of the soil and farmyard manure is provided in Tables 1 and 2, respectively. In addition, meteorological data were obtained from a meteorology station, Meteorological Organization of Alborz, located 7 km away from the experimental field Province (Fig. 1). The experiment was conducted using a randomized complete-block design with a split plot arrangement of treatments through four replications. The first factor included four pre-sowing treatments (2 green manure treatments including pre-sowing treatment of perko PVH and pre-sowing treatment of buko, Farmyard manure and Black fallow) as main plot, and the second factor included three nitrogen rates (120 and 240 and 360 kg ha^{-1}, utilized urea source) as sub plot.

Table 1. Soil physiochemical properties site

Soil depth, (cm)	soil texture	pH_{CaCl2}	EC (dS m^{-1})	C_{org} %	N_t %	P (mg kg^{-1})	K
0–30	sandy-clay	7.8	2.83	0.81	0.08	11.8	342
30–60	sandy-clay	7.6	3.7	0.63	0.06	9.8	298

C_{org} – organic carbon; N_t – total N.

Table 2. Properties of the farmyard manure

K	P	DM (%)	C_{org}	N_t
1.25	1.07	91.74	21.12	1.11

C_{org} – organic carbon; N_t – total N; DM – dry matter.

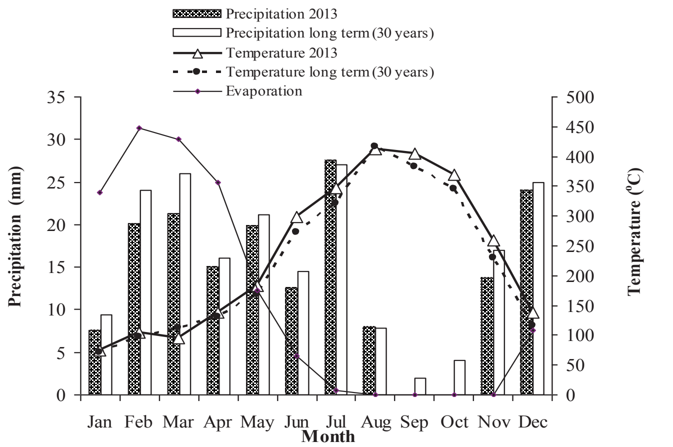

Figure 1. Monthly temperature, precipitation and Evaporation during the growing seasons in 2013 and long term.

Cultivating the pre-sowing plants was done in March 2013. For cultivating the pre-sowing plants, seeds of buko and perko PVH 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 plants, pre-sowing plant returns to the soil in conducted. First, the plant floor action was done and then return operation was conducted by the crop rotator. Preparation of silage corn farm was done on 10 July. Plots were prepared after plowing and disk-harrowing. The plots were 5 m long and consisted of six rows, 65 cm apart. The distance between the plants in the rows was 13 cm; thus, the plant density was approximately 12 plants per m^2. There were 2.5 m gaps between the blocks, and a 1.5 m alley was established between the plots to prevent lateral water movement and other interferences. 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, nitrogen fertilizer is used in three steps by 10% in 5–6 leaves, 70% in the stem elongation and 20% in grain filling stage of urea resources. In addition, for applying the treatment of farmyard manure in plots, the amount of 7 ton ha^{-1} was given to the soil before the cultivation. Corn cultivation was done by pneumatic devices in July 10 in a mechanized way. During the growing season for weed control, weeding was done by hand. 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 was taken from each port subject to the marginal effect.

Green forage which is immediately weighed and then a 2 kg sample of each plot (a total of 48 samples) after drying in 65 °C oven, first, the relevant samples are milled (at least 50 g) and then qualitative characteristics including DMD, WSC, CP, ADF, NDF and total ash are identified and used by near infrared spectroscopy which has the most accurate and at the same time the fastest technique for estimating the chemical composition of agricultural products. Data analyses are done using SAS statistic software Version 9.1.3 (SAS Institute, 2004). Mean comparison was done using the LSD test at the level of 5%.

RESULTS AND DISCUSSION

Water Soluble Carbohydrates (WSC)

The effects of pre-sowing treatments, N rates and the Pre-sowing × N interaction on the WSC were significant (Table 3). The maximum WSC (30.5% in dry matter) was observed for those plots that received 240 kg N ha^{-1} with perko PVH as pre-sowing treatment, and the minimum WSC (20.22% in dry matter) was obtained from application of the lowest levels of N fertilizer (120 kg N ha^{-1}) with farmyard manure as pre-sowing treatment (Fig. 2). Since the increase in WSC is known as a positive factor, thus, if the plant has enough reserves of soluble sugars can be further grown and don't lose due to the weakness and lack of food especially when photosynthesis is impaired or plants exposed to biotic and abiotic stresses (Buxton, 1996). Soluble carbohydrate that constitutes a significant portion of non-structural carbohydrates (Rostamza et al., 2011) are one of the most important components of determining forage quality which has the duty of supplying energy to the micro organisms of the rumen and maintain a healthy digestive system of livestock. Results showed that N application enhancement and perko PVH as green manure led to a significant increase in the WSC. The dominant reasons for this result are (i) N absorption by crop residues when N is more available (by applying N fertilizer) and (ii) the slow release of N by perko PVH residues during the corn growth period. Mirlohi et al. (2001) reported that by increasing the amount of nitrogen in the soil by plant debris and consumption of nitrogen fertilizer the percentage of forage WSC significantly increased.

Table 3. Analysis of variance (mean square) on different corn forage traits as affected by pre-sowing and N treatments

Sources of variation	d.f	#WSC	CP	ADF	Ash	DMD	NDF	FY
Replication	3	0.72	0.23	0.17	0.26	2.19	3.24	19.19
Pre-sowing (P)	3	86.15 **	21.27 **	124.39 **	10.48 **	158.37 **	300.25 **	487.82 **
Error A	9	1.05	0.10	1.08	0.21	1.69	3.04	52.87
Nitrogen (N)	2	33.94 **	5.84 **	75.88 **	11.06 **	253.85 **	15.39 **	845.63 **
P×N	6	5.71 **	0.79 **	5.28 **	1.33 **	5.72 n.s.	2.69 n.s.	118.90 n.s.
Error B	24	1.14	0.11	1.07	0.33	2.71	2.42	34.88
C.V. (%)		4.37	5.07	4.01	10.27	2.95	4.3	12.78

#WSC: Water Soluble Carbohydrates; CP: Crude Protein; ADF: Acid Detergent Fiber; Ash: Total Ash; DMD: Dry Matter Digestibility; NDF: Neutrals detergent fiber FY: Forage Yield; *, ** and ns: significant at 0.05, 0.01 probability level and no significant, respectively.

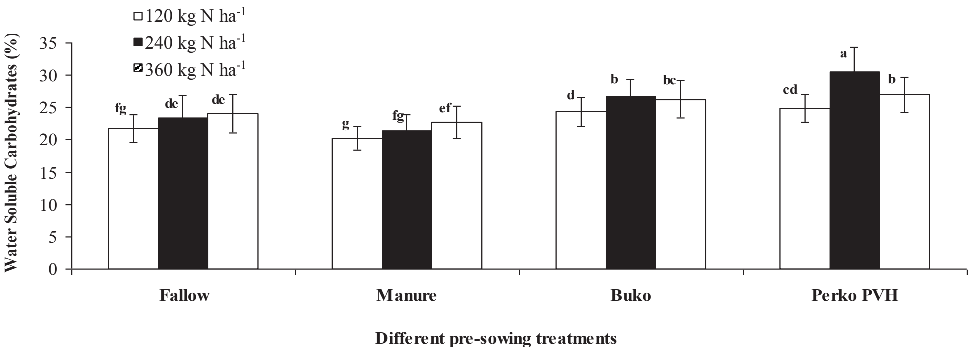

Figure 2. Interaction effect of Pre-sowing treatments × N rates on corn forage water soluble carbohydrates content. Means followed by the same letter are not significantly different ($P \leq 0.05$). Vertical bars indicate standard deviation (n = 4).

Crude Protein

Crude protein is one of the major nutritious compounds in livestock feeding, and its deficiency in forage could reduce livestock production yield (Gholamhoseini et al., 2012). The effects of pre-sowing treatments, N rates, and their interaction on crude protein were significant (Table 3). The integration of the medium N level (240 kg N ha^{-1}) with the perko PVH pre-sowing treatment generated the highest crude protein (9.07% in dry matter). In contrast, 12 kg N ha^{-1} + farmyard manure yielded the lowest crude protein (4.60% in dry matter) (Fig. 3). It seems that increasing the percentage of corn crude protein after is related to the deep and wide perko PVH roots that can absorb nutrients from the soil depth and also the remains of its rapid decay which increase soil nitrogen. Moreover, the crude protein enhancement with increasing in fertilizer levels may be due to enhancement in amino acid formation affected by fertilization and N availability. By contrast, Muhammad et al. (2002) reported that crude protein index of fenugreek forage was impressed by organic fertilizers (farmyard manure) and nitrogen. However, the corn crude protein percentage significantly decreased with farmyard manure application in the different rates of N due to increase N leaching intensity (Yan-Wang et al., 2002; Basso & Ritchie, 2005) when N was available in soil after farmyard manure distribution.

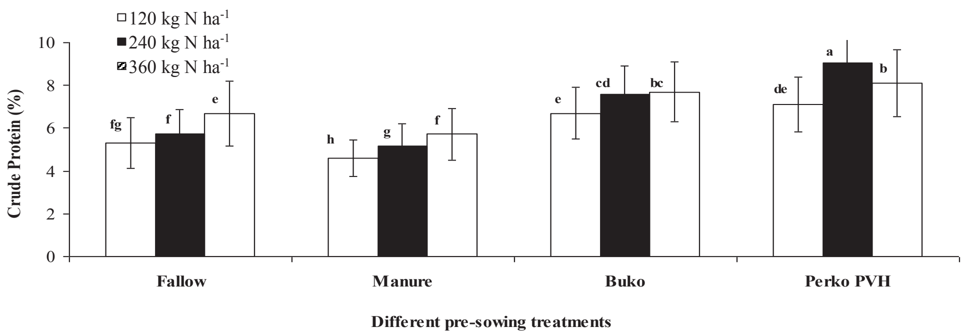

Figure 3. Interaction effect of Pre-sowing treatments × N rates on corn forage crude protein content. Means followed by the same letter are not significantly different ($P \leq 0.05$). Vertical bars indicate standard deviation (n = 4).

Acid Detergent Fiber (ADF)

Acid detergent fiber is an appropriate index to determine forage digestibility because it contains a high lignin ratio; thus, greater forage ADF decreased the digestibility of feed dry matter (NRC, 2001). In addition, Van Soest (1982) showed that ADF is the best index for representing of the nutritional value compared to the crude fiber and cellulose. Results revealed that the effects from pre-sowing treatments, N rates, and the pre-sowing × N interaction were significant for the ADF (Table 3). A comparison between the combined treatments indicated that under perko PVH pre-sowing treatment, application of 240 kg N ha^{-1} significantly increased the ADF when compared with other treatments (Fig. 4). The results demonstrated that both perko PVH and buko plants as pre-sowing treatments significantly enhanced the ADF under different N rates (Fig. 4). Also, results showed that the application of farmyard manure accompanied by N fertilizer consistently resulted in lower ADF than that found in other pre-sowing treatments. Valk et al. (2000) reported that increasing the nitrogen rate lead to the increasing of the ADF. Unfortunately, no one has reported the influence of pre-sowing treatments on the forage ADF percentage. However, it seems that increasing soil N by pre-sowing decomposing organic remains of plants is responsible for the ADF enhancement.

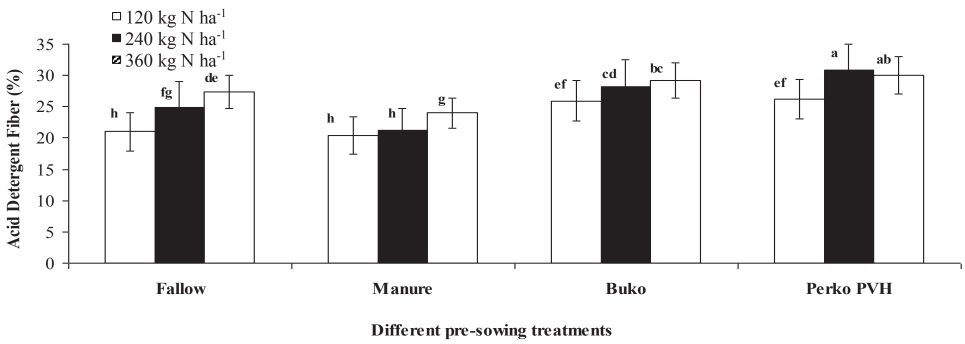

Figure 4. Interaction effect of Pre-sowing treatments × N rates on corn forage acid detergent fiber content. Means followed by the same letter are not significantly different ($P \leq 0.05$). Vertical bars indicate standard deviation (n = 4).

Total Ash

According to the data analysis, the effects from the pre-sowing treatments and N rates on the corn forage total ash were significant (Table 3); furthermore, the pre-sowing × N interaction was significant for this trait (Table 3). Comparison of means among treatments showed that the highest forage total ash was observed in plots fertilized with 240 kg N ha^{-1} and application of green manure (Perko PVH pre-sowing treatment) (Fig. 5). In contrast, the lowest ash content in forage was achieved in plots fertilized by minimum amount of chemical fertilizer (120 kg N ha^{-1}) accompanied by organic fertilizer (farmyard manure). The application of perko PVH and buko plants had a significant effect on forage quality traits, especially in those plots in which 240 kg N ha^{-1} was supplied by urea. The total ash content is used to determine the percentage of phosphorus, calcium, magnesium, potassium and other trace elements in the forage. It is quite obvious that mineral elements can be effective in forage quality (Sharma, 2002). Mineral elements in the forage are important as they involved in the animal metabolism and are necessary for body cell activity. In fact, ash forage represents the amount of minerals in plant tissues (Halil et al., 2009). So, in accordance with the direct relationship between total ash and forage quality, it is expected that increased total ash for corn forage in perko PVH and buko pre-sowing treatment accompanied with moderate N rate enhances forage quality and animal metabolism.

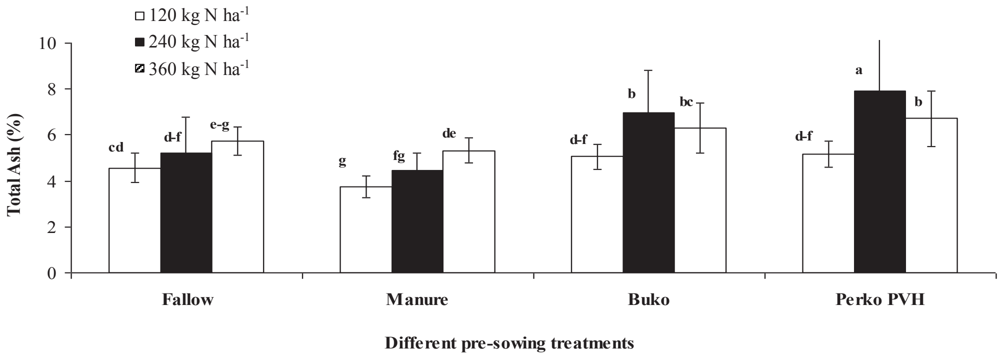

Figure 5. Interaction effect of Pre-sowing treatments × N rates on corn forage total ash content. Means followed by the same letter are not significantly different ($P \leq 0.05$). Vertical bars indicate standard deviation (n = 4).

Dry Matter Digestibility (DMD)

Digestibility usually calculated based on dry matter and is mentioned as a ratio or percentage. Also, digestion index is defined as preparing food for absorption by the digestive system of animal (McDonald et al., 1997). Results showed that corn forage DMD content was significantly affected by pre-sowing treatments and N rates (Table 3). An increase in the N fertilizer rates from 120 to 240 and 240 to 360 kg N ha^{-1} enhanced the forage DMD by 13 and 1%, respectively (Table 4). In fact, N efficiency was reduced by higher levels of this fertilizer. On the other hand, application of minimum amount of N fertilizer (120 kg N ha^{-1}) compared with other N treatments produced less DMD compared with the other N treatments. Almodares et al. (2009) reported that DMD will gradually increase with the increase of nitrogen, which is consistent with the results of the present study. Moreover, the maximum DMD (59.77% dry matter) was observed after the application of prko PVH plant as green manure, and the minimum DMD (51.26% dry matter) was observed after the application of farmyard manure in the soil. Since an increase in DMD is known as an advantage or positive factor, superior treatments of pre-sowing perko PVH and buko is important. In addition, it seems that, in those plots that received farmyard manure, leaching of N was the most important reason for DMD reduction.

Neutrals Detergent Fiber (NDF)

The amount of NDF in the feed is an indication of cell wall quantity, and the forage digestion coefficient can be predicted from the cell wall percentage (Gholamhoseini et al., 2012). The effects of pre-sowing and N treatments on the NDF were significant (Table 3). In N treatments the highest and lowest NDF values (37.27 and 35.44% dry matter, respectively) were generated using the 120 and 240 kg N ha^{-1}, respectively (Table 4). Suyama et al. (2007) reported that NDF value is significantly and negatively correlated with dry matter intake of ruminants, as NDF includes the structural cell wall components of plants (except pectins) and consists of the slowest digesting fractions (cellulose, hemicelluloses, lignin, and cutin). Therefore, it could be stated that high NDF restricts average daily body weight gains of cattle. In contrast, application of prko PVH and buko plants as pre-sowing treatments abrogated the increasing NDF such that the lowest NDF was observed from application of these plants as green manure compared with other pre-sowing treatments (Table 4). On the other hand, maximum forage NDF content was observed after the farmyard manure application (Table 4). Soluble fiber in neutral detergent includes sum of lignin, cellulose and hemicellulose and is a criteria for measuring the volume of the cell wall. By aging the plant, digestibility of dry matter and protein reduces and the amount of crude fiber and lignin increases (Halil et al., 2009). Since the reduction of soluble fiber is known as a positive factor in neutral detergent, so in this study, the treatment of 240 kg N ha^{-1} accompanied by pre-sowing of perko PVH and buko plants was the best treatment.

Forage yield

According to the data analysis, the effects from the pre-sowing treatments and N rates on the corn forage yield were significant (Table 3). The enhanced N application from 120 to 360 kg N ha^{-1} resulted in a 22% rise in forage yield (Table 4). Enhanced N fertilizer application enhanced the forage yield such that the highest yield (77,000 kg ha^{-1}) was from the 360 kg N ha^{-1} treatment, and the lowest yield (63,000 kg ha^{-1}) was from the 120 kg N ha^{-1} treatment (Table 4). It has been reported that N increases crop biomass through enhance of green area resulting in higher N assimilation (Gholamhoseini et al., 2013). Nitrogen assimilation enhancement is closely associated to an increase in net photosynthesis that finally results in enhanced plant dry weight. It should be stated that higher amounts of N above 240 kg N ha^{-1} did not significantly increase the corn forage yield (Table 4). On the other word, increase in N application from 240 to 360 kg N ha^{-1} increased forage yield only by 3%. These results suggested that increasing amounts of N application more than 240 kg N ha^{-1} does not increase yield production but does increase the environmental damaging side effects such as nitrate contaminated groundwater. The results demonstrate that application of green manure (especially perko PVH) increased the forage yield significantly (Table 4). Because the pre-sowing treatment of perko PVH increases the N availability and fertilizer efficiency, enhanced forage yield from this treatment is reasonable. Further, the ability of green manure to supply more nutritional elements gradually and during the plant growth period and improving soil physicochemical properties resulted in enhanced forage corn yield. Yield associated with various methods of fallow and pre-sowing treatments has been studied by many researchers (Biederbeck et al., 2005; Henry, et al., 2008). For example, Larsen et al. (2014) reported that, application of pre-sowing plants compared to the black fallow (unseeded fallow) leads to significantly higher corn yield quantities. They attributed the latter to the collapse of soil hard layer with plant roots, which makes better soil ventilation. It should be mentioned that C/N ratio in plant remains is critical for effectiveness of green manure. Therefore, low C/N ratio of buko and perko PVH plants (in the range of 15) is the reason for the increase of their effectiveness and rapid decay of buko and perko PVH remains. In comparison between black fallow and green manure, results showed that black fallow treatment had the lowest corn forage yield, being 12% lower than for perko PVH pre-sowing treatment (which had a maximum corn forage yield) (Table 4). This can be explained by the fact that corn forage yield is related to both nutrient and water availability and green manure (especially pre-sowing with perko PVH) unlike black fallow improved soil physical characteristics and resulted in greater corn root distribution and penetration. Only corn forage yield was enhanced at black fallow treatment compared with farmyard manure application treatment (Table 4) and this can be elucidated by greater nutrients leaching (especially N) due to manure activity in soil. Results showed that a significant and direct correlation between the total corn dry weight and leaf dry weight was existed. Ideally, those treatments that enhanced leaf dry weight (240 kg N ha^{-1} + pre-treatment of perko PVH or buko) because of their good digestibility can be categorized as optimum treatments.

Table 4. Main effect of Pre-sowing and N treatments on some corn forage traits

Traits Treatments	WSC* (%)	CP (%)	ADF (%)	Ash (%)	DMD (%)	NDF (%)	Forage Yield (ton ha^{-1})
Pre-sowing treatments							
Perko PVH	27.45 a	8.09 a	29.00 a	6.59 a	59.77 a	31.65 b	78.23 a
Buko	25.77 b	7.32 a	27.78 b	6.10 a	57.42 b	32.00 b	74.31 ab
Farmyard manure	21.48 d	5.16 b	21.92 d	4.50 c	51.26 d	40.95 a	63.71 c
Fallow	23.04 c	5.89 b	24.45 c	5.17 b	55.05 c	39.98 a	68.58 bc
Standard deviation (n = 4)	2.68	1.33	3.21	0.93	3.63	5.00	6.37
Nitrogen rates (kg ha^{-1})							
120	22.78 b	5.93 c	23.39 b	4.63 b	51.29 b	37.27 a	62.9 b
240	25.51 a	6.88 b	26.34 a	6.12 a	57.94 a	35.44 b	74.3 a
360	25.01 a	7.04 a	27.64 a	6.02 a	58.41 a	35.74 b	76.42 a
Standard deviation (n = 4)	1.45	0.60	2.17	0.83	3.98	0.98	7.27

WSC: Water Soluble Carbohydrates; CP: Crude Protein; ADF: Acid Detergent Fiber; Ash: Total Ash; DMD: Dry Matter Digestibility; NDF: Neutrals detergent fiber; Means with the same letter are not significantly different from each other (LSD test, $P > 0.05$).

CONCLUSIONS

According to the results it is clearly showed that pre-sowing of perko PVH and buko has a significant and positive effect on silage corn quality parameters and the reaction of the corn to the pre-sowing crops and N rates were different. Our results indicated that the best management treatments for the production of corn forage was an integrated treatment of N moderate rate in which N was combined with perko PVH and buko plants as pre-sowing treatments. These treatments improved corn yield and quality. In general, we can conclude that the cultivation of the pre-sowing plants and returning their remains to the soil, because of soil fertility and consequently improve the quantity and quality of corn forage, can be considered as one of the ways to achieve sustainable agriculture.

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