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Effect of the Mycorrhiza Application on the Agronomical Properties of Sweet Corn Varieties.

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Research Article

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Key words: Arbuscular mycorrhiza, flag leaf, leaf number, maize, plant height.

ABSTRACT

This experiment was conducted in 2012-2013, by using the Factorial experiment on four varieties (Jubilee, Martha, Merit and Sunshine) in 3 repetitions. In the experiment, the effects of the mycorrhiza application on the Plant Height, Stem Diameter, Leaf Number, Flag Leaf Length, Flag Leaf Width, Number of grains per plant, 100-seed weight and protein percent of the varieties were observed. Accordingly, it was observed that the mycorrhiza application increases the Plant Height, Stem Diameter, Leaf Number, Flag Leaf Width, Number of grains per plant, 100-seed weight and protein percent values for the varieties, while the increase in the Flag Leaf Height was deemed to be statistically insignificant. It is believed that the mycorrhiza application will be beneficial from the perspective of enhancing plant development both in natural and agricultural ecosystems.

INTRODUCTION

Microbial populations living in rhisosphere where the root and soil integrates effect the plant development and health and are important for the sustainability of the agro-ecosystem. Mycorrhiza is among the most important fungi that can be found in many organisms. Compared with some grains, they compose 70% of the mass of the soil fungi and can be found in pretty much all of the ecosystems in the world [1]. All plants form a symbiotic relation with mycorrhiza in some way. Therefore, living with mycorrhiza is among the most fundamental and common symbiotic relations in the world [2].

The most important property of the mycorrhizas is that they increase the yield in low yield soils. It was proven that mycorrhizas increase the absorption of macro elements in the soil and they provide a better development for the plants' roots, bodies and leaves, and as a result of this they increase yield through increased dry matter amount [3] and increase the absorption of Zn and Cu which are very scarce in arid region soils, thus increasing the plant's resistance to draught stress [4,5]. But many symbiotic systems cannot benefit sufficiently from this relation. Because the pesticides and fungicides used in agricultural production cause the death of these organisms as well. Due to these, we end up with less productive soils that are getting ever poorer from the biological perspective [6]. Yet the mycorrhiza fungi levels in the soil increase the EC level, prohibits toxic materials and pathogens and neutralizes them for the plant, that enhance plant growth [7,8,910,11,12] that contribute to the aggregation of soil [13,14].

The mycorrhiza fungi species in the soil differentiate from each other and from other fungi varieties in the fixation of plant nutritional materials in the soil –especially phosphorus absorption-, healthy plant development and increasing plant resistance towards stressful conditions [15,16]. Arbuscular Mycorrhiza (AM) are the ones that are associated with many various plant families [17].

Corn plant is the third most important grain product in the world, following wheat and rice. Both in human nutrition and as an animal feed, it can be used as a raw material in various branches of industry, thus becoming an easily used material in the agricultural product design of many countries. Approximately 90% of the corns produced

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in the world are being used for human nutrition and as an animal feed. Of this, about 65-70% are used as animal feed, while 20% is used directly by people. The rest 8-10% are being used in industry.

Besides many researches that focused on the effectiveness of mycorrhiza under stress conditions (drought, salinity, acidity etc.) and obtained positive outcomes, this research is among the rather few ones that focused on determining the effectiveness of mycorrhiza under normal cultivation conditions.

MATERIALS AND METHODS

Materials

This experiment was conducted in Uludag University Technical Sciences Vocational High School Test Field in 2012-2013 and by using four varieties (Jubilee, Martha, Merit and Sunshine).

Methods

The study used Factorial experiment on four varieties (Jubilee, Martha, Merit and Sunshine) in 3 repetitions. During the vegetation, the plants were given 200 kg.ha^{-1} nitrogen, 30 kg.ha^{-1} potassium and 90 kg.ha^{-1} phosphorus fertilizer. The first half of the nitrogen and all of the potassium and phosphorus were mixed in the soil prior to planting. The rest of the nitrogen was given via drip irrigation method once the plants reached 40-50 cm of height (4-6 leave phase). Each field experiment was set with 70 cm between lines and 20 cm above the lines, in an area of 21 m^2 (5m x 4.2.m). Once the corn emerged and reached 15-20 cm of height, the large leaved grasses were hand-picked. The varieties were watered four times; in the seedling, before tasselling, silking and finally during the seed filling (ear filling) stages, via drip irrigation. The *glomus mosseae* variety mycorrhiza was used in the research. The seeds of the varieties used in the experiment were separated into two patches, as inoculated with mycorrhiza and not inoculated with mycorrhiza. The characteristics of the experiment soil are presented in Table 1 below.

During the experiment, Plant Height, Stem Diameter, Leaf Number, Flag Leaf Length, Flag Leaf Width, Number of grains per plant, 100-seed weight and protein percent of the varieties were observed.

The variance analyses were conducted using the Minitab 16 software.

Table 1: Characteristics of soil test.

pH	EC (ds/m)	Sand (%)	Clay (%)	Silt (%)	Total N (%)	P (ppm)	K (ppm)	Organic C (%)
7.3	2.0	3.4	71	15	0.10	3.2	130	1.7

RESULTS AND DISCUSSIONS

Plant Height

The first property that was analyzed in the research was the plant height. The variance analysis for plant height of corn varieties that were and were not applied mycorrhiza are presented in Table 2. According to this table, plant height and mycorrhiza efficiency for the varieties were found to be statistically significant, while the Variety x Mycorrhiza effectiveness was found to be statistically insignificant. The highest plant height in mycorrhiza applied was achieved by Jubilee while the lowest was achieved by Sunshine (Fig 1).

Table 2: Analaysis of variance means sequares traits varieties of Corn

Source	df	Mean Squares							
		Plant Height	Stem Diameter	Leaf number	Flag Leaf length	Flag Leaf width	Number of grains per plant	100 seed weight	Percent protein
Block	2	17.55^{ns}	0.07^{ns}	0.63^{ns}	0.35^{ns}	0.07^{ns}	15.4^{ns}	4.70^{ns}	0.38^{ns}
Mycorrhiza	1	269.34*	0.67*	1.34*	2.55^{ns}	1.27**	3352.4**	103.21*	2.34**
Variety	3	205.37*	0.01^{ns}	2.55**	4.86**	0.25*	7847.8**	1003.84**	4.73**
VarietyxMycor.	3	1.15^{ns}	0.01^{ns}	0.05^{ns}	0.04^{ns}	0.01^{ns}	36.0^{ns}	5.90^{ns}	0.04^{ns}
Error	14	8.91	0.14	0.28	0.86	0.07	180.1	24.53	0.12

* = 5% significant, **=1% significant, ns=non- significant

We know that plant height can change due to genetic factors and environmental conditions. In the research, it was observed that mycorrhiza application contributes positively to plant height compared with the samples that were not applied mycorrhiza. Many research conducted in this topic show that mycorrhiza application contributes positively to plant height [18,19,20,21].

Stem Diameter

As can be seen in Table 2, the difference between the stem diameters of the varieties were found to be statistically insignificant, while the effect of mycorrhiza application on stem diameter was found to be statistically

significant. But Variety x Mycorrhiza interaction was found to be statistically insignificant. The largest stem diameter in mycorrhiza applied was achieved by Merit and Sunshine with 5.62 cm (Fig 2).

The stem diameter in corn varieties that were applied mycorrhiza were increased in our experiment, and this result is in parallel with the findings of some researchers [22,23,23].

Leaf Number

As a result of the conducted variance analysis, the difference between the number of leaves for corn varieties and mycorrhiza efficiency was found to be statistically significant, while But Variety x Mycorrhiza interaction was found to be statistically insignificant. The highest number of leaves in mycorrhiza applied was achieved by Merit (12.46) and the lowest by Jubilee (10.90) (Fig 3).

Flag Leaf Length

The variance analysis for flag leaf length of corn varieties that were and were not applied mycorrhiza are presented in Table 2. As can be seen in Table 2, the difference between the flag leaf length of the varieties were found to be statistically significant at 5% level while Variety x Mycorrhiza interaction with mycorrhiza application was found to be statistically insignificant. The highest flag leaf length in mycorrhiza applied was achieved by Sunshine (Fig 4).

Flag leaf and other leaves of the plant are fundamental photosynthesis organs of the plant. A growth that can be induced in those organs will clearly result in the photosynthesis amount, thus will reflect positively to the yield of the varieties. The leave numbers of the varieties used in the experiment, as well as the flag leaf length and width were positively affected by the mycorrhiza application to an extent, yet this increase in the flag leaf length was deemed to be statistically insignificant (Table 2).

Flag Leaf Width

As a result of the variance analyses for flag leaf width; statistical differences were determined for mycorrhiza application at 1% level while differences for the species were found at 5% level, while Variety x Mycorrhiza interaction was found to be statistically insignificant (Table 2). The largest flag leaf width in mycorrhiza applied was achieved by Sunshine variety (4.55 cm) and the smallest was achieved by Merit (4.08 cm)(Fig 5).

Number of Grains per Plant

Another criteria observed in the research was number of grains per plant. As a result of the variance analyses conducted, both the differences between the species and the mycorrhiza application were found to be statistically insignificant, while Variety x Mycorrhiza interaction was found to be statistically insignificant, as it was in the other results (Table 2). The largest number of grains per plant in mycorrhiza applied was achieved by Sunshine with 885.28 number of grains per plant (Fig 6).

100-Seed Weight

The variance analysis for 100-seed weight for corn varieties that were and were not applied mycorrhiza are presented in Table 2. As can be seen from Table 2, the differences were determined for mycorrhiza application at 1% level while differences for the species were found at 5% level. The highest number of leaves in mycorrhiza applied was achieved by Martha (272,1gr) and the lowest by Merit (245,7gr) (Fig 7).

The research show that applications increase the 100-seed weight [18,25]. Our research provided similar outcomes to these (Fig. 7).

Protein Percent

As a result of the variance analyses, the difference between the protein percent between the varieties and the mycorrhiza application were found to be statistically significant at 1% level while Variety x Mycorrhiza interaction was found to be statistically insignificant (Table 2). The highest protein percent in mycorrhiza applied was achieved by Jubilee variety (11.85%) and the lowest was achieved by Martha (10.0%) (Fig 8).

The last property that was analyzed was protein percent. Similar to many other properties, mycorrhiza application was found to increase protein percent (Fig. 8). This result is similar to that found by Uyanoz et al [26].

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Figure 1: Variation in the plant height of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza

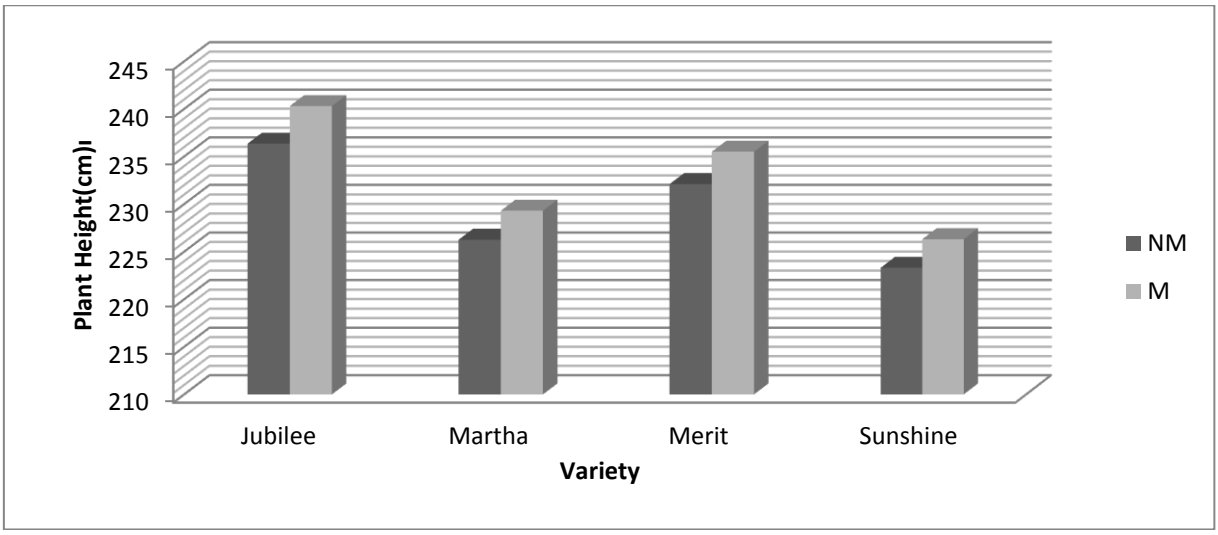

Figure 2: Variation in the stem diameter of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza

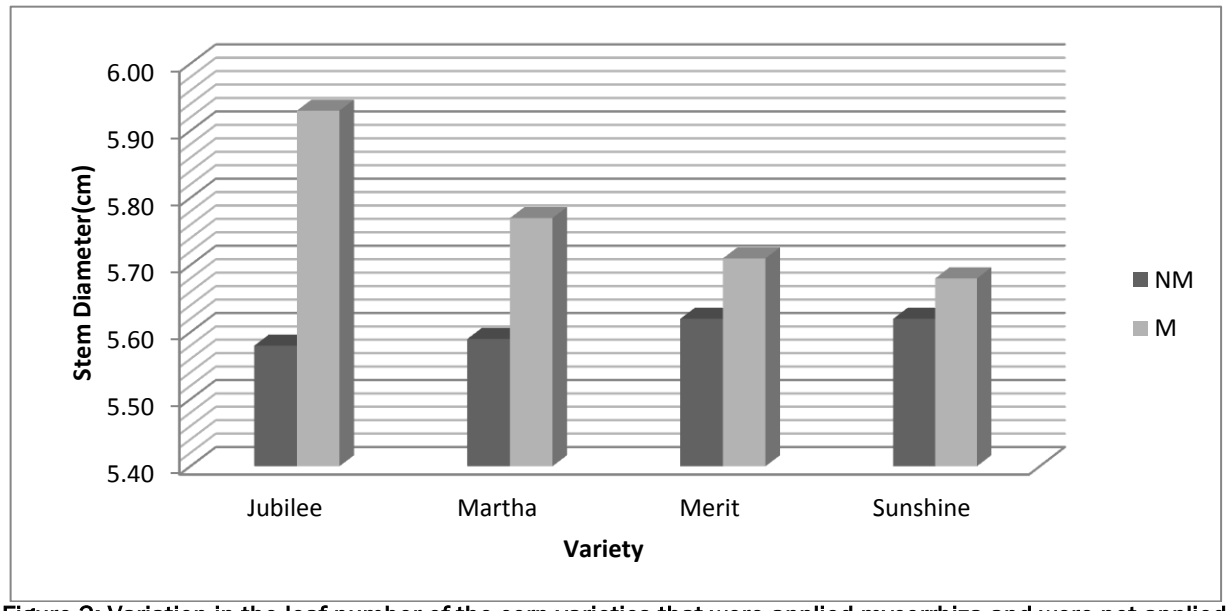

Figure 3: Variation in the leaf number of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza

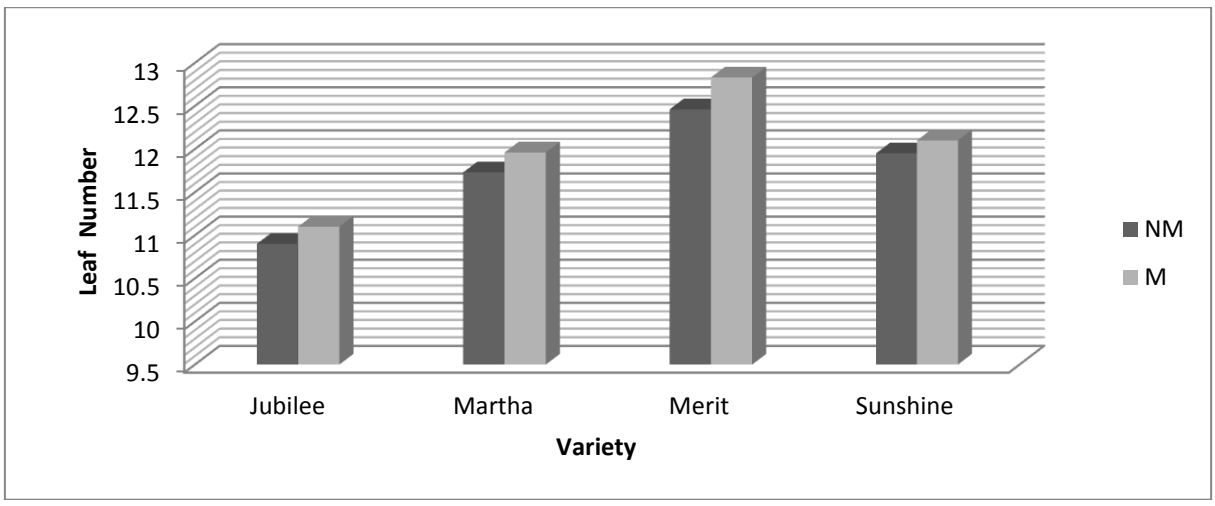

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Figure 4: Variation in the flag leaf length of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza

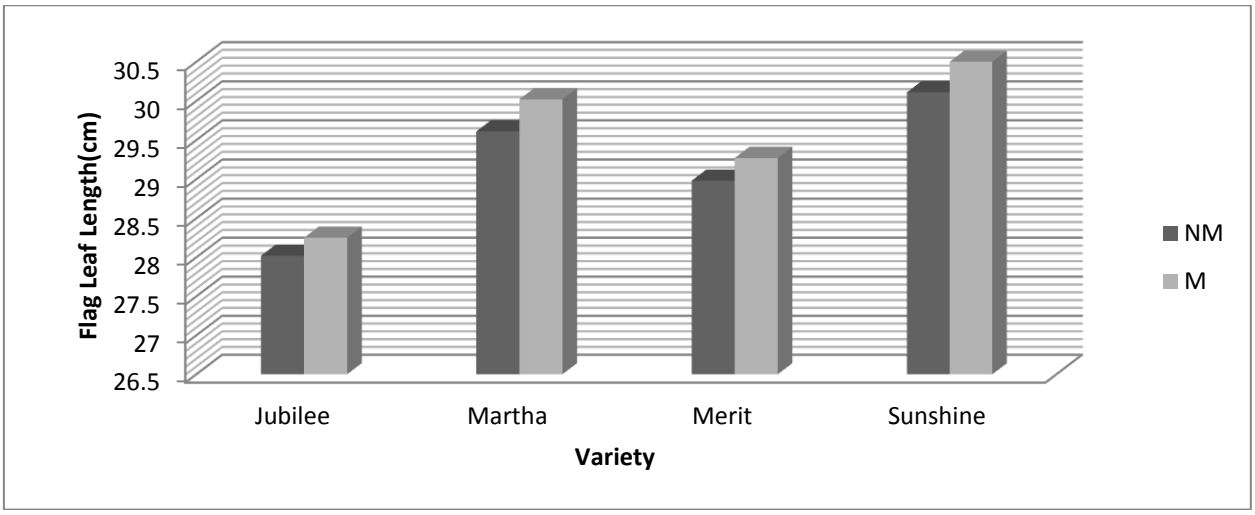

Figure 5: Variation in the flag leaf width of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza

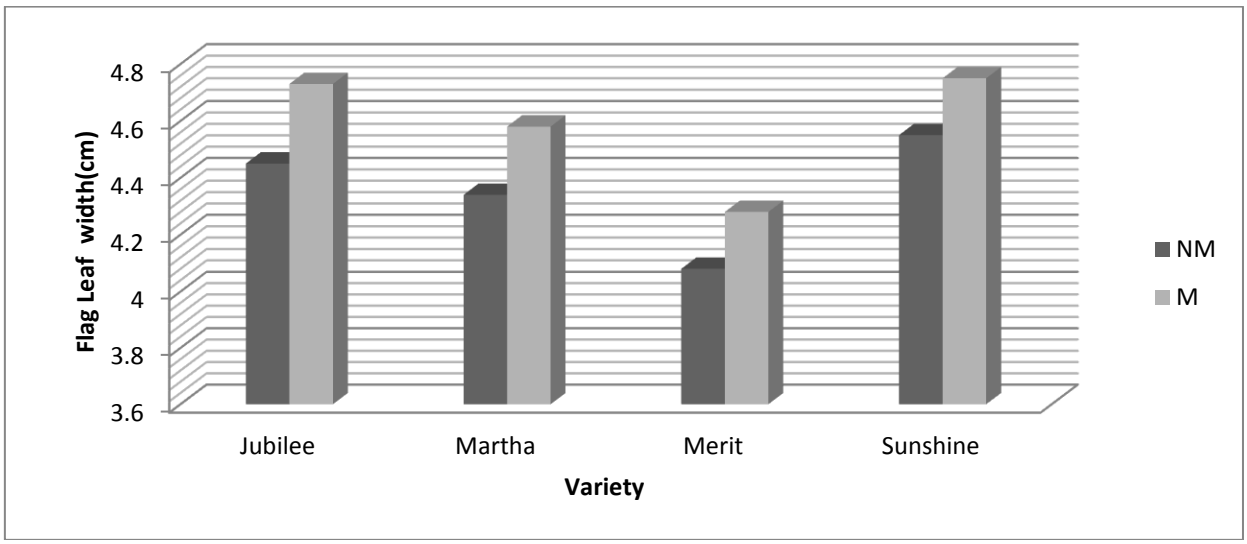

Figure 6: Variation in the number of grains per plant of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza

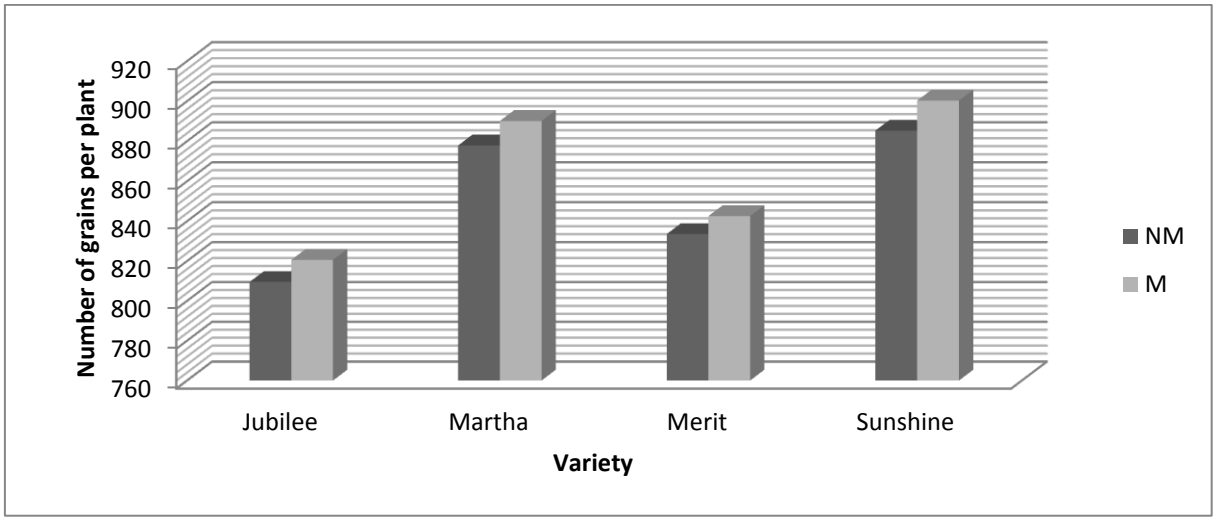

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Figure 7: Variation in the 100-seed weight of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza

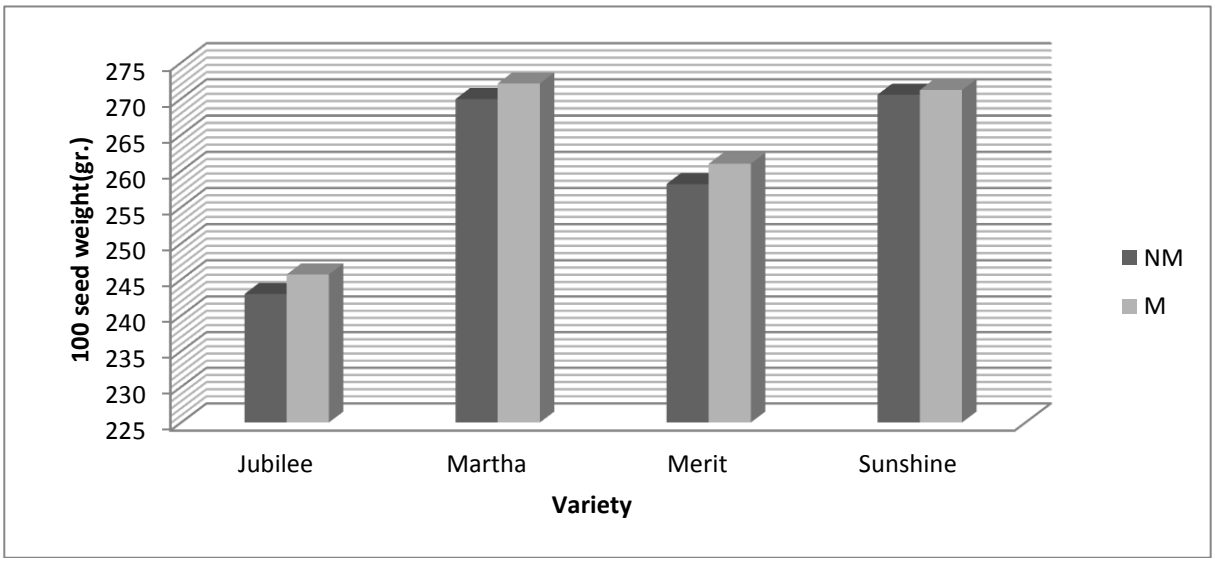
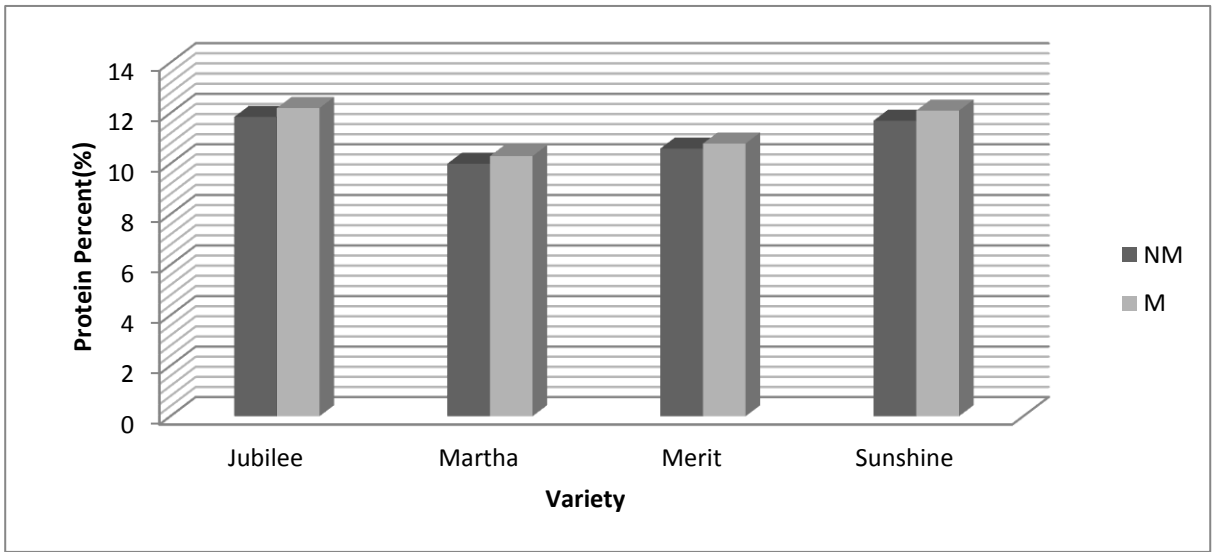


Figure 8: Variation in the protein percent of the corn varieties that were applied mycorrhiza and were not applied mycorrhiza



CONCLUSION

As a result, the effects of Mycorrhizas on the host plant differ from plant to plant [27,28]. Therefore, it is believed that considering the dependency of different plants on the mycorrhiza life effects the plants' population structure and dynamic on the first hand, determination of VAM creation in different plant families and different plant varieties within the same family, doing the diagnosis and revealing the differences or similarities between these varieties will be beneficial with respect to enhancing plant development both in natural and in agricultural ecosystems [29,30].

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