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THE PRELIMINARY STUDY ON THE EFFECTS OF DIFFERENT DOSES OF NITROGEN AND INOCULANTS ON YIELDS OF FRESH FORAGE, HAY, PROTEIN AND DRY MATTER WITH PROTEIN CONTENT IN HUNGARIAN VETCH (Vicia pannonica Crantz)

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ABSTRACT: *This research was conducted in the Kenan Evren Research and Applying Farm, Faculty of Agriculture, University of Ankara in the 1996-97 growing seasons. In this research which was established in split plots design with three replications, it was aimed to determine the effects of different inoculations and different nitrogen doses on the yields of fresh forage, hay, protein yield, dry matter yield, and protein content in Hungarian vetch. The seeds of Hungarian vetch were used as seed material and also* ***Rhizobium leguminosarum*** *was used as inoculant in the research. Seed inoculation, soil inoculation and control (non-inoculation) applications were placed in main plots, whereas different nitrogen doses (0,2,4 kg/da) were located in the sub plots. The sowing of non-inoculated seeds was carried out first in order to prevent contamination from inoculated seeds to non-inoculated seeds, and after that the sowing of inoculated seeds was carried out. The dose of 6 kg/da phosphate was used in all plots as triple superphosphate in sowing date. The results showed that, inoculation causes to significant increases in the yield of fresh forage and which was risen depending on increasing of nitrogen doses. The average of fresh forage yield was varied between 1578.33 and 2147.67 kg/da. Hay yield was similar to fresh forage yield, inoculation and nitrogen application caused yield increases. The average of hay yield was varied between 434.67 kg/da and 600.67 kg/da. While protein content was affected from inoculation and nitrogen doses in positive direction, inoculation methods were not shown disparity. The highest protein rate was found 19.67 % with 4 kg/da nitrogen doses of soil inculation method. The average of protein content was varied between 13.80 % and 19.67 %. The yield of protein and dry matter are similar to each other and the increase of hay yield has been effective in positive direction. In sowing date, using the dose of 4 kg/da nitrogen with Rhizobium inoculant was found effective at significant level in Hungarian vetch.*

Keywords*: Hungarian vetch,* ***Vicia pannonica*** *Crantz, nitrogen,* ***Rhizobium leguminosarum****, hay yield, dry matter, protein*

FARKLI DOZLARDA UYGULANAN AZOT VE BAKTERİ AŞILAMANIN MACAR FİĞİNDE (Vicia pannonica Crantz) YEŞİL OT, KURU OT, PROTEİN VE KURU MADDE VERİMLERİ İLE PROTEİN İÇERİĞİNE ETKİLERİ

ÖZ: *Bu araştırma, Ankara Üniversitesi, Ziraat Fakültesi, Kenan Evren Araştırma ve Uygulama Çiftliğinde 1996-1997 yetiştirme döneminde yürütülmüştür. Bölünmüş parseller deneme deseninde 3 tekerrürlü olarak kurulan bu denemenin amacı, Macar fiğinde farklı aşılama yöntemleri ve N'lu gübre dozlarının yeşil ot, kuru ot, protein, kurumadde verimleri ile protein oranları üzerine olan etkilerini belirlemektir. Araştırmada tohum materyali olarak Macar fiği tohumları, aşılama materyali olarak da* ***Rhizobium leguminosarum*** *kullanılmıştır. Tohuma aşılama, toprağa aşılama ve kontrol (aşılama yapılmayan) uygulamaları ana parsellerde yer alırken, farklı N dozları (0,2,4 kg/da) alt parsellerde yer almıştır. Aşılanmayan tohumların ekimi, aşılanmış tohumlardan olabilecek bir bulaşmayı engellemek amacıyla öncelikle yapılmış, daha sonra da aşılanmış tohumların ekimine geçilmiştir. Ekim tarihinde bütün parsellere 6 kg/da hesabıyla triple süper fosfat verilmiştir. Elde edilen sonuçlar, aşılamanın artan N dozlarına bağlı olarak yeşil ot veriminde önemli artışlara neden olduğunu göstermiştir. Ortalama yeşil ot verimi 1578.33 ve 2147.67 kg/da arasında değişmiştir. Kuru ot verimi, yeşil ot verimi ile benzer sonuçlar göstermiş olup, aşılama ve N uygulaması verimde artışa neden olmuştur. Ortalama kuru ot verimi 434.67 ve 600.67 kg/da arasında değişmiştir. Protein içeriği, aşılama ve farklı N dozlarından pozitif yönde etkilenirken, aşılama yöntemleri bakımından farklılık göstermemiştir. Ortalama protein oranı %13.80-19.67 arasında değişmiştir. Protein verimi ve kurumadde verimi birbiriyle benzerlik göstermiş ve kuru ot verimindeki artış pozitif yönde etkilenmiştir. Macar fiğinde ekim zamanı, uygulanan 4 kg/da'lık N dozu ve Rhizobium ile aşılama önemli düzeyde etkili olarak bulunmuştur.*

Anahtar Sözcükler: *Macar fiği,* ***Vicia pannonica*** *Crantz, azot,* ***Rhizobium leguminosarum****, kuru ot verimi, kuru madde, protein.*

INTRODUCTION

Forage crops which are the most important sources of plant and animal production, have not been taken part in agriculture of our country sufficiently. Although our country has a fortunate position with regard to growing possibilities of forage crops, the proportion of forage crops is rather low (2-3 %) in our crop areas. Because of heavy grazing by livestock, our meadows and rangelands have become not productive to feed enough our animal potential. Our meadow and pasture lands, which were approximately 12.4 million ha, couldn't reply to needed forage of our animal potential. It will be possible that forage lacking can be removed by improving of forage crops farming.

Among the forage crops , vetch is the most widespread genus that has been cultivated in annual leguminous forage crops. Approximately, 150 vetch species are

present in the world, meanwhile 59 of them are grown naturally in various parts of Turkey (Davis, 1970).

The growing of vetch has begun to get importance as both growing alone and growing of mixture in our forage crops cultivation, recently. In addition to this, vetch plant is more important as regards fixing atmospheric free nitrogen to the soil by the way of symbiotic living with *Rhizobium* species bacteria and sustaining of soil fertility. Although vetch has low ratio of fixing nitrogen in comparison with perennial forage crops, its annual characteristic has caused to increase emphasis on crop rotation system. Besides, soil fertility can be increased in a good crop rotation which vetch is placed in, some crops can be grown in a year. Recent years, problems of environmental pollution and damaging of natural sources have been appeared in order to provide increase of production and yield because of using agricultural incomes and growing techniques extremely in field farming. This situation urged the researchers and agronomists that biological incomes were used in agriculture within the scope of sustainable agriculture. Since chemical nitrogen fertilizers cause the enviromental pollution, biological N fixation should be considered exceptionally. For this reason, growing of crops have been taken in consideration in agriculture, because Leguminosae forage crops can accumulate nitrogen in soil by symbiosis with *rhizobium* spp bacteria. With this aim, significant increases were shown in the amount of nitrogen that leguminous plants accumulated in soil by inoculation of leguminous plants with *Rhizobium* spp. bacteria and soil fertility could continue.

When leguminous farming is done , especially on the soils in which it hasn't been done for many years, the importance of inoculation is increasing very much.

In this research, we aimed to determine the effects of different doses of nitrogen and methods of bacterium inoculation on some yield and yield components of Hungarian vetch under Ankara conditions.

MATERIAL AND METHODS

This research was carried out on the field in which leguminous plants were not cultivated for many years at the Applied Farm of Kenan Evren, Faculty of Agriculture, University of Ankara in growing period of 1996-97.

MATERIAL

Hungarian vetch seeds and inoculant (*Rhizobium leguminosarum*) were used as a material in this research.

METHODS

The research was laid out in a split plots design with three replications. Seed inoculation, soil inoculation and without inoculation (check) were placed in main plots while nitrogen fertilizer doses (0, 2 and 4 kg/da) were located in subplots. The doses of 6 kg/da phosphate was used in all plots as triple superphosphate.

The seed was hand planted in 20 cm between and 3 cm within row spacing. Sowing of non-inoculated seeds in check plots was completed firstly in order to prevent contamination from inoculated seeds to non-inoculated seeds, then inoculated seed plots were sown.

The plants which were harvested from each plots (excluding the effect of edges) weighed and then the yields of fresh forage were determined in harvest time.

The plants which were obtained from each plot after harvest were dried and the yields of hay were determined.

After harvesting and determining of the yields of fresh forage and hay, sufficient numbers of plant samples were taken from the plants and protein contents were determined in Hungarian vetch.

Protein yield was determined by multiplying protein content and hay yield of each plot and this value was changed to decare.

Dry matter yields were calculated by multiplying hay yields of plots and dry matter contents and variance analysis was done with the data obtained.

The characteristics of fresh forage yield in the harvest time; hay yield, protein content, protein yield and dry matter yield after harvest in this research were obtained. The variance analysis was done with data determined and the Duncan's Multiple Range Test was applied.

RESULTS AND DISCUSSION

Fresh forage yield

According to the results of variance analysis differences among inoculation methods, nitrogen doses and the interaction between inoculation methods and nitrogen doses were significant at 0.01 level. The results of Duncan's Multiple Range Tests were given in Table 1.

Table 1. The average yields of fresh forage in inoculation methods in respect of different nitrogen doses in Hungarian vetch (kg/da).

Applications	Averages
Soil inoculation - N4	2147.67 A *
Seed inoculation - N4	2140.67 A
Soil inoculation - N2	1914.33 B
Seed inoculation - N2	1902.33 B
Soil inoculation - N0	1863.33 C
Seed inoculation - N0	1853.33 C
Control - N4	1787.00 D
Control - N2	1724.67 E
Control - N0	1578.33 F

* Letters significant at %5 level, numbers significant at %1 level

As it was shown in Table 1, the yields of fresh forage have increased at significant level depending on increasing of nitrogen doses in control plots, the differences among yields of fresh forage were significant at 0.01 level. Similar results were observed at both seed inoculation method and soil inoculation method. The highest yields of fresh forage were determined in 4 kg/da nitrogen dose at control and the other two inoculation methods.

Hay yield

Analysis of variance related to hay yield data showed that the differences among nitrogen doses and inoculation methods were significant at 0.01 level. But the interaction between inoculation methods and nitrogen doses were nonsignificant. The results of Duncan's Multiple Range Tests were given in Table 2.

As it was seen in Table 2, significant differences were observed between inoculated plots and non-inoculated (control) plots with regard to hay yields. The lowest hay yield was 461.44 kg/da and obtained in control plots, and the highest hay yield was obtained as 567.33 kg/da in soil inoculation. The differences between seed and soil inoculation methods were nonsignificant as regards hay yields.

Table 2. The average of hay yields in inoculation methods in respect of different nitrogen doses in Hungarian vetch (kg/da)

Inoculation methods	Nitrogen doses			Average
	N_0	N_1	N_2	

Control	434.67	454.67	495.00	461.44 b
Seed inoculation	529.00	562.33	596.34	562.56 a
Soil inoculation	536.66	564.67	600.67	567.33 a
Average	500.11 c	527.22 b	564.00 a*	

***** Letters significant at %5 level, numbers significant at %1 level

The hay yields have increased at significant levels depending on increasing of nitrogen doses. As regards hay yields 4 kg/da nitrogen dose was placed at first the first rank. While 2 kg/da nitrogen dose was placed at the second rank, non-fertilized plots were placed at the last rank.

As seen, hay yields have increased in comparasion with the control in both inoculation methods. This positive effect has caused to increase depending on increasing of nitrogen doses of significant level.

Protein content

Analysis of variance show that the differences among nitrogen doses and inoculation methods were significant at 0.01 level and the interaction between nitrogen doses and inoculation methods was significant at 0.05 level. The results of Duncan's Multiple Range Tests were summarized in Table 3.

Table 3. The average protein contents in inoculation methods in respect of different nitrogen doses in Hungarian vetch (%).

Applications	Averages
Soil inoculation - N_4	19.67 A *
Seed inoculation - N_4	19.20 AB
Soil inoculation - N_2	18.67 B
Seed inoculation - N_2	18.63 B
Soil inoculation - N_0	17.67 C
Seed inoculation - N_0	16.87 D
Control - N_4	15.00 E
Control - N_2	14.10 F
Control - N_0	13.80 F

***** Letters significant at %5 level, numbers significant at %1 level

As it was examined in Table 3, protein content has also increased depending on increasing of nitrogen doses in control plots. In control plots, the highest protein content was observed in 4 kg/da nitrogen dose and the differences between non-fertilized plots and 2 kg/da nitrogen dose plot were not significant. The highest protein contents were determined in 4 kg/da nitrogen dose in both seed and soil inoculation

methods. But the lowest protein contents were determined in non-fertilized plots. While average protein content was 14.30 % in control plots, this value has been 18.23-18.67 % in inoculation methods.

Protein yield

According to the results of analysis of variance, differences among inoculation methods and nitrogen doses and the interaction between inoculation methods and nitrogen doses were significant at 0.01 level. The results of Duncan's Multiple Range Tests were shown in Table 4.

Table 4. Protein yields in inoculation methods in respect of different nitrogen doses in hungarian vetch.

Applications	Averages
Soil inoculation - N_4	118.10 A *
Seed inoculation - N_4	114.50 B
Soil inoculation - N_2	105.40 C
Seed inoculation - N_2	104.80 C
Soil inoculation - N_0	94.82 D
Seed inoculation - N_0	89.22 E
Control - N_4	74.24 F
Control - N_2	64.11 G
Control - N_0	60.00 H

* Letters significant at %5 level, numbers significant at %1 level

As it was seen in Table 4, protein yields have increased clearly depending on increasing of nitrogen doses in control and every two inoculation methods and the highest protein yield was determined in 4 kg/da nitrogen dose. The doses of 2 kg/da were the second rank whereas control plots were the last rank. It can be said that increases in protein content and in particular increased in hay yield cause to increases of protein yield.

Dry matter yield

According to the results, the differences among inoculation methods and nitrogen doses were significant at 0.01 level whereas the interaction between inoculation methods and nitrogen doses was not significant. The results of Duncans Multiple Range Tests were given in Table 5.

Table 5. Dry matter yields in inoculation methods in respect of different nitrogen doses in hungarian vetch (kg/da).

Inoculation methods	Nitrogen doses			Average
	N_0	N_1	N_2	
Control	390.93	415.43	449.10	418.49 b
Seed inoculation	486.00	514.37	544.90	515.09 a
Soil inoculation	489.43	510.47	550.43	516.78 a
Average	455.46 c	480.09 b	514.81 a*	

* Letters significant at %5 level, numbers significant at %1 level

As Table 5 was examined, the difference between soil inoculation and seed inoculation methods was nonsignificant as regards the average of dry matter yield. In control dry matter yield was 418.49 kg/da and in seed inoculation method this value was 515.09 kg/da whereas dry matter yield was risen to 516.78 kg/da in soil inoculation method. Significant increases were observed with inoculation in dry matter yield. Also the average of dry matter yield was increased at significant level depending on increasing of nitrogen doses, and the highest dry matter yield was obtained in 4 kg/da nitrogen dose. The lowest dry matter yield was determined in non-fertilized plots. It can be said that increases in dry matter content and in particular increases in hay yield depending on increasing of nitrogen doses cause to increases of dry matter yield.

As our findings were evaluated as a whole, the effect of inoculation and nitrogen fertilization has been at different level in examined characteristics of winter Hungarian vetch under Ankara conditions. The yield of fresh forage has been shown significant increases depending on increasing of nitrogen doses; especially significant increases were observed with inoculation in fresh forage yield. The highest yield of fresh forage was obtained from the plots where 4 kg/da N and inoculation were used. It was determined that inoculation and nitrogen application affected on hay yield positively; both nitrogen application and inoculation increased hay yield at significant level in Hungarian vetch. Similar results were obtained at the study which was done in broad bean by Beyene (1988), and the researcher stated that 6 kg/da nitrogen application with inoculation increased hay yield in double in respect of control. However, significant differences were not observed in hay yield with inoculation to soil or seed at our research. As regards protein content, in particular increasing of nitrogen doses with inoculation was affected at significant level; the highest protein content was determined in 4 kg/da nitrogen application. Solh (1988) stated that inoculation and fertilization increased protein content at the average of ratio of 30-35

% at the study which was done in lupine. The findings of the researcher are in accommodation with our research results.

Inoculation affected protein yield positively and increasing nitrogen doses increased protein yield at significant level. The highest protein yield was obtained from 4 kg/da nitrogen application at two inoculation methods and control. It was observed that increases in protein yield were affected from increases in hay yield more than protein content.

Inoculation and nitrogen application affected on dry matter yield positively, and it was determined that increasing nitrogen doses with inoculation increased dry matter yield. It was stated that inoculation increased dry matter yields of soybean and vetch at significant quantity at the study done by Papastylianou (1988). The findings of the researcher have been shown similarity with our research results.

In conclusion, the results of our one year research showed that inoculation and 4 kg/da nitrogen application increased the yields of fresh forage and hay winter crop in Hungarian vetch in dry farming lands.

It was determined that influence of inoculation and nitrogen application together was positive and at the significant level.

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