MEDWELL PUBLISHING
Journal of Animal and Veterinary Advances 8 (3): 557-561, 2009
ISSN: 1680-5593

Possibilities of Reducing the Use of Chemical Nitrogen in Vetch + Corn Production System

Seyda Zorer Celebi, Korhan Sahar, Rafet Celebi and Omer Terzioglu
Department of Field Crops, Faculty of Agriculture, Yuzuncu Yil University, Van, Turkey

Abstract: The study is carried out in Otluca Village bounding to city of Van in 2004-2005 years. In this study, it is aimed at investigating the possibilities of reducing amount of chemical nitrogen used in corn production which is planted before the vetch plant. In the 1st year of trial, in some part of the field, vetch is planted and its green herbage yield rates are determined. In the 2nd year of trial, planting activity is carried out in 2 trials as planting vetch both to the place it was previously planted and to where, it was not planted. In the trial, corn is applied chemical nitrogen in 5 different doses (0, 5, 10, 15 and 20 kg day^{-1}). According to the results of the investigation, it is assigned that the corn, which is planted on the vetch, can be cultivated by using fertilizers with lower nitrogen. By the reduction in the amount of chemical nitrogen used, both the expenses will get lower and environmental pollution based on washing of fertiliser will be prevented. While, no difference is found on the corn planted after vetch that is applied 15 and 20 kg day^{-1} nitrogen doses, in the corn, which is planted on the previously empty area, considerable difference is found between the doses. No considerable difference is found between 2 applications in terms of leaf, stem and ear ratios. The green and dry herbage yields at the corn, planted after vetch, vary between 5068.1 and 3033.3 and 1057.0 and 783.2 kg day^{-1}, respectively. However, these values at the corn, planted at the empty area in the preceding year, vary between 5134.4 and 2600.0 kg day^{-1} and 1003.6 and 481.5 kg day^{-1}, respectively.

Key words: Corn, nitrogen dose, vetch, herbage yield, dry herbage yield, alternate planting

INTRODUCTION

Corn is a hot climate plant importance of which is gradually increasing for its both being human food, animal food and a raw material of industry. Within the other grains in the world, after wheat and rough rice, corn is in the 3rd place with the ratio of 21.2% in terms of planting area and in the 1st place with the ratio of 29.7% in terms of production. As for Turkey, its ratio in terms of planting area is 4.1% and in production, it is in the third place with the ratio of 7.1% in terms of production after wheat and barley. While, its planting area is 138,896,000 ha and production is 602,026,000 ton in the world, those ratios in Turkey are 500,000 ha and 2.200,000 ton, respectively (Anonymous, 2002).

Corn is a selective plant in terms of soil. A good soil for corn should be rich in nutrition and feasible for drainage. Corn plant presents the best development and maximum yield in the soil; which is rich in organic materials and obtainable nutrition and drainage and ventilation of which is good. In loamy and loamy clayed soil, corn develops better than it is in other types of sand. In extremely sandy or clayed soil, adequate yield is difficult to obtain (Acikgoz, 1991; Kun, 1994).

It became one of the most important silage plants for; being the plant that produce the maximum green herbage in unit area, its feasibility in silage production, its silage being nutritious and the most tasty one (Acikgoz, 1991).

The researches carried out show that nutritions get from soil by corn are high. In order for the collection of 1.5 ton dry material per decare, it gets 16.2 kg chemical nitrogen, 3.4 kg phosphor, 11 kg potassium, 1.2 kg calcium and 1.4 kg magnesium (Sayre, 1955). When corn that get high amount of nutrition from the soil is planted repeatedly in the same area, the soil became poor and amount of production degrease. In this point, in order to improve production, the amount of chemical fertiliser will increase. When chemical nitrogen rich fertiliser is used in the corn produced in irrigable conditions, plants may not be able to use chemical nitrogen wholly and washing of the fertiliser took place with the irrigation water (Acar, 1978). In the recent years, it is emphasised that the use of chemical nitrogen is controlled mandatorily because of environmental pollution and economic

Corresponding Author: Seyda Zorer Celebi, Department of Field Crops, Faculty of Agriculture, Yuzuncu Yil University, Van, Turkey

reasons (Keeney, 1982; Ulger *et al*., 1990; Gok *et al*., 1995). While, more usage of chemical nitrogen brings extra economical burden for the producer, the extra of this chemical nitrogen is washed by the irrigation water and mixed in the groundwater and then it is mixed in to the resources used as drinking water. This condition creates situations unfavourable for human health.

In order to avoid these negative effects, it will include a grave importance to involve plants that enable having the use of biological nitrogen and plants that are effective in increasing the amount of organic materials in the soil in the present agricultural system. There are legume plants to carry-out this aim (Saglamtimur *et al*., 1986).

Anlarsal *et al*. (1996) stated that in the corn plant produced after green herbage phase, contrary to the one planted on wheat, positive effects are observed. Okant and Kilic (1988) has determined that corn planted on vetch + barley mixture rather than the one planted on different legumes like lentil, chick-pea gives more yield than the latter. Ulger *et al*. (1990), have detected in Cukurova that the yield of corn in an area where *Leucaena leucocephala* is produced for 3 years with 10 kg chemical nitrogen per year is higher than the corn, which is grown on an are free from *Leucaena leucocephala* plant with 25 kg day^{-1} chemical nitrogen applied.

Kahnt (1983a) reports that while underground and surface equipments of broad beans serve 8-14 kg day^{-1} of chemical nitrogen, underground and surface equipment of vetch and green pea plants serve 5-8 kg day^{-1} of chemical nitrogen. The same researcher states that broad bean plants planted as catch crop for the purpose of green and dry herbage or green fertiliser degreases C:N ratios, is helpful in processing the soil, it provides chemical nitrogen to soil and it degreases the monoculture base roughness and intensity of weeds in the soil as the roots go deeply into the soil and this study insistently recommends this kind of activity to be applied in the soils with heavy nature because of these effects (Kahnt, 1983b). Vetch and Corn products are very important for animal nutrition.

In this study, the aim is to look for the opportunities to degrease the use of chemical nitrogen in alternate planting of corn with vetch, which is a single season plant.

MATERIALS AND METHODS

The research is carried out in producer's field at Otluca Village in Van province. For trial material, 'Efes-79' type ordinary vetch and 'TTM-815' type cross-bred corn is used.

The soil of trial field determined to be sandy in nature, lightly alkaline, medium limey, law in organic matter content and high in phosphor content (Gunes *et al*., 1998).

Some climate values about the months which coincide with vegetation period are given in Table 1. When, we have a look at the Table 1, it is understood that total precipitation in vegetation period in both of the years of trial is found to be lower than the average of long years. Average temperature in the same period is found to be parallel with long year's average in the first year while it is higher in the 2nd one. Average relative humidity recorded in 2004 vegetation period is found to be lower than that of long years when it is found to be higher in 2005.

The research is set according to randomised blocks design in 3 repetitions in 2 different trials. In the 1st trial, ordinary vetch is planted in the research area as a pre plant. In vetch planting, 15 kg day^{-1} seed is used and no fertiliser applied. Vetch are harvested when they were in 50% of their blooming period and 2000-2300 kg day^{-1} green herbage yield is get. After the vetch harvest, by processing the soil, remnants are made to mix in the soil. Soil is ploughed in crops before corn is planted and planting is started. Research field chosen for the 2nd trial field is left empty for the 1st year and by soil processing to be carried out in the following spring, corn planting is facilitated. For corn planting, 3.5×5 = 17.5 m^2 parcels are prepared. Planting is carried out in 5 rows on 5 m long parcels by 70 cm distances and 1600 plant day^{-1}

Table 1: Some climate changes concerning 2004 and 2005 and some longer years*

	Temperature (°C)			Relative humidity (%)			Precipitation (mm)		
Months	2004	2005	UYO	2004	2005	UYO	2004	2005	UYO
April	6.9	8.9	7.4	66.4	64.1	62.0	26.9	55.9	56.6
May	12.4	13.3	13.0	67.8	62.5	56.0	68.7	35.8	45.0
June	18.5	18.7	18.0	57.8	55.9	50.0	3.1	13.0	18.5
July	21.4	24.1	22.2	52.7	51.3	44.0	2.0	0.3	5.2
August	22.2	23.4	21.8	46.5	62.1	41.0	-	4.0	3.4
September	18.0	17.2	17.2	48.7	55.4	44.0	-	9.2	13.0
Average	16.6	17.6	16.6	46.7	58.6	49.5			
Total							100.7	118.2	141.7

*Records of van regional directorship of meteorology

closeness. In each parcel, 8 kg day^{-1} P_2O_5 amount of chemical nitrogen fertiliser is given by planting. In both of the period, chemical fertiliser is given in 5 different doses (0, 5, 10, 15 and 20 kg day^{-1}). Distribution of fertiliser doses are decided randomly and while half of the fertiliser is given during planting; the other half is given when the plants get 45 cm in height. Irrigation is carried out by sprinkling water. Harvest is made in the lactation period. After determining the total wet weights of parcels, the ratios about height, leaf, stem and ear are determined by choosing 20 random plants. By taking 1500 g samples from each parcel, they are first waited in shadow and than dried in oven at 78°C until, it gets its fixed weight and then all are grind with their ear. Raw protein ratios of these samples dried are determined by the help of Kjeldahl device.

RESULTS AND DISCUSSION

Green and dry herbage yields: Values concerning the effects of different chemical nitrogen fertilisation levels of corn planted after vetch and corn planted on formerly emptied land on green and dry herbage yields are given in Table 2. When Table 2 is observed, there is a statistically sifinificant difference between the 2 types of corn planted in the trial field. In the 1st trial, corn which was planted on pre-plant vetch, difference between chemical nitrogen fertiliser in terms of green herbage is found to be statistically significant. In the 2nd trial, the highest green herbage yield is found to be 20 and in 15 kg day^{-1} N applications, it is found to be 5068.1-5061.9 kg day^{-1}, respectively. In the 2nd trial, planted in the 2nd time at the field that was not used the previous year, the effects of doses of chemical nitrogen on green herbage yield of the corn is found to be statistically significant. The highest green herbage yield in the 2nd trial is found to be 5134.4 in 20 kg day^{-1} N application and it is followed by 15 kg day^{-1} N application with the ratio 4457.1 kg day^{-1}. The lowest chemical nitrogen levels are found to be in the parcel where no chemical nitrogen application is made with the ratio of 2600.0 kg day^{-1}.

In Table 2, the difference in dry herbage yields of 1st and 2nd trial are found to be statistically significant. In the corn planted at 1st trial, chemical nitrogen doses have effected dry herbage yield in a big extend and the highest dry herbage yield is obtained as 1057.0 and 1041.1 kg day^{-1} with the applications of fertilising in 20 and 15 kg day^{-1} N, respectively. The lowest dry herbage yield is found in non chemical nitrogen applied parcel with 783.2 kg day^{-1}. Also in 2nd trial, the effects of chemical nitrogen doses on dry herbage yields is found to be statistically significant and the highest rate of dry herbage yield is detected as 1003.6 in 20 kg day^{-1} fertilisation and this is followed by 839.7 kg day^{-1} fertiliser application with the ratio of the parcel such as 481.5 kg day^{-1}.

Height of plant: Between the heights of the corns planted in both trials, a statistically significant difference is found (Table 3). Chemical nitrogen doses in the corn planted after vetch have affected the plant's height in a big extent and the maximum plant height is found to be 216.8 and 216.7 cm with the fertiliser application of 20 and 15 kg day^{-1}, respectively. Lowest rates are measured in the parcel without chemical nitrogen addition and 5 kg day^{-1} N application as 194.1 and 195.9, respectively. Even in the corn planted in the area which was not used the previous year, doses of chemical nitrogen have effected the height of plants considerably and maximum plant height became 210.6 cm after 20 kg day^{-1} N fertilisation application and it is followed by 200.9 cm with 15 kg day^{-1} N fertilisation activity. The lowest plant height is obtained from the parcels on which no chemical nitrogen is applied.

Leaf, stem and ear ratios: According to the results of statistical analysis made, there is no difference found in leaf, stem and ear sizes of both corn planted 1st and 2nd trial (Table 3 and 4). Chemical nitrogen doses applied in

Table 2: Average dry and green herbage yield values of corn plants, based on the doses of chemical nitrogen that are planted after vetch plant and in formerly spared field and results of duncan multiple comparison method

Doses of chemical nitrogen	Green herbage yield (kg day^{-1})		Dry herbage yield (kg day^{-1})	
	1st trial	2nd trial	1st trial	2nd trial
0 kg N day^{-1}	3033.3d	2600.0e	783.2b	481.5e
5 kg N day^{-1}	3360.8c	2919.1d	605.4c	630.9d
10 kg N day^{-1}	3746.3b	3600.0c	814.3b	750.7c
15 kg N day^{-1}	5061.9a	4457.1b	1041.1a	839.7b
20 kg N day^{-1}	5068.1a	5134.4a	1057.0a	1003.6a
Average	4054.1a	3742.1b	860.2a	741.3b

*There is no significant difference between averages within the same letter group according to $p<0.05$

Table 3: Average values concerning the effect of chemical nitrogen doses on plant height and leaf ratio of corn planted after vetch plant and on the place where was previously empty and results of duncan multiple comparison method*

Doses of chemical nitrogen	Plant height (cm)		Leaf ratio (%)	
	1st trial	2nd trial	1st trial	2nd trial
0 kg N day^{-1}	194.1c	186.1d	16.0	16.5b
5 kg N day^{-1}	195.9c	194.0c	19.1	18.2ab
10 kg N day^{-1}	204.7b	199.2bc	19.6	19.5ab
15 kg N day^{-1}	216.7a	200.9b	16.1	20.8a
20 kg N day^{-1}	216.8a	210.6a	19.0	18.9ab
Average	2205.8a	198.1b	17.9	18.78

*There is no significant difference between averages within the same letter group according to $p<0.05$

Table 4: Average values concerning the effect of chemical nitrogen doses on stem and ear ratios of corn planted after vetch plant and on the place where was previously empty and results of duncan multiple comparison method*

Doses of chemical nitrogen	Stem ratio (%)		Ear ratio (%)	
	1st trial	2nd trial	1st trial	2nd trial
0 kg N day^{-1}	48.7	57.4	35.3	26.0
5 kg N day^{-1}	56.6	55.2	24.2	26.5
10 kg N day^{-1}	54.5	54.2	25.8	26.3
15 kg N day^{-1}	52.5	51.9	31.4	27.3
20 kg N day^{-1}	53.4	50.9	27.5	30.1
Average	53.1	53.9	28.8	27.2

Table 5: Average values concerning raw protein ratios and yields of corn planted after vetch plant and on the place where was previously empty and results of duncan multiple comparison method*

Doses of chemical nitrogen	Raw protein ratios (%)		Raw protein yields (kg da^{-1})	
	1st trial	2nd trial	1st trial	2nd trial
0 kg N day^{-1}	6.2c	5.9c	48.0c	28.5e
5 kg N day^{-1}	6.4c	6.9b	38.7c	43.5d
10 kg N day^{-1}	7.1b	7.1ab	58.6b	53.2c
15 kg N day^{-1}	7.5ab	7.3a	78.1a	61.8b
20 kg N day^{-1}	7.7a	7.5a	81.2a	75.0a
Average	7.0	7.0	61.0a	52.4b

*There is no significant difference between averages within the same letter group according to $p<0.05$

the corn planted after vetch hasn't affected leaf, stem and ear ratios. As for the corn planted in previously emptied place, while doses of chemical nitrogen are found to have effects on leaf sizes, no effect is found to have taken place in stem and ear. While, in the 2nd trial, maximum leaf ratios are found to be 15, 10, 20, respectively based on 5 kg day^{-1} N applications, minimum ratios are obtained from the parcels where no fertilisation activity is applied.

Raw protein ratio and yield: The values concerning the affects of different chemical nitrogen fertilisation doses on raw protein ratio and yield in first and 2nd trial are given in Table 5. When we have a close look at Table 5, in the corn, which is planted after vetch and the one planted in previously empty place are displaying no statistically significant difference in terms of raw protein yields. In the 1st trial, difference between doses of chemical nitrogen is found to be statistically significant in terms of raw protein yield. The maximum raw protein ratios are found to be 7.7-7.5%, respectively with the application of 20 and 15 kg day^{-1} N. The lowest raw protein ratios are get from applications such as 0 and 5 kg day^{-1} N. In the 2nd trial, the effects of chemical nitrogen doses applied on raw protein ratio of corn is found to be statistically significant. Also, in the 2nd trial, maximum raw protein ratios are found to be 20 within the application with the percentages like 7.5-7.3%, respectively. The lowest protein level is found in 0 kg day^{-1} N fertilisation with the percentage of 5.9%.

Taking raw protein values mentioned in Table 5 into consideration, the planting after vetch plant and in the land, which was previously emptied have statistically significant effects in contributing to the yield. In the corn planted in 1st trial, the effects of chemical nitrogen in different doses on raw protein yield is found to be statistically significant and the maximum raw protein yield are obtained from parcels with chemical nitrogen applied in 20 and 25 as 81.2-78.1 kg day^{-1}. The lowest raw protein values on the other hand is get from 5 and 0 kg day^{-1} applications as 38.7-48.0 kg day^{-1}, respectively. In the corn planted in the 2nd trial, the effects of chemical nitrogen in different doses on raw protein yield are found statically significant. Maximum raw protein yield is found to be 75.0 kg day^{-1} with the application of 20 kg day^{-1} chemical nitrogen and lowest raw protein yield is get from the parcel where chemical nitrogen addition do not took place with the value of 28.5 kg day^{-1}.

As we look at the results, in the 1st and 2nd trial set after vetch plant and to formerly emptied location, the effects of chemical nitrogen doses on plant height, green herbage, dry herbage and raw protein yield is found to be significant. According to the results obtained, while no significant difference is found between the yield of the corns planted after vetch in practices such as 15 and 20 kg day^{-1} N, in the corn planted on the land that was previously emptied, yields are found to be different in both 15 and 20 kg day^{-1} amount of chemical nitrogen application. This results show that vetch planted as a pre-plant betters the condition of the soil and makes it rich in chemical nitrogen. However, Ulger *et al.* (1990) have detected in Cukurova that the yield of corn in an area where *Leucaena leucocephala* is produced for three years with 10 kg chemical nitrogen per year is higher than the corn, which is grown on an are free from *Leucaena leucocephala* plant with 25 kg day^{-1} chemical nitrogen applied. Tisdale and Nelson (1962) in their research detected that while, in alternately planting where ordinary vetch does not took place, there is 163 kg decare^{-1} corn yield, the ratio in corn planted after vetch is increased to 489 kg parcel^{-1}. Selcuk (1978) at a study, in which he used ordinary vetch as green fertiliser plant, states that 6 kg day^{-1} of chemical nitrogen together with green fertiliser supplies increased yield in corn, wheat and cotton, the effect of green fertiliser keeps on three years and corn, wheat and cotton reduces the requirement they have for chemical nitrogen approximately to half.

CONCLUSION

In this study carried out under conditions of Van, when corn is put in an alternate planting with vetch, an

important improvement took place in the structure of the soil; the yield of soil increase and use of fertiliser with chemical nitrogen at corn planted after vetch is degrease. This condition not only supplies producer an economical income but also prevents an environmental pollution based on the washing of the fertilised soil. This system will be more profitable in the institutions of place, where there is 2 times yield get every year. It is better to look for research possibilities of vetch to be produced as a second production.

REFERENCES

Acar, J., 1978. Nitrite Poisoning. Modernistic Agricultural Technics. TMMOB Agric. Engin. Assoc. Adana Regional Agency, 4: 5-7.

Acikgoz, E., 1991. Forage plants. Uludag Uni. Agric. Faculty, Bursa, Publishing No.: 7-025-0210.

Anlarsal, A.E., A.C. Ulger, M. Gok, C. Yucel, B. Cakir and I. Onac, 1996. The possibilities of Nitrogen usage at Maize production and Nitrogen fixation with Legume herb yields in Maize crop system plus Annual legume forages under Cukurova. III Grassland and Forage Plants Congress, Erzurum, pp: 362-368.

Anonymous, 2002. Agricultural Structure and Production. T.C. Prime Ministry Government Statistic Institute Publishings, Ankara.

Gok, M., A.E. Anlarsal, A.C. Ulger, I. Onac and C. Yucel, 1995. The effect of green fertilizer plants on nitrogen-min contents and its some biological components KUKEM J., 18 (2): 2.

Gunes, A., M. Alpaslan and A. Inal, 1998. Experimental Technics. Ankara Univ. Agric. Facult. No.: 1501. Lecture Notes: 455, Ankara.

Kahnt, G., 1983a. Grundung. DLG-Verlag, Frankfurt (Main), pp: 146S.

Kahnt, G., 1983b. Die Bedeutung der Leguminosen in der Fruchtfolge, Nungesser Agric. Tips, 1: 1-2.

Keeney, D.R., 1982. Nitrogen Management for Maximum Efficiency and Minimum Pollution. In: Stevenson, F.J. (Ed.). Nitrogen in Agric. Soils, pp: 605-649.

Kun, E., 1994. Cereals II. Ankara Univ. Agric. Faculty Ankara, Publishings No.: 1360-1394.

Okant, M. and H. Kilic, 1988. The effect of previous crops on the yield and yield components of Maize (*Zeamays* L.) cultivated as second crop under Diyarbakir condition Turkey. III Grassland and Forage Plants Congress, Erzurum, pp: 761-766.

Saglamtimur, T., H. Gulcan, T. Tukel, V. Tansi, A.E. Anlarsal and R. Hatipoglu, 1986. Adaptation Experiments of Fed Plants Under Cukurova Condition. Cukurova Univ. J. Agric. Faculty C.U. Zir. Fak. Dergisi, 1 (3): 37-51.

Sayre, J.D., 1955. Mineral nutrition of corn. Corn and Corn Impovement. Am. Soc. Argon., Academic Press Inc., New York, pp: 293-313.

Selcuk, F.S., 1978. Determination of green fertilizer value of vetch plant under *Menemen* ova. Republic of Turkey, Soil-water General Managership Menemen Regional, Soil Water Res. Inst. Menemen, Izmir, Publishing No.: 57.

Tisdale, L.S. and W.L. Nelson, 1962. Soil Fertility and Fertilizers, Macmillan Publishing Co Inc., Translator: Gunel, N. (Ed.). Cukurova Univ. Agric. Faculty, Lecture Book: 18, Adana, Publishing No: 168.

Ulger, A.C., T. Tutel and R. ve Hatipoglu, 1990. The effect of different nitrogen doses on seed yield and yield components of Maize grown after *Leucaena leucocephala* plant under Cukurova condition. Cukurova Univ. J. Agric. Fac., 5 (4): 161-172.