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An investigation on determining the most suitable nitrogen and zinc fertilizer doses for the main crops of Sorghum-Sudangrass Hybrids (*Sorghum bicolor* X *Sorghum sudanense*) in the Çukurova Region (Turkey)

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Abstract

This study was carried out in order to determine the most suitable nitrogen and zinc fertilizer doses for the main crops of sorghum-sudangrass hybrids in the Çukurova Region during 2001-2002 at Çukurova Agricultural Research Institution. Grazer cultivar of Sorghum-Sudangrass hybrids and as pure fertilizer doses 0, 7, 14, 18, 24 kg/da nitrogen and 0, 0.5, 1.0 kg/da zinc were used in the study. As a result of this research, while the highest total fresh yield was obtained with 5722.97 kg/da value from N18-Zn0 treatment, the lowest total fresh yield was obtained with 4415.00 kg/da value from N0-Zn0 treatment. While the highest total dry matter yield was obtained with 1602.87 kg/da value from N14-Zn1 treatment, the lowest total dry matter yield was obtained with 1185.88 kg/da value from N0-Zn0.5 treatment. In general, the effect of nitrogen and zinc treatments on the fresh and dry matter yield was found to be significant. While the highest crude protein yield was obtained with 5498.085 kd/da value from N18-Zn0 treatment, the lowest crude protein yield was obtained with 4030.665 kg/da value from N0-Zn0.5 treatment. In general, N and Zn application increased crude protein yield. While the ADF rate was obtained with % 47.560 values from N7-Zn1 treatment, the lowest ADF rate was obtained with % 44.525 values from N0-Zn0.5 treatment. The rate of increasing Zinc ration caused maturation, low protein and high ADF contents.

Key words: Sorghum-Sudangrass Hybrids, Nitrogen, Zinc, Yield

1. Introduction

Turkey's total land area is 783,577 km^2, of which 759,752 km^2 are in Asia and 23,825 km^2 in Europe. The population was 65,311,000 in 2000. The agricultural population is declining year by year. While half of the population was involved in agriculture in 1983, this is now 34 % (22,205,740) (SIS-State Institute of Statistics, SPO - State Planning Organization, 1994)

Turkey has favorable conditions for animal husbandry. Traditionally most farmers in many parts of Turkey are involved in raising a few cattle, some small ruminants and poultry to meet their domestic needs.

There are 20 indigenous cattle breeds, 17 sheep breeds and 5 goat breeds (Akman et all, 2000). The ruminant population in 2001 was 10,686,000 heads of cattle and buffalos, and 33,994,000 heads of sheep and goats (SIS, 2002 a,b).

Most of the cattle are still raised under traditional management approaches based mainly on extensive grazing, and receiving poor quality feed, particularly in winter, and in most cases very little animal husbandary care except for vaccination. Similarly a high proportion of small ruminants is raised under traditional systems. Since 1990, the number of small ruminants has decreased, while cattle numbers are stays almost stable. This indicates a structural change in the livestock sector through a move to more intensive systems.

Quality forage sorghum silage is a useful feed for dairy and beef cattle, but it is lower in feeding value than well-cured, well-matured corn silage. The farmers' main interest in growing sorghum for silage is to produce a high dry matter yield with a low water requirement. (Extending Livestock Feed Supplies, 2003).

Sudangrass and sorghum-sudangrass hybrids provide excellent temporary pasture. Seeding in late May or early

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June will provide three to four times grazing. They can also be harvested for hay or silage. Total yields generally increase with delaying harvesting time from vegetative stage through boot, flower and dough stages; however, protein concentration decreases.

The hybrids offer increased vigor and higher forage yields, a particular advantage is silage and hay when they are harvested for.

Increased feeding frequency of low fiber, high grain diets increases milk fat levels. Cows require a minimum acid detergent fiber (ADF) level of 19 to 21 % of dry matter in the ration. Maintain total neutral detergent fiber (NDF) intake above 26 % of the total ration dry matter. Below these levels, cows are at an increased risk for acidosis, feed intake fluctuations, laminitis, and rapid and extensive body condition loss especially in early lactation. Protein Feeding Guidelines: Generally, dietary crude protein level affects milk yield but not milk protein percent, unless the diet is deficient in crude protein. Normal changes in dietary protein ranges do not consistently affect milk fat percentage. Theoretically, insufficient amounts of rumen-degradable protein might result in decreased milk fat percentage if the concentration of ammonia in the rumen does not support the optimal digestion of fiber and microbial growth. The crude protein requirement for a 612.35 kg cow producing 3.6 % milk fat ranges from 14.0 % of total dry matter (TDM) for 22.68 kg of milk to 18.0 % TDM for 45.36 kg of milk. Depending on the stage and level of production, the recommended level of undegradable protein ranges from 32 % to 38 % of crude protein. Keep soluble protein between 30 to 32 % of crude protein, or about half of the degradable protein intake level. It is essential to meet the cow's requirement for both crude protein and rumen undegradable protein to avoid a negative impact on dry matter intake and fiber digestibility (Looper, 2001).

Crude protein in the present study is at the level permissible for optimal feed intake and rumen function considering the IVDMD of 61% DM. (Abdulrazak et all, 2000)

Sudangrass and sorghum-sudangrass crosses require adequate nitrogen fertilization to ensure maximum yield. Phosphorous, potassium and other nutrients may also be needed by the crop (Parker et all, 2004)

Adequate levels of nitrogen (N), phosphorous (P) and potassium (K) are important if good growth rates are to be achieved. Forage sorghum is sensitive to zinc deficiency and to some extent manganese and sulphur deficiencies. To prevent micro-nutrient deficiency, trace elements should be applied three to five weeks after emergence as a foliar treatment, based on plant tissue test results.

Development of methods to adjust N rates in relation to the amount of N supplied by indigenous soil resources. As a result, N fertilizer recommendations are typically made for districts or regions with the implicit assumption that soil N supply is relatively uniform within these domains.

Recent work has shown the importance of root-induced changes in the rhizosphere for solubilizing Zn and increasing its plant uptake.

The efficiency of utilization of N by maize and sorghum (defined as grain yield per unit N uptake) varies under different climatic, soil, and management conditions (Fischer, 1998).

Nitrogen is the most limiting nutrient for grain sorghum and forage sorghum production. Adequate soil fertility is one of the requirements for profitable grain and forage sorghum production. N is the most yield-limiting nutrient, unless high N fertilizer rates or manure applied to the previous crop have left high residual NO_3-N levels in the soil. P is the next most limiting nutrient, while Zn and Fe also may be limiting in some soils.

Zn deficiencies are common on soils where the subsoil is exposed, or on soils with high levels of free lime. Zn availability decreases with increasing soil pH, and most Zn deficiencies are reported on soils with pH levels higher than 7.0. Incorporation of manure in eroded soils may correct Zn deficiencies, as well as improve soil structure.

Zn is involved in the necessary functions of plant growth. It helps produce auxins, a growth-promoting substance that controls growth of shoots. Zn also forms enzyme systems, which regulate plant life.

Because of its high insolubility and immobility in the soil, zinc should be applied under the subsoil with a starter fertilizer or by root zone handing.

This study was carried out in order to determine the most suitable nitrogen and zinc fertilizer doses at sorghum-sudangrass hybrids in the Çukurova Region.

2. Material and methods

This study was carried out in order to determine the most suitable N and Zn fertilizer doses at the main crops sorghum-sudangrass hybrids in the Çukurova Region during 2001-2002 at Çukurova Agricultural Research Institution. Grazer cultivar of Sorghum-Sudangrass hybrids was used as crop material and pure fertilizer doses 0, 7, 14, 18, 24 kg/da N and 0, 0.5, 1.0 kg/da Zn nutrient doses in this study.

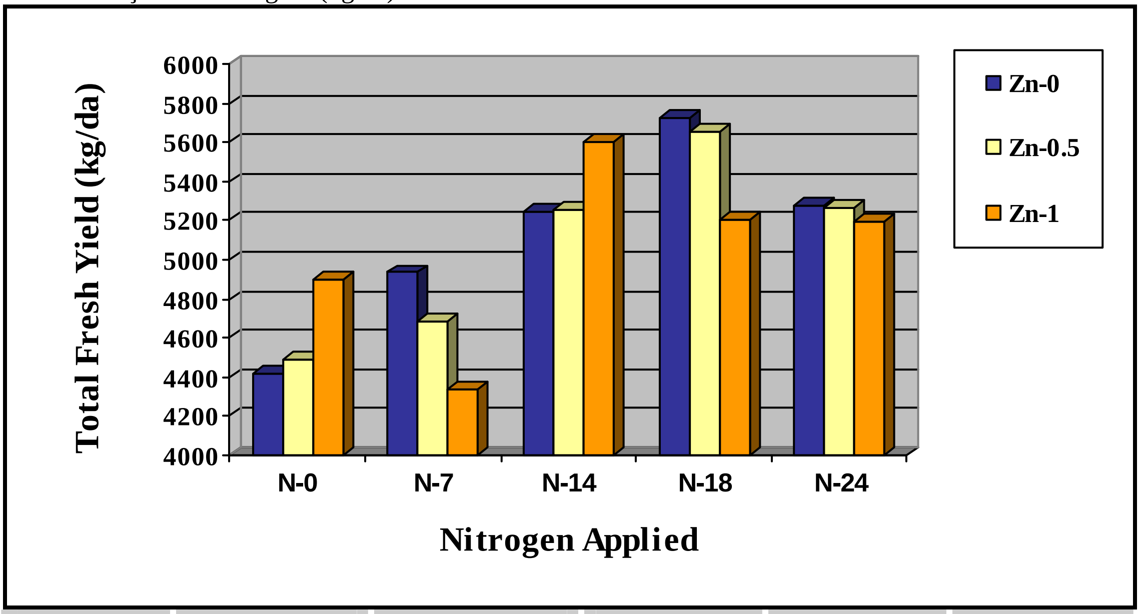
The trial was split-split plot block design with three replication. In the trial cuttings form main parcels,nitrogen doses form sub parcels, and zinc doses form sub-sub parcels. The plants were established in plots of 2.8 x 5 m and each parcel was planted in 4 rows at 0.75 m spacing.

Samples were taken randomly from the three replicates at the vegetative stage dried and stored until analysed. The dried samples were ground to pass through a 2 mm screen and analysed for acid detergent fibre (ADF), nitrogen (Kjeldahl method). Acid detergent fiber was measured by the methods described by Van Soest (1967).

3. Results and discussion

Total Fresh Yield obtained from Different N and Zn Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region are presented in figure 1.

Figure 1. Total Fresh Yield from Applied Different N and Zn Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region (kg/da).



	N-0	N-7	N-14	N-18	N-24
Zn-0	4415,00	4933,25	5248,67	5722,97	5271,35
Zn-0.5	4486,45	4686,42	5258,67	5649,13	5261,97
Zn-1	4897,58	4334,85	5604,70	5204,70	5192,85

According to results given in figure 1, in general, nitrogen application increased total fresh yields but not after 18 kg/da N doses. According to work by Johnston (2000), N fertilizer has significantly increased yield in the past few decades as compared to any other agricultural input. Smith et al (1990) reported that corn and sorghum yield would have dropped by 41 and 19%, respectively, without N fertilizer application. This increasing total fresh yield with N application up to N-18 application and then, increasing N application caused to a reduction total fresh yield.

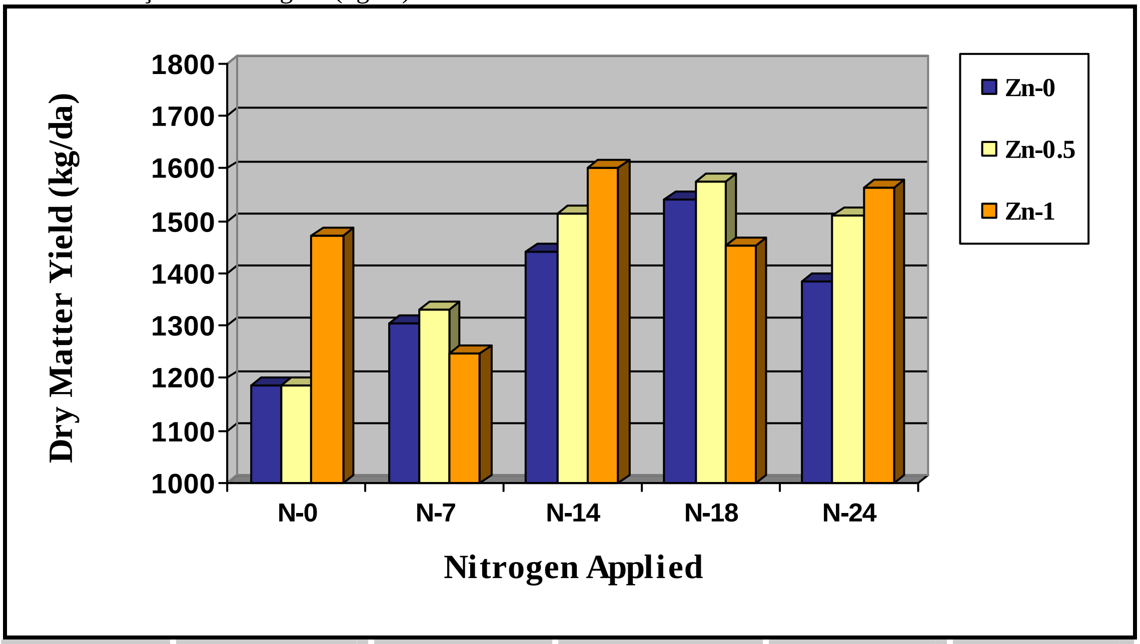
No signification differences in total fresh yield were observed in Zn application. However, especially N-0 and N-14 application together Zn application increased total fresh yield. In addition, while the highest total fresh yield was obtained with 5722.97 values from N-18, Zn-0 application, the lowest total fresh yield was obtained with 4415.00 values from N-0, Zn-0 application.

Total Dry Matter Yield obtained from Different N and Zn Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region are shown in figure 2.

In regard to figure 2, nitrogen application had a positive impact on dry matter yield but this impact was not as effective as total fresh yield. Zn application had the most efficient impact on dry matter yield especially at the application of Zn-0.5.

In addition to, while the greatest dry matter yields occurred with 1602.87 values from application of N-14 and Zn-1, the littlest dry matter yields occurred with 1185.88 values from application of N-0 and Zn-0.5.

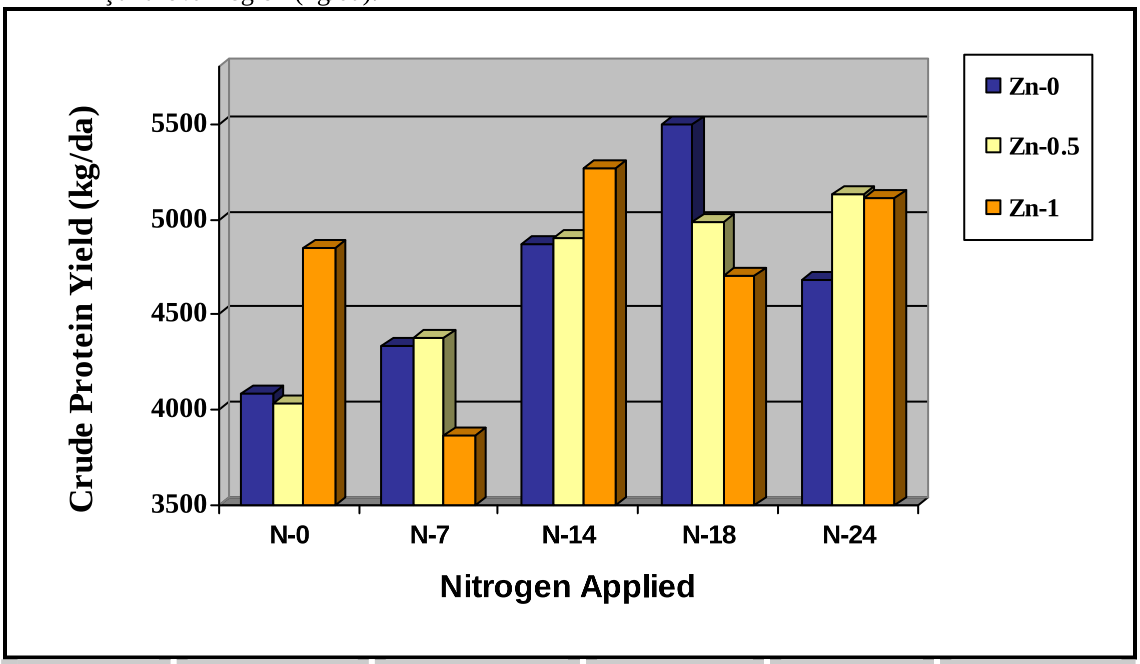
Figure 2. Total Dry Matter Yield from Applied Different N and Zn Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region (kg/da).



	N-0	N-7	N-14	N-18	N-24
Zn-0	1188,42	1306,22	1440,88	1542,52	1385,88
Zn-0.5	**1185,88**	1331,63	1513,50	1575,03	1510,57
Zn-1	1471,98	1245,88	**1602,87**	1453,48	1563,30

Crude Protein Yield obtained from Different Nitrogen and Zinc Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region are shown in figure 3.

Figure 3. Crude Protein Yield from Applied Different N and Zn Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region (kg/da).



	N-0	N-7	N-14	N-18	N-24
Zn-0	4084,670	4336,835	4872,670	**5498,085**	4680,750
Zn-0.5	**4030,665**	4377,830	4902,500	4988,915	5135,165
Zn-1	4848,330	3866,585	5264,835	4698,500	5112,080

According to results given in figure 3, in general, N application increased crude protein yield. This increasing crude protein yield with N application up to N-18 application and then, increasing N application caused a very little reduction of crude protein yield. N is normally used by plants for chlorophyll and protein production, which in turn is used in formation of new plant cells (Pall et all, 1996).

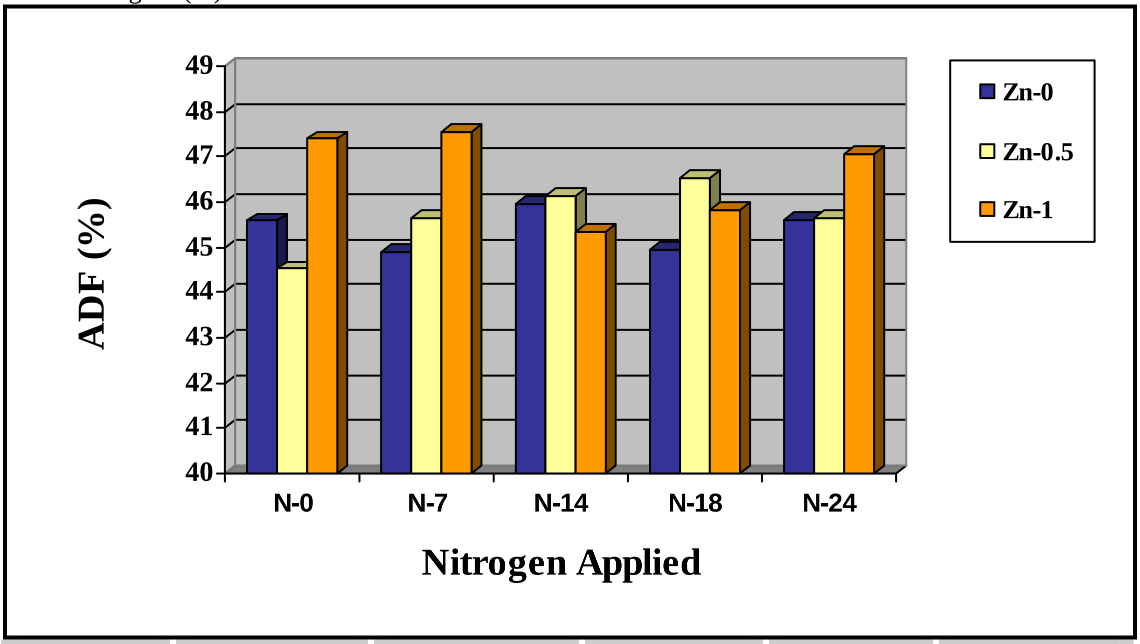
Zn application had the most efficient impact on crude protein yield. Especially at the application of Zn-1 with N-0 and N-14 caused the most efficient impact on crude protein yield.

Generally, according to work by Madibela and Modiakgotla (2004), CP content is positively correlated with quality. In other words, high-protein forages generally are high-quality forages. CP content is positively correlated to energy content of forages. High-protein forages generally are more digestible and provide more energy per pound than low-protein forages.

In addition to, while the greatest crude protein yields occurred with 5498.085 kg/da value from application of N-18 and Zn-0, the littlest crude protein yields occurred with 4030.665 kg/da value from application of N-0 and Zn-0.5.

ADF Rate obtained from Different Nitrogen and Zinc Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region are shown in figure 4.

Figure 4. ADF Rate from Applied Different N and Zn Fertilizer Doses at Sorghum-Sudangrass Hybrids in the Çukurova Region (%).



	N-0	N-7	N-14	N-18	N-24
Zn-0	45,580	44,910	45,950	44,950	45,590
Zn-0.5	**44,525**	45,635	46,135	46,510	45,660
Zn-1	47,390	**47,560**	45,350	45,830	47,070

In regard to figure 4, in generally, N application had a no positive impact on ADF rate, but Zn application had the most efficient impact on ADF rate. Especially at the application of Zn-1 caused the most efficient impact on ADF rate. Weiss et al (1999) reported that fiber content of forages is inversely related to quality. Forages with high concentrations of fiber generally will support less milk production than will low-fiber forages. Plant fiber is composed largely of cellulose and hemi cellulose.

Fiber content and energy content are closely related since almost all laboratories use fiber (either ADF or NDF) to estimate available energy. Concentration of fiber is negatively related to quality because forages with high concentrations of fiber contain less available energy and are consumed in lesser amounts by cows than are forages with low amounts of fiber.

In addition to, while the greatest ADF rate occurred with % 47.560 values from application of N-7 and Zn-1, the littlest ADF rate occurred with % 44.525 values from application of N-0 and Zn-0.5.

4.References

Abdulrazak, S. A., Fujihara, T., Ondiek, J.K. Qrskov, E. R. 2000 Nutritive evaluation of some Acacia trees leaves from Kenya. Animal Feed Science and Technology 85:89-98.

Akman, N., K. Özkütük, S. Kumlu and S. M. Yener. 2000. Cattle Raising in Turkey and its Future. In: Vth Technical Congress of the Agriculture, 17-21 Jan., 2000. P:741-764. Chamber of Agricultural Engineers.

Extending Livestock Feed Supplies - Section Three. Manitoba Agriculture and Food. August 2003.

Fischer, K.S. Nutrient use efficiency in rice cropping systems. Special issue of Field Crops Research, 56(1-2):1-236, March 1998.

Johnston, A. E. 2000. Efficient use of nutrients in agricultural production systems. Common Soil Sci Plant Anal 31:1599-1620.

Looper, M. Managing Milk Composition. Maximizing Rumen Function. Guide D-105. Research Agricultural Experiment Station. This Publication is scheduled to be updated and reissued 1/06. New Mexico State University is an equal opportunity/affirmative action employer and educator. NMSU and the U.S. Department of Agriculture cooperating. March 2001.

Madibela, O.R., Modiakgotla, E. 2004. Chemical Composition and in Vitro Dry Matter Digestibility of Indigenous Finger Millet (*Eleusine coracana*) in Botswana. Livestock Research for Rural Development 16 (4) 2004.

Pal, M. S., Singh, O. P., Malik, H. P. S., 1996. Nutrient Uptake Pattern and Quality of Sorghum (Sorghum bicolor (L.) Moench) Genotypes as Influenced by Fertility Levels Under Rainfed Conditions. Field Crop Abst. Vol. 50 No:10

Parker, R., Evans, D. Morrison, K., Stevens, R., Ley, T., Fransen, S. Growing Sudangrass and Sorghum-Sudangrass Crosses in Washington. Issued by Washington State Cooperative Extension, and the U.S. 2004.

Smith, E.G., R.D. Knutson, C.R. Taylor, J.B. Penson. 1990. Impact of chemical use reduction on crop yields and costs. Texas A&M Univ., Dep. of Agric. Economics, Agric. and Food Policy Center, College Station.

State Institute of Statistics. 1994. General Agricultural Census, 1991. Results of the Agricultural Holdings (Households) Survey.

State Institute of Statistics. 1997. Agricultural Structure. Production, Price, Value.

State Institute of Statistics. 1999. The Summary of Agricultural Statistics.

State Institute of Statistics. 2000. Statistical Yearbook of Turkey, 1999.

State Institute of Statistics. 2002a. The summary of Agricultural Statistics 1982-2001.

State Institute of Statistics. 2002b. Statistical Yearbook of Turkey,2001.

Van Soest, P. J. 1967. J. Anim. Sci. 26:119-128.

Weiss, W.P., East Ridge, M.L., Underwood J.F., Forages for Dairy Cattle AS-0002-99. Animal Sciences 2129 Fyffe Rd., Columbus, Ohio 43210.

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