Journal of Applied Biological Sciences
Uygulamalı Biyoloji Bilimleri Dergisi
E-ISSN: 2146-0108, 11 (2): 20-23, 2017, www.nobel.gen.tr

Effects of Different Planting Densities and Nitrogen Doses on Yield and Quality Properties of Taro (Colocasia Esculenta var. Esculenta)

Necdettin Saglam[1]*, Iskender Ipek[2]

[1] Gaziosmanpasa University, Faculty of Agriculture, Department of Horticulture, Tokat, Turkey
[2] Provincial Directorate of Agriculture, Mersin, Turkey

*Corresponding Author
E-mail: necdettin.saglam@gop.edu.tr

Received Tarihi: April, 15, 2017
Accepted Tarihi: August, 10, 2017

Abstract
This study was conducted to determine the effects three of planting densities (100 cm x 30 cm, 100 cm x 40 cm, 100 cm x 50 cm,) and three nitrogen doses (100 kg/ha, 175 kg/ha, 250 kg/ha,) on yield and quality of Taro under Mut/Mersin(Icel)/Turkey ecological conditions between April-November in 2014. The cormels were planted on April 1st, 2014. The experiment was carried out randomized complete split plots in block design with three replications. Harvest was done on November 1st, 2014. The average cormel weight was affected significantly by planting densities and nitrogen doses. When planting spaces was increased, the average corm weight was decreased. When nitrogen doses were increased, the average corm weight was increased. The maximum corm weight (295,87 g) was obtained from 100 cm x 40 cm at planting density and 250 kg/ha nitrogen dose. The marketable yield was affected significantly by planting densities, while it was not affected by nitrogen doses except control. When planting spaces was increased, the marketable yield was decreased. When nitrogen doses were increased, the marketable yield was not increased. The maximum marketable yield (7,93 t/ha) was obtained from 100 cm x 30 cm at planting density and 175 kg/ha nitrogen dose. The cormels number per plant was not affected significantly by planting densities and nitrogen doses. The maximum cormels number per plant (7,98 per plant) was obtained from 100 cm x 40 cm at planting density and control application.
Keywords: Taro, planting density, nitrogen doses, yield, quality properties

INTRODUCTION

Taro (*Colocasia Esculenta var. Esculenta*), called Colocasia, is belong to Araceae family as botanical and one of the most important vegetable crops in Africa, Asia, Australia, Northern Cyprus and Turkey (10.108.223 tonnes). It is origin pacific islands, and moved to tropical, subtropical and other regions, and cultured in India, and grown for 6000-7000 years. It is grown spontaneously Mersin (Icel) (Bozyazi, Anamur districts) and Antalya (Gazipasa and Alanya districts) provinces in Turkey (805 tonnes) [1,2,3].

There are many factors that limit taro production such as low temperature, moisture, unknown of growing techniques, consuming culture etc. It contains calcium oxalate and mucilage substances. It is eaten after cooking. Its tubers, cormels, leaves, and leaf stem are consumed as meal, canned, cream, flour, chips, noodle, and frozen food chain [4,5,6,7]. It has many health benefits such as capillary vein cracking, eye problems, preventing cancer cell development etc. [8].

Taro enjoys both high temperature and high moisture. It can be grown where underground water level is high. It is no affected by groundwater. It needs 1500-2000 mm rainfall or irrigation and has tolerance for salt. If it is irrigated, it can be cultivated in dried soils. Sandy soils are better for growing, but it can be grown other soil types. Taro needs average 21 °C and propagated by cormels [9,10]. It is grown between April and November. Cormels are stored in frost free conditions.

Taro has opportunity for commercially in Turkey, but it needs scientific studies and introduction for growing and consuming.

Aim of this study is to determine the suitable tuber planting distances and nitrogen doses for marketable yield, cormels number and its parameters.

MATERIALS and METHODS

This study was conducted out at Mut district of Mersin (Icel) in 2014. Mut is situated between 36° 42' North latitude and 33° 35' east longitude and has 275 meter elevation, but experiment plot has 650 meter elevation.

The cormels, used in the experiment, were obtained from local people. Three planting densities (100 cm x 30 cm, 100 cm x 40 cm, 100 cm x 50 cm,) and three nitrogen doses (100 kg/ha, 175 kg/ha, 250 kg/ha,) were used [11]. The cormels were planted on April 1st, 2014. The experiment was carried out randomized complete split plots in block design with three replications. Harvest was done on November 1st, 2014. Data were collected on plant length (cm),

leaf number per plant, average tuber weight (g), average cormels number per plant, average cormels weight (g), marketable tuber and cormels yield (t/ha), soluble solid dry matter (%), pH value and total dry matter (%). They were analyzed with one-way analysis of variance (ANOVA). The means were separated using Duncan test for P=0.05.

RESULTS

There were no significantly effect of planting density, nitrogen doses, and their interactions on plant length (cm) and leaf number per plant. The plant length (cm) was changed between 125.44 cm – 133.49 cm. The leaf number per plant was determined between 4.14 cm – 4.24 cm (Table 1,2).

Table 1. Effects of planting density and nitrogen doses on plant length (cm)

Nitrogen Doses	Planting Densities			Average^ns
	30 cm	40 cm	50 cm	
Control	138,17	130,33	126,60	**131,70**
N_1	126,87	135,70	127,07	**129,88**
N_2	128,60	132,83	129,23	**130,22**
N_3	138,53	135,10	118,87	**130,83**
Average^ns	**133 ,04**	**133,49**	**125,44**	

Planting density x Nitrogen doses: ns

Table 2. Effects of planting density and nitrogen doses on leaf number per plant

Nitrogen Doses	Planting Densities			Average^ns
	30 cm	40 cm	50 cm	
Control	4,30	4,17	4,27	**4,24**
N_1	4,33	4,10	4,07	**4,17**
N_2	4,20	4,27	4,03	**4,17**
N_3	4,13	4,03	4,27	**4,14**
Average^ns	**4,24**	**4,14**	**4,16**	

Planting Density x Nitrogen Doses: ns

Average tuber weight (g) was significantly affected by planting density, nitrogen doses, and their interactions. It was increased by nitrogen doses than control, while there were no difference among them. According to planting densities, 100 cm x 40 cm (269.64 g) and 100 cm x 50 cm (268.78 g) were higher than 100 cm x 30 cm (213.55 g) (Table 3).

Table 3. Effects of planting density and nitrogen doses on average tuber weight (g)

Nitrogen Doses	Planting Densities			Average**
	30 cm	40 cm	50 cm	
Control	152,10	246,93	276,53	**225,19 b**
N_1	226,87	283,40	268,20	**259,49 a**
N_2	237,73	251,97	261,33	**250,34 a**
N_3	237,50	295,87	269,03	**267,47 a**
Average**	**213,55 b**	**269,54 a**	**268,78 a**	

Planting Density x Nitrogen Doses: *

Average cormels number per plant was no significantly affected by planting density, nitrogen doses, and their interactions (6.23-6.90 per plant), whereas average cormels weight (g) and yield (t/ha) were significantly affected by nitrogen doses and planting densities. The highest average cormels weight (g) was obtained from the whole nitrogen doses (39.01 g -39.82 g) and 100 cm x 40 cm (39.68 g) and 100 cm x 50 cm (40.11 g). The most cormels yield (t/ha) was found out the whole nitrogen doses (1.01-1.03 t/ha) and 100 cm x 30 cm planting density (1.14 t/ha), The best interaction was nitrogen doses and 100 cm x 30 cm planting density (1.22 t/ha) (Table 4,5,6).

Table 4. Effects of planting density and nitrogen doses on cormels number per plant

Nitrogen Doses	Planting Densities			Average^ns
	30 cm	40 cm	50 cm	
Control	5,75	7,98	6,49	**6,74**
N_1	6,18	6,23	7,41	**6,61**
N_2	6,53	6,65	6,15	**6,45**
N_3	6,51	6,74	6,98	**6,74**
Average^ns	**6,23**	**6,90**	**6,76**	

Planting Density x Nitrogen Doses: ns

Table 5. Effects of planting density and nitrogen doses on average cormels weight (g)

Nitrogen Doses	Planting Densities			Average**
	30 cm	40 cm	50 cm	
Control	26,65	31,05	43,11	**33,61 b**
N_1	36,71	45,56	36,20	**39,49 a**
N_2	36,55	37,91	42,56	**39,01 a**
N_3	36,69	44,20	38,58	**39,82 a**
Average**	**34,15 b**	**39,68 a**	**40,11 a**	

Planting Density x Nitrogen Doses: **

Table 6. Effects of planting density and nitrogen doses on average cormels yield (t/ha)

Nitrogen Doses	Planting Densities			Average**
	30 cm	40 cm	50 cm	
Control	0,89	0,78	0,86	**0,84 b**
N_1	1,22	1,14	0,72	**1,03 a**
N_2	1,22	0,95	0,85	**1,01 a**
N_3	1,22	1,11	0,77	**1,03 a**
Average**	**1,14 a**	**0,99 b**	**0,80 c**	

Planting Density x Nitrogen Doses : **

Marketable tuber yield (t/ha) was significantly affected by nitrogen doses and cm planting densities. The marketable tuber yield (t/ha) was increased when planting spaces was decreased (7.12, 6.74 and 5.38 t/ha respectively). The nitrogen doses were higher (6.48-6.90 t/ha) than control (5.59 t/ha), yet there were no difference among them. The best interaction was 175 kg-250 kg/ha nitrogen doses and 100 cm x 30 cm planting density (7.93 t/ha) (Table 7).

Soluble solid dry matter (4.10-4.47%) and pH value (6.39-6,41) were no significantly affected by planting density, nitrogen doses, and their interactions (Table 8,9), whereas total dry matter (%) was significantly affected by planting densities and nitrogen doses. The highest total dry matter (%) was observed at control (20.25%) and 100 cm x 40 cm (18.04%) and 100 cm x 50 cm (18.70%) (Table 10).

Table 7. Effects of planting density and nitrogen doses on marketable tuber yield (t/ha)

Nitrogen Doses	Planting Densities			Average**
	30 cm	40 cm	50 cm	
Control	5,07	6,18	5,53	**5,59 b**
N_1	7,56	7,08	5,36	**6,67 a**
N_2	7,93	6,30	5,23	**6,48 a**
N_3	7,92	7,40	5,38	**6,90 a**
Average**	**7,12 a**	**7 ,74 a**	**5,38 b**	

Planting Density x Nitrogen Doses : **

Table 8. Effects of planting density and nitrogen doses on soluble solid dry matter (%)

Nitrogen Doses	Planting Densities			Average^{ns}
	30 cm	40 cm	50 cm	
Control	4,32	4,53	4,26	**4,37**
N_1	4,50	4,33	3,84	**4,22**
N_2	4,43	4,42	4,35	**4,40**
N_3	4,14	4,60	3,95	**4,23**
Average^{ns}	**4,35**	**4,47**	**4,10**	

Planting Density x Nitrogen Doses :^{ns}

Table 9. Effects of planting density and nitrogen doses on pH value

Nitrogen Doses	Planting Densities			Average^{ns}
	30 cm	40 cm	50 cm	
Control	6,39	6,38	6,42	**6,39**
N_1	6,38	6,42	6,42	**6,40**
N_2	6,42	6,39	6,39	**6,40**
N_3	6,41	6,35	6,41	**6,39**
Average^{ns}	**6,40**	**6,38**	**6,41**	

Planting Density x Nitrogen Doses :^{ns}

Table 10. Effects of planting density and nitrogen doses on total dry matter (%)

Nitrogen Doses	Planting Densities			Average**
	30 cm	40 cm	50 cm	
Control	20,21	21,11	19,42	**20,25 a**
N_1	17,16	20,14	19,31	**18,87 b**
N_2	16,45	14,38	16,90	**15,91 c**
N_3	14,08	16,54	19,18	**16,60 c**
Average**	**16,97 b**	**18,04 a**	**18,70 a**	

Planting Density x Nitrogen Doses :**

DISCUSSION

The whole parameters were significantly affected by nitrogen doses than control, but there were no significantly difference among them. The plant length (cm), leaf number per plant, average cormels number per plant, soluble solid dry matter (%), and pH value were no significantly affected by nitrogen doses. It can be originated by soil or climatic conditions.

The plant length (cm) is in agreement with Onwueme (1999) [10]. The leaf number per plant and average cormels number per plant are in agreement with McCartan ve ark., (1996) [12].

Average tuber weight (g) - marketable tuber yield (t/ha), average cormels weight (g) - cormels yield (t/ha), and total dry matter (%) were significantly affected by planting density applications. The other parameters were no significantly affected them.

Average tuber weight (g) is in agreement with Sen et al., (1999). They reported that Average tuber weight (g) was 125.8 g in Anamur districts and it was 536,62 g was in Bozyazı district [4]. It shows that Average tuber weight (g) has been changed according to locations.

Marketable tuber yield (t/ha) is in agreement with Silva et al., (1992). They reported that taro tuber yield was 7 (t/ha) [13]. Average tuber weight (g) has affected marketable tuber yield (t/ha). Therefore it has been affected by locations.

The nitrogen doses x planting densities interactions were significantly important which parameters were significantly affected by nitrogen doses and planting densities.

Soluble solid dry matter (%) and pH are in agreement with Sen et al., (1999). They reported that they were 6,10-6,60% and 6,38-6,41 respectively [4]. The total dry matter (%) is in agreement with Osorio et al., (2003) [14], Sen et al., (1999) [4], and Agbor-Egbe ve Rickard (1990) [15].

CONCLUSIONS

Taro can be grown as a commercial vegetable in the East Mediterranean region and other suitable regions where underground water level is high. It is important for product diversity and nutrition. Also, it can be exported after it is processed.

Optimum nitrogen dose can be 100 kg/ha and optimum planting space and density can be 100 cm x 40 cm and 25.000 plant /ha. The highest marketable yield can be obtained around 7 ton/ha and 155.750/ha marketable cormels can be marketed each year at 100 kg N and 25.000 plant /ha planting density applications.

REFERENCES

[1] Anonim, 2017. FAOSTAT-Agriculture, www.faostat.fao.org, Visiting: 02.07.2017.

[2] Purseglove, J.W. (1972) Tropical Crops. Monocotyledons. Longman London.

[3] Gohl, B.1981. Tropical Foods. Food and Agriculture Organization. FAO Ani. Pro. and Health Series, 12, 314, Rome.

[4] Şen, M., Akgül, A., Özcan,M. 1999. Gölevez [*Colocasia Esculenta* (L.)Schott] Yumrusunun Fiziksel ve Kimyasal Özellikleri İle Kızartma ve Püreye İşlenmesi,Turkish Journal of Agriculture and Forestry.Vol.25,Number 6,P:427-432.TÜBİTAK 2001.Ankara.

[5] Catherwood, D.J., Savage, G.P., Mason, S.M., Scheffer, J.J.C. and Douglas, J.A., 2007, Oxalatecontent of Cormels of Japanese Taro (*Colocasia Esculenta* (L.) Shoot) and the Effect of Cooking. Journal of Food Composition and Analysis, 20: 147-151.

[6] Aboubakar, Y.N., Njintang, J.S. and Mboufung C.M.F., 2008, Physicochemical, thermal Properties and Mi-

crostructure of Six Varieties of Taro (*Colocasia Esculenta* L. Schott) Flours and Starches, Journal of Food Engineering, 86: 294-305.

[7] Axtell, B., Adams, L. 1993. Root Crop Processing. Intermediate Tec. Publ. London, England.

[8] Cambie, R.C. and Ferguson, L.R., 2003, Potential Functional Foods in the Traditional Maori Diet, Mutation Research, 523-524: 109-117.

[9] Nip,W-K. 1990. Taro Food Products. Proc. Taking Taro into the 1990s: A Taro Conference. Hollyer, J .R.,D.M.S. (Eds.). Resources Extension Series, College of Tropical Agriculture and Human Resources. University of Hawaii.114:3-5, United States of America.

[10] Onwueme, 1999. Taro Cultivation in Asia and the Pacific. Agriculture Department, University of Technology, Lae, Papua New Guinea. Food and Agriculture Organization. FAO of the United Nations Regional of fice For Asia and the Pacific, Bangkok, Thailand 1999.

[11] Alfred, E., Hartemink, M., Johnston, J.N. O'Sullivan, S. Poloma, 2000, Nitrogen Use Efficiency of Taro and Sweet Potato in the humid Lowlands of Papua New Guinea, Agriculture, Ecosystems and Environment 79 271–280.

[12] Mccartan, S.A.Staden, J.V., Finnie, J.F. 1996. in Vitro Propagation of Taro (*Colocasia Esculenta*). J.S. Afr. Soc. Hort.Sci.6;1-3

[13] Silva, J.A., Coltman, R., Paul, R., Arakaki, A. 1992. Response of Chinese Taro To Nitrogen Fertilization and Plant Populations. In Proceed. of the Workshop on Taro Human and Tanier Modeling. Singh,U. (Ed). College of Tropical Agriculture and Resources. 13-16, Honolulu, Hawaii.

[14] Osorio, N.W. , Shuai, X., Miyasaka, S., Wang, B. Shirey, R.L. and Wigmore, W.J. 2003, Nitrogen Level and Form Affect Taro Growth and Nutrition, Hort. Science February Vol. 38 No. 1 36-40.

[15] Agbor-Egbe, T., Rickard, J.E. 1990. Evaluation of the Chemical Composition of Fresh and Stored Edible Aroids. J.Sci. Food Agric. 53: 487-495.