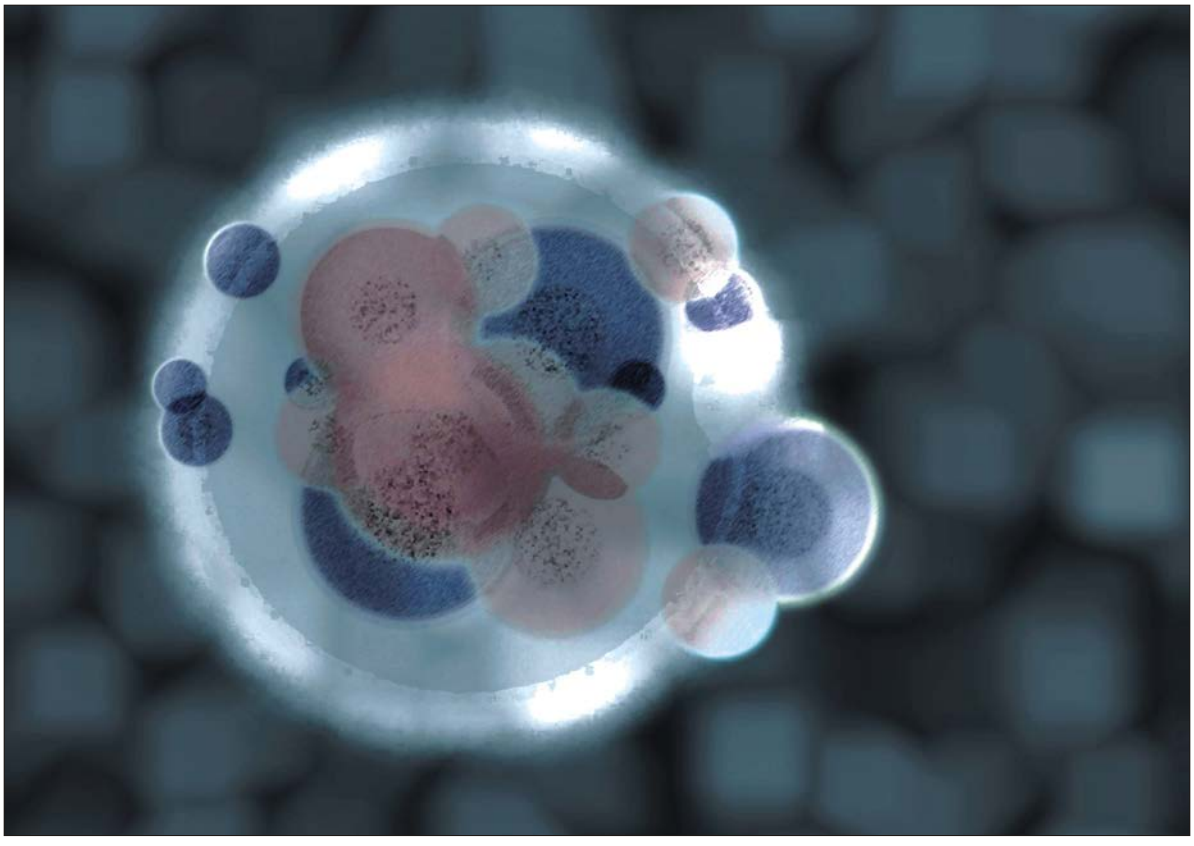

Journal of Biological Sciences

ISSN 1727-3048

science alert

ANSInet
an open access publisher
http://ansinet.com

Journal of Biological Sciences 5 (6): 786-789, 2005
ISSN 1727-3048

The Effects of B-Zn Fertilization on Yield, Cluster Drop and Nut Traits in Hazelnut

[1]Ümit Serdar, [2]Ayhan Horuz and [1]Taki Demir
[1]Department of Horticulture, [2]Department of Soil Science,
Faculty of Agriculture, Ondokuz Mayıs University, 55139 Samsun, Turkey

Abstract: In this study, the effects of B-Zn fertilization on the yield, cluster drops and nut traits in hazelnut were examined during 2001-2002. Tombul and Cakıldak hazelnut cultivars were used. The doses of 150 and 300 g of a B-Zn fertilizer consist of 10.0 % B, 4.0% Zn were used per ocak in January 2001. This fertilizer was applied with broadcast in Cakıldak cv. and with ground in Tombul cv. Following characters were examined: nuts per cluster, nut and kernel weights, kernel percent (%), shell thickness (mm), good kernel (%), blank nut (%), shriveled kernel (%). In addition, cluster drop (%) was examined in both years. Consequently, the best yield and nut traits were obtained from dose of 150 when the B-Zn fertilizer applied to the ground in Tombul cv. and dose of 300 when it applied to broadcast in Cakıldak cv.

Key words: *Corylus avellana*, bore, zinc, fertilization, hazelnut, yield, drop, nut traits

INTRODUCTION

Hazelnut is produced commercially in various locations in the northern hemisphere under a wide range variety of management practices including nutrient applications[1]. Hazelnuts have been grown for centuries in Anatolia and adapted to ecological conditions in the Black Sea region.

Nutrients especially B and Zn involved there is considerable potential for imbalances and many nutrient management questions are unresolved. Boron is considered one of the fundamental nutrients essential for optimum fruit set and for improvement of fruit and nut quality in some species[2,3]. This mineral is known to be involved in cell division, synthesis of nucleic acids and translocation of sugars[4].

Boron and zinc deficiency are fairly widespread through the Black Sea region and have been reported on several crops, including corn, sunflower, sugar beet, deciduous fruits and especially in Hazelnut[5-7]. Several reports have documented a positive influence of boron and zinc applications on fruit-set, yield quantity and quality in different fruit species[8-11]. Solar and Stampar[11] reported that there were significant differences in percentage of blanks between treated and untreated hazelnut trees and yield in the year of Zn and B application was highest in the treatment B2Zn (2 I ha^{-1} bortract + 1I ha^{-1} zintract) and lowest in the treatment B1Zn (1 I ha^{-1} bortract + 1 I ha^{-1} zintract).

The main objective of this study was to determine the effects of a B-Zn fertilizer on the yield, cluster drops and nut traits of the hazelnut cultivars Tombul and Cakıldak.

MATERIALS AND METHODS

This study was carried out in an orchard in Fatsa County in Ordu province, Turkey during 2001-2002. Tombul and Cakıldak hazelnut cultivars were used in the study. The trial orchards, located at 225 m altitude, were established with ocak training system (a traditional bush form) in space of 4×4 m in 1955. In the ocaks, 5-7 stems with 26.7±6.7 cm diameter were performed in Tombul and 9-12 stems with 11.4±3.5 cm diameter in Cakıldak.

Soil samples were taken from a depth of 0-30 cm from each orchard prior to application of the fertilizer treatments in October 2000. Samples were air dried and ground to pass a 2 mm screen. Soil analyses was determined in saturation mud pH and salt[12] organic matter by walckley black method[13], lime by scheibler calsimeter[14], texture by hydrometer method[15], exchangeable cations (Ca, Mg, K and Na) by 1 N NH_4OAc method[16], CEC with plus of exchangeable cations, P by Olsen method for neutral soil[17] and for acid soil by Bray and Kurtz No.1 method[18], extractable Fe, Mn, Cu and Zn from soils by the DTPA method[19] and available B soluble in hot water was measured by the Azometine-H method in spectrophotometer at 420 nm[20]. Soil characteristics were presented in Table 1 and 2. P were added to orchard with 0.6 kg/ocak (46% DAP) in November 2000 and N were added with 1 kg/ocak (33% AN) in April 2001 and 2002.

Corresponding Author: Dr. Ümit Serdar, Department of Horticulture, Faculty of Agriculture, Ondokuz Mayis University, 55139, Samsun, Turkey

Table 1: Main soil characteristics of trial orchards

Cultivar	pH (paste)	OM (%)	Lime (%)	Salt (%)	CEC (me/100g)	Sand (%)	Mil (%)	Clay (%)	Texture class
Cakıldak	7.10	2.03	1.3	0.024	62.9	23.8	29.2	47.0	C
Tombul	6.60	1.84	0.0	0.022	52.5	24.3	38.0	37.6	CL

Table 2: Available macro and micro nutrient contents of trial orchards

Cultivar	P (ppm)	K (me/100 g)	Ca (me/100 g)	Mg (me/100 g)	Na (me/100 g)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)	B (ppm)
Cakıldak	12.5	0.33	55.2	7.1	0.29	11.3	6.2	2.0	0.54	0.44
Tombul	7.2	0.27	46.7	5.5	0.01	17.7	14.7	1.4	2.05	1.11

The doses of 150 and 300 g of the B-Zn fertilizer consist of 10.0% B, 4.0% Zn were used per ocak in January 2001. This fertilizer was applied with broadcast in Cakıldak cv. and with ground in Tombul cv. The experimental design was randomized plots. Three replicates and one ocak in each replication were used. Statistical analyses were conducted according to Tosun[21] and the means were compared using Duncan's Multiple Range Test.

Harvest was made in the middle of August. Yield was determined for per ocak. A sample of 100 cluster and 200 nuts was used for fruit characteristics. For each sample, the following characters were examined: nuts per cluster, nut and kernel weights, kernel percent (%), shell thickness (mm), good kernel (%), blank nut (%), shriveled kernel (%). In addition, cluster drop (%) was examined in both years.

RESULTS AND DISCUSSION

The cluster drop varied from 3.0 to 20.4% in Cakıldak cv. and 4.9 to 20.9% in Tombul cv. (Table 3). In both of the years the lowest cluster drop was obtained from dose of 150 in Cakıldak cv. which seemed to be the first applications dose the more favorable, besides, the dose of 300 increased the cluster drop in both years when compared with the dose of 150. In Tombul cv. doses of fertilizer decreased significantly the cluster drop when compared with the control. However, there was no significant difference for cluster drop between the doses. The cluster drop and nut quality were notified by some authors that was connected with low B content[3].

In Cakıldak cv. the highest yield per ocak was obtained from dose of 300 in both of the years (Table 3). In Tombul cv., dose of 150 had the highest yield with 3427 g in 2001 (Table 3). In this cultivar, dose of 300 had the same yield with dose of 150 in 2002 although it had lower yield than control in 2001. The reason of this effect may probably be used by hazelnut plants of available boron and zinc in all treatments and decreased of the affecting in 2002. Another factor may also be soil reaction, in soil of Tombul cv. orchard has lower pH (6.6) than soil of Cakıldak cv. orchard and effected of B and Zn uptake on hazelnut plants, in these conditions was boosted availability of micro nutrients[22]. As a results show that B and Zn application were increased nut yields in the different doses according to the control (untreatment) in 2001 and 2002.

In Cakıldak cv. dose of 150 had the highest nut and kernel weights and kernel percent in 2002 although both of the B-Zn doses had generally better fruit traits than control treatment in 2001 (Table 4). In 2001 blank nut percent was decreased significantly with B-Zn applications, however, in 2002 there was no differentiation among the treatments. Shriveled kernel was the lowest in dose of 150 in both of years. A reduced number of blank nut showed that an improvement of nut and kernel weight was achieved when B and Zn are applied to both ground and surface and in the best convenient concentrations (at 150 g per/ocak). The positive answer to the treatment is probably due to the involvement of theirs on plant metabolism[23-26].

In Tombul cv. dose of 150 had the highest number of nuts per cluster and the lowest blank nut and shell thickness in 2001 (Table 5). Nut weight, kernel weight, kernel percent, good kernel were better in B-Zn applications than control treatment. In 2002 there were no generally significant differences with respect to fruit traits, although nut weight and good kernel percent were best in dose of 300. The similar results were obtained by Korkmaz *et al.*[7]. They were reported that nut yield and kernel weight of 100 nuts increased 13.0, 57.1, 55.5 and 42.9% according to control with respect to increasing of doses 0, 6, 12, 18 and 24 g B per ocak, respectively and the most suitable dose for soil application was 12 g B per ocak.

Table 3: Effect of B-Zn fertilizer on cluster drop and yield of hazelnut cultivars

		Cluster Drop (%)		Yield(g/ocak)	
Years	Application (g/ocak)	Cakildak cv.	Tombul cv.	Cakildak cv.	Tombul cv.
2001	0	6.0ab*	15.6b	2149.0b	2675.0b
	150	3.5a	11.0a	2488.0b	3427.0a
	300	7.6b	9.8a	3380.0a	2419.0b
2002	0	14.8b	20.9b	1227.0b	1712.0b
	150	3.0a	6.9a	1397.0b	2981.0ab
	300	20.4b	4.9a	2021.0a	3136.0a

*Means followed by the same letters in a year are not significantly different at the 0.05 level

Table 4: Nut and kernel traits of Cakıldak hazelnut cv. in 2001 and 2002

Year	Application (g/ocak)	No. of nuts per cluster	Nut weight (g)	Kernel weight (g)	Kernel percent (%)	Shell thickness (mm)	Good kernel (%)	Shriveled kernel (%)	Blank nut (%)
2001	0	2.66	1.11b*	0.57b	46.8b	0.80	84.4b	10.1b	4.7b
	150	2.70	1.32a	0.72a	50.0a	0.78	92.9a	2.8a	1.9a
	300	2.87	1.28a	0.60ab	47.5b	0.78	92.3a	6.7b	2.2a
2002	0	2.30	1.65b	0.90c	50.2b	0.82	93.9ab	3.7b	1.3
	150	2.24	1.90a	1.05a	52.7a	0.89	96.3a	1.3a	1.8
	300	2.41	1.69b	0.91b	49.8b	0.86	91.4b	2.8b	2.1

Table 5: Nut and kernel traits of Cakıldak hazelnut cv. in 2001 and 2002

Year	Application (g/ocak)	No. of nuts per cluster	Nut weight (g)	Kernel weight (g)	Kernel percent (%)	Shell thickness (mm)	Good kernel (%)	Shriveled kernel (%)	Blank nut (%)
2001	0	3.27b	1.18b	0.67b	48.2b	0.84b	81.1b	10.0b	7.4b
	150	4.13a	1.45a	0.84a	52.4a	0.81a	91.8a	1.9a	5.0a
	300	3.55b	1.51a	0.89a	50.8ab	0.92c	87.1ab	4.3a	9.4c
2002	0	3.16b	1.64b	0.82b	53.2b	1.01b	91.8ab	3.9b	3.4
	150	3.58a	1.66b	0.97a	52.3b	0.90a	86.9b	2.4ab	2.7
	300	3.33ab	1.74a	1.01a	54.8a	0.95ab	94.9a	1.7a	2.5

*Means followed by the same letters in a year are not significantly different at the 0.05 level

In the study, the best yields and nut traits were obtained from dose of 150 when the B-Zn fertilizer applied to the ground in Tombul cv. and dose of 300 when it applied to broadcast in Cakıldak cv. This effect was probably texture that induced leaching slowly lower from upper soil of B in Cakıldak hazelnut orchard soil, besides, it has lower water soluble B concentration (unsufficient level 0.44 mg kg^{-1}) than Tombul orchard soil (sufficient level 1.11 mg kg^{-1}). Thus, it may be influencing to the kernel mass[7,22].

Consequently, we can advice the dose of 150 (15 g B and 6 g Zn per ocak) when the B-Zn will be applied to the ground. In addition, we can also advice the dose of 300 (30 g B and 12 g Zn per ocak) when it will be applied to broadcast.

REFERENCES

1. Tous, J., J. Girana and J. Tasias, 1994. Cultural practices and costs in hazelnut production. III. Intl. Cong. Hazelnut, Alba, Italy, september 14-18. Acta Hortic., 351: 395-418.
2. Alkoshab, O., T.L. Righetti and A.R. Dixon, 1988. Evaluation of dris for judgin the nutritional status of hazelnuts. J. Am. Soc. Hortic. Sci., 113: 643-647.
3. Borges, O.M.P., L.R.S. Carvallo, A.P. Silva and A. Santos, 2002. Effecet of foliar boron sprays on yield and nut quality of Segorbe and Fertile de Coutard hazelnuts. Proc. V. Intl. Cong. Hazelnut, Acta Hortic. 556: 300-302.
4. May, G.M. and M.P. Pritts, 1993. Phosphorus, zinc and boron influence yield components in Earliglow strawberry. J. Am. Soc. Hortic. Sci., 118: 43-49.
5. Horuz, A. and A. Korkmaz, 2000. Determination of nutrient status in hazelnut leaves sampled from Terme and Ünye regions. Proc. of Intl. Symp. Desertification, Konya, Turkey, pp: 465-470.
6. Tarakcıoğlu, C., 2001. Ordu yöresinde yetistirilen fındık (*Corylus avellena* L.) bitkisinin beslenme durumunun toprak ve bitki analizleri ile belirlenmesi ve fındık meyvesinin bazı kalite özellikleri. (Doktora tezi) Ankara Univ. Fen Bil. Enst., Ankara.
7. Korkmaz, A., N. Özdemir, C. Gülser, R. Kızılkaya and A. Horuz, 2005. Fındık ve Mısırda borlu gübrelemenin verim ve bor kapsamına etkileri. Onat B., S. Sener, A. Mergen and U. Bilici (Eds.), I. Ulusal Bor Calıstayı Bildiriler Kitabı. Ulusal Bor Arastırma Enstitüsü ve Eti Maden Isletmeleri Genel Müdürlüğü, Ankara, 28-29 Nisan, pp: 125-132.
8. Gobara, A., 1998. Response of Le-Conte pear trees to foliar application of some nutrients. Egyp. J. Hortic., 25: 55-70.
9. Stampar, F., M. Hudina, K. Dolene and V. Usenik, 1999. Influence of Foliar Fertilization on Yield Quantity and Quality of Apple (*Malus domestica* Borkh.). In: Anac, D. and P.P. Martin, (Eds.), Improved Crop Quality by Nutrient Management. Kluwer Acedemic Publishers, Dordrecht/Boston/ London, pp: 91-94.
10. Wojcik, P., G. Cieslinski and A. Mika, 1999. Apple yield and fruit quality as influenced by boron applicatiıns. J. Plant Nutr., 22: 1365-1377.
11. Solar, A. and F. Stampar, 2001. Influence of boron and zinc application on flowering and nut set in Tonda di gifoni hazelnut. Proc. V. Intl. Cong. Hazelnut. Acta Hortic., 556: 307-309.
12. Kacar, B., 1994. Bitki ve Toprağın Kimyasal Analizleri III. Ankara Univ. Ziraat Fak. Eğitim, Arastırma ve Gelistirme Vakfı Yayınları, pp: 89-98.
13. Nelson, D.W. and L.E. Sommers, 1982. Total Carbon, Organic Carbon and Organic Matter. Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties. Agronomy Monograph No. 9, (2nd Edn.), ASA-SSDA, Madison Wisconsin, USA., pp: 539-579.

14. Kurucu, N., M. Börekçi, I. Gedikoğlu, B. Sönmez, F. Eyüpoğlu and A. Ağar, 1990. Toprak ve Su Analizleri Laboratuvarları El Kitabı. T.C. Tarım Orman ve Köyisleri Bakanlığı Genel Müd. (Ed. Tüzüner, A.,) Ankara, pp: 61-84.
15. Demiralay, I., 1993. Toprakta Fiziksel Analiz Yöntemleri. Atatürk Üniversitesi Ziraat Fakültesi yayınları. Erzurum, pp: 111-120.
16. Sağlam, T., 1997. Toprak ve Suyun Kimyasal Analizleri. Trakya Üniv. Ziraat Fak. Yayın, pp: 164.
17. Olsen, S.R. and L.A. Dean, 1965. Phosphorus. In: Black, C.A. *et al.,* (Ed.), Methods of Soil Chemical Analysis, Part 2. Agron. Am. Soc. Agron, Inc., Madison, Wisconsin, 9: 1035-1049.
18. Bray, R.H. and L.T. Kurtz, 1945. Determination of Total, Organic and Available Forms of Phosphorus in Soils. Soil Sci., 59: 39-45.
19. Lindsay, W.L. and W.A. Norwell, 1978. Development of a DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J., 42: 421-428.
20. Jhon, M.K., H.H. Chuah and J.H. Neufeld, 1975. Application of improved azometine-H method to determination of boron in soils and plants. Anal. Lett., 8: 559-568.
21. Tosun, F., 1991. Tarımda Uygulamalı Istatistik Metotları. Ondokuz Mayıs Üniv. Ziraat Fak. Ders Notu, pp : 256.
22. Tisdale, S. and W. Nelson, 1975. Soil Fertility and Fertilizers. 3rd Edn., Macmillan Publishing Co., Inc. New York, pp: 301-330.
23. Shkolnik, M.Y., T.A. Krupnikova and Y.S. Smirnov, 1981. Activity of polyphenol oxidase and sensitivity to boron deficiency in monocots and dicots. Sov. Plant Physiol. (Engl. Transl.), 28: 279-283.
24. Faust, M., J. Wiley and S. Wiley, 1989. Physiology of Temperate Zone Fruit Trees. Intersci. Publication: New York, pp: 338.
25. Aktas, M., 1994. Bitki Besleme ve Toprak Verimliliği. Ankara Üniv., Ziraat Fak., pp: 341.
26. Aydemir, O. and F. Ince, 1989. Bitki Besleme. Dicle Üniversitesi Eğitim Fakültesi Yayınları, pp: 654.