INT. J. BIOL. BIOTECH., 11 (2-3): 295-298, 2014.

EFFICACY OF BORON & GIBBERELLIC ACID ON GROWTH AND FRUIT YIELD IN OLIVE (*OLEA EUROPAEA* L.) CV. GEMLIK

Muhammad Ali[1], Mukhtar Ahmad[2], Naveed Anjam[2], Hafeez-ur-Rehman[2], M. Imran Kasana[2], Sudheer Tariq[2] and Aasia Ramzan[2]

[1]*National Institute of Organic Agriculture, NARC, Islamabad*
[2]*Fruit Crops Program, Horticultural Research Institute, NARC. Islamabad*
Corresponding Author E-mail: alikhan.fos@gmail.com

ABSTRACT

A field experiment was undertaken to evaluate the efficiency of Boron and Gibberellic Acid (GA_3) on fruit setting phenomenon in Olive cultivar Gemlik at the Experimental area in Olive fruit orchard at NARC, HRI during 2010-2011. The Olive plants were sprayed with 3 concentrations of Boron i.e. 0.03, 0.06 and 0.09 % and GA_3 in 3 concentrations i.e. 20, 25 and 30 ppm after flowering opening. The results showed that maximum flowering (No. 789) with the application of Boron treatment @ 0.09%, while GA_3 maximum flowering (No. 422) with 30 ppm treatment. Maximum percent fruit setting (26.5) was recorded with GA_3 spray @ 30ppm, and it was followed by the application of GA_3 @ 25ppm (21.25) and maximum fruit setting (13.07) was observed with Boron treatment and @ 0.09%. Maximum fruit setting on the basis of total number of flowers was also observed in the application of GA_3 treatment @ 30ppm (7.53%). Maximum number of fruits, fruit size and fruit yield observed with 30ppm GA_3 was 75.00, 3.569cm and 3.425 kg, respectively and maximum fruits, fruit size and fruit weight was recorded with Boron treatment @ 0.09% was 65.30, 3.372 cm and 3.342 kg, respectively. It may be concluded that application of Boron @ 0.09% and GA_3 @ 30ppm was optimum for the maximization in number of flowers, fruit set, fruit size and even fruit weight in Olive cv "Gemlik"

Key words: Olive. Gibberellic acid. Boron. Foliar application. Fruit setting. Yield

INTRODUCTION

Olive culture is rapidly growing in terms of both production volumes and geographical spread. The crop is now grown in countries not traditionally associated with its cultivation, although in such countries olive cultivation is not economically significant. Furthermore, climatic changes have resulted in the expansion of olive culture to years more Northerly than the Mediterranean countries. The olive is not only a significant food source but it also contributes to human health, with olive products representing an important part of Mediterranean diet, which an increasing number of people all over the World are embracing for reasons of health. Olive is an evergreen plant of Mediterranean region and is widely distributed tree grown in many arid zones of the world. Fruit yield quality is affected by environmental conditions. Olive plant (*Olea europaea* L.) is of the family Oleaceae. Oleaceae family has a high economic value and many countries such as Iran and Turkey and Mediterranean use its oil and conserved fruits (Payvandi *et al.,* 2001). Olive needs winter chilling for flower initiation whereas long warm dry summer promotes the development of oil in the fruit. Two flowering aspects were possibly affected by establishing girdling and spraying of gibberellins nutrients, either singly or in combination compared to the check treatment (EL-Khawaja, 2007). Several studies have reported the importance of boron fertilization to increase olive productivity (Larbi *et al*., 2011; Soyergin, 2010). Other studies demonstrated the importance of boron nutrition in flower quality and fruit set (Perica *et al.,* 2002) and calcium on Mango (Sabour, 2001) improved fruit setting. Brown (2001) studied the effect of boron fertigation on pistachio cv. Kerman, olive cv. Manzanillo and found that foliar application boron increased fruit setting and yield even applied during reproductive growth. Foliar application of boron @ 0.25% or 0.50% significantly decreases the percentage of imperfect flowers and improved fruit setting. All the nutrients play an important role in activating growth and fruiting through encouraging cell division and stimulating the biosynthesis of organic foods and the number of inflorescences/shoot and number of flowers per inflorescences did not alter with girdling and some nutrient treatments in the first season of study, while in the second season, such two flowering aspects were positively affected by establishing girdling and spraying of macro and micro nutrients either singly or in combination compared to check treatment (EL- Khawja, 2003, 2007). Generally olive plant may flower profusely but fruit set is poor. Certain chemicals such as 2% biuret urea, 3% potassium nitrate and 4% potassium sulphate, applied as foliar spray during first and second fruit development stage have been shown to decrease fruit drop and increased yield, fruit quality and oil contents. Enhancing fruit growth such as citrus (Eman *et al*., 2007; EL-Sese, 2005), guava (EL-Sharkawy and Mahaisew, 2005), in all species so far studied, gibberellins had the potential for increasing fruit size. Most of the olive cultivars planted at NARC produced the flowers profusely, but fruit set and yield is very low. It is necessary to explore various procedures to

decrease the fruit drop and increase yield of olive cultivars. The present study was initiated with the objectives to check the positive response of GA_3 and boron on olive cv. Gemlik, which is very popular in Islamabad climate due to ripening after the onset of rains.

MATERIALS AND METHODS

Olive (*Olea europaea* L. cv. Gemlik) trees of similar vigor, age (eight years old) and size were selected for sprays treatments during 2010-2011 session. For each replication of treatment, same shoot with regard to height, thickness, vigor and number of flowers and orientation was selected.

The trees were grown in sand loamy soil with 3 x 3.5 m apart from plant to plant and row to row. The plants were grown on a single wire trellis system at experimental farm of olive research orchard. For each replication of treatment, same shoot with regard to height, vigor and number of flowers were selected. The experiment was laid out in RCBD design with four replications fashions, in each treatment. The spray material was applied in full coverage with hand sprayer. Different concentrations of Boron spray @ (0, 0.03%, 0.06% and 0.09%) was applied to bearing olive cv. Uslu, approximately two weeks before anthesis, while Gibberellic acid (GA_3) was also applied in three levels viz., 20ppm, 25ppm and 30ppm after flower opening and control plans received no GA_3 'Uslu' is an early maturing olive cultivar in potahar region of Islamabad. Total number of inflorescence and flower developed were counted from each treatment after one week of foliar Boron application, while total perfect flowers were counted after flower opening a week later of Boron spray. Number of imperfect flowers was determined by subtracting from total number of flowers. Number of fruit set was counted after three week of pollination. The data was analyzed statistically by computer using 'statistics' 8.1' package and the means were compared using least significance difference (LSD) test at 0.05% significance level (Steel and Torrie, 1984). All data presented here is on the basis of fresh fruit set.

RESULTS AND DISCUSSION

Results regarding of all three characteristics showed significant difference among the treatments. The data regarding the effect of Boron and Gibberellic acid on percentage of perfect flowers, number of imperfect flowers, total inflorescence and fruit setting were recorded during 2010 (Table 1)

Number of Perfect Flower

Perfect flowers play an important role in fruit set and yield in olive. The data of both Boron and Gibberellic acid showed that all the treatments increased the percentage of perfect flowers, fruit set percentage over control. Maximum number of perfect flowers was observed in the treatment where Boron was applied @ 0.09% (7280), which was significantly higher than the treatments, where Boron was applied @ 0.06 %(55400) and @ 0.03% (2207). The largest number of perfect flowers was found with Gibberellic acid when GA3 was applied @ 30ppm (8760), which was followed by 25ppm and 20ppm, which were (4480, 2590). Obtained results of GA3 and Boron sprays are in line with those reported by Eman *et al*, (2007), however, they applied GA3 and Zinc, reported that the role of GA3 in improving fruit quantity namely, fruit weight and fruit size may be due to its role in increasing cell elongation. Increasing yield due to GA3 or Boron may be attributed to their effects on increasing levels of IAA.

Fruit Set Percentage on the basis of Perfect flowers

The data presented in Table 1 showed that fruit set percentage on the perfect flowers was significantly higher with the application, where GA_3 was applied @ 30ppm (26.50) than rest of the treatments and it was followed by the treatment (22.58) where GA3 was applied @ 25ppm and it was followed by treatment with GA3 @ 20ppm was found (15.18). Boron @ 0.09% had the minimum percentage of fruit setting (13.07) on the basis of perfect flowers. The Boron application in different concentrations did not produced good fruit setting indicating that Boron does not has good influence. Many researchers have now demonstrated that foliar application of Boron, immediately prior to flowering effectively increase the fruit set in olive trees (Arrobas *et al*., 2010)

Fruit set percentage on the basis of total number of flowers

Fruit set percentage provides the information about determining the production of the olive at economic and commercial level. The data regarding to fruit set percentage on the basis of perfect flowers indicated that in table 1, clearly showed that there was significant difference among the treatments for fruit setting percentage. The fruit set percentage on the basis of perfect flowers was significantly higher in treatment with GA_3 @ 30ppm (7.53%) followed by the treatment with GA_3 @ 25ppm (5.95%) and GA_3 @ 20ppm (3.32 %). Boron @ 0.09% had the

minimum percentage (2.23%) on the basis of total flowers. The Boron application in different concentrations did not produced good fruit setting , indicating that Boron does not has good influence on fruit setting percentage on the basis of perfect flowers. Increasing efficiency of GA_3 in fruit setting may be attributed to their effects on increasing of IAA. Enhancement and improvement of fruit setting could also be attributed due to the accumulation of carbohydrates and essential elements, which could have balanced C/N ratio in the leaves to a level, which enhanced the production of perfect flowers as well as increased the percentage of fruit setting. The obtained results are supported by Abd EL-Migeed (2002) on Washington navel and EL- Sharkawy and Mehaisen (2005) on guava.

Fruit Numbers

The number of fruits plays an important role on fruit yield in olive. As it is depicted from the data (Table 1), the number of fruits varied among the treatments. Maximum number of fruits 75.00 GA3 @ 30ppm and it was followed by GA3 @ 25 and 20ppm was 60.24 and 50.50. Boron also showed similar results, the best result in fruit numbers was found with Boron @ 0.09% 65 followed by 47.50 and 28.30 at 0.06 and 0.03%, respectively. Our results are in line with Ramezani and Shekafandeh (2007), however they used Zink sulphate and GA3 and reported that these treatments accelerated fruit growth of olive, and also increased both fruit size and total yield per tree.

Table 1. Effect of boron and gibberellic acid on growth and fruit yield of olive (*Olea europaea* L.) cv. GEMLIK.

Treatments	Perfect Flowers percentage	Fruit Setting % on the basis of perfect flowers	Fruit Setting % on the basis of total flowers	Fruit Number	Fruit Size (cm)	Fruit Weight (kg)
Control	1.280 e	5.387 d	0.4417 d	17.57 e	1.647 a	1.254 b
Boron @ 0.03%	2.207 de	7.450 cd	0.5980 cd	28.30 d	2.277 a	2.122 ab
Boron @ 0.06%	5.540 bc	9.120 bcd	0.9250 cd	47.50 c	3.142 a	3.156 a
Boron @ 0.09%	7.280 ab	13.07 bc	2.249 cd	65.30 b	3.372 a	3.442 a
GA3 @ 20ppm	2.590 de	15.18 b	3.321 bc	50.50 c	2.165 a	2.268 ab
GA3 @ 25 ppm	4.480 cd	22.58 a	5.945 ab	60.24 b	3.328 a	3.163 a
GA3 @ 30ppm	8.760 a	26.50 a	7.528 a	75.00 a	3.569 a	3.425 a
LSD < 0.05	2.450	7.309	2.822	7.831	1.969	1.832

Fruit Size

The data regarding fruit size, the maximum out-put was recorded with GA 30 ppm @ (3.56 cm) followed by GA_3 @ 25 ppm (3.33 cm). However, GA_3 applied @ 20 ppm produced (2.17 cm). Similar results were found with Boron application. Best result in fruit size achieved with application of Boron @ 0.09% (3.34 cm) followed by Boron treatments @ 0.06% and @ 0.03% i.e. (3.17 cm) and (2.28 cm) respectively. Minimum result in fruit size (1.485 cm) was found in control treatment. Our results are in line with Larbi *et al*. (2011), however they used Boron application and reported that these treatments accelerated plant growth and fruit growth of olive and also increased both fruit size total yield per tree. Overall non-significant results were recorded in fruit size.

Fruit Weight

The data regarding fruit weight as shown in Table 1 resulted that GA_3 sprays @ 30ppm had the best result than applying GA_3 at other concentration and control. Results regarding fruit weight as illustrated that GA_3 @ 30 ppm produced prominent (3.43 g) and (3.12 g) with GA_3 @ 25 ppm concentration respectively and it was followed by (2.27 g) at GA3 20 ppm. Boron treatments also showed significant response in fruit weight among each other. Most excellent (3.45 g) were produced by 0.09% and it was followed by (3.12 g) by 0.06% and (2.13 g) at 0.03% respectively. Most repulsive (1.16g) results were shown by control treatment. Response of GA3 in improving fruit quantity namely fruit weight and fruit size may be due to its role in increasing cell elongation. Moreover increasing fruit yield due to GA3 or Boron may be attributed to their effects on increasing levels of IAA (Rodrigues *et al.,* 2011).

CONCLUSION

The present study concluded that GA_3 @ 30 ppm and Boron @ 0.09% encouraged cell enlargement which in turn caused a significant improvement in the perfect flowers, fruit set percentage, fruit size and fruit weight. The

improvement that occurred in the fruit set could is attributed to the effects of plant growth regulators synthesis in growing fruits. It is recommended that GA_3 or Boron could be used for fruit set and yield enhancement.

REFERENCES

Abd El-Migeed, M.M.M. (2002). Improving productivity and fruit quality of Washington naval orange trees by using some macro-elements and GA3 sprays. *Egypt J. Appl. Sci*., 17(10): 787-801.

Arrobas, M., J. I. Lopes, F. Pavao, J.E. Cabanas and M.A. Rodrigues (2010). Comparative boron nutritional diagnosis for olive based on July and January leaf samplings. *Commun. Soil Sci. Plant Anal*., 41: 709-720.

Brown, P. H. (2001). Transient nutrient deficiencies and their impact on yield a rationale for foliar fertilizer. *Acta. Hort*., 564: 217-223

EL-Khawaja, A. S. (2003). Effect of girdling and foliar application of some nutrients on growth, flowering, yield and fruit quality of Manzaalillo olive trees grown in sandy soil. *J. Agric. Sci*., 28(3): 2124-2124.

EL-Khawaja, A. S. (2007). Improving growth and productivity of Manzaalillo olive trees with foliar application of some nutrients and girdling under sandy soil. *J. Agric. Res*., 3(9): 818-822.

El-Sese, A.M.A. (2005). Effect of gibberellic acid (GA3) on yield and fruit characteristics of Balady mandarin. *Assiut J. Agric. Sci*., 36(1): 23-35.

El-Sharkawy, S.H.M.M. and S. M.A.Mehaisen (2005). Effect of gibberellin and potassium foliage sprays on productivity and fruit quality of guava trees. *Egypt. J. Appl. Sci*., 20(3): 151-162.

Eman, A.A., M.M.M. Abd El-moneim, O. Abd El Migeed and M.M. Ismail (2007). GA3 and Zinc sprays for improving yield and fruit quality of Washington Navel Orange trees grown under sandy soil conditions. *Res. J. Agric. Biol. Sci*., 3(5): 498-503.

Larbi, A., K. Gargouri, M. Ayadi, A.B. Dhiab and M. Msallern (2011). Effect of foliar boron application on growth, reproduction, and oil quality of oil trees conducted under a high density planting system. *J. Plant Nutr*., 3: 2083-2094.

Payvandi, M., A. Dadshian, H. Ebrahimzadeh and A. Majid (2001). Embryogenesis and rhizogenesis in mature zygotic embryos of olive (*Olea Eropaea* L.) cultivars Mission and Kroneiki. *J. Sci. IR Iran,* 12(1): 9-15.

Perica, J., P.H. Brown, J.H. Connell and H. Hu (2002). Olive response to foliar B application. *Acta Hort*., 586: 381-382.

Ramezani, S. and A. Shekafandeh (2007). Roles of gibberellic acid and Zink sulphate in increasing size and weight of olive fruit. *African J. of Biotech*., 8(24): 6791-6794.

Rodrigues, M.A., F. Pavao, J.I. Lopes, V. Gomes. M. Arrobas, J. Moutinho-Pereira, S. Ruivo, J.E. Cabnas and C.M. Corriea (2011). Olive yields and tree nutritional status during a four year period without nitrogen and boron fertilization. *Commun. Soil. Sci. Plant Anal*., 42(7): 803-814.

Sabour, A. M. T. (2001). Influence of Calcium and Zink on controlling inflorescence malformation and improving fruiting of Hindy Bisinnara mango trees. *J. Agric. Sci*., 26(4): 2263-2269.

Soyergin, S. (2010). Effects of soil and leaf treatments to eliminate boron deficiency in olives. *Commun. Soil. Sci. Plant Anal*., 41: 2004-2010.

Steel, R.G.D. and J. H. Torrie (1984). *Principles and Procedures of Statistics. A Biological approach*, 2nd ed. MC Graw Hill Book CO, IUCN, NY, USA.

(*Accepted for publication January 2014*)