Proceedings of The World Avocado Congress III, 1995 168 - 171

THE EFFECT OF NITROGEN FERTILISER ON THE GROWTH, YIELD AND MINERAL CONTENTS OF LEAVES OF THE AVOCADO CV FUERTE

Marianthi H. Loupassaki
Subtropical Plants and Olive Trees Institute
73 100 Chania Crete Greece.

Abstract

The effect of nitrogen on the growth, yield and mineral contents of leaves of the cv Fuerte was studied in a 6-years experiment comprising four levels of urea-N fertiliser (N_0=0, N_1=0.5, N_2=1.0, and N_3=2.0 Kg of N per tree per year). The treatments were allocated in a 15 year-old avocado orchard in the area of Chania Crete, planted at 7 x 7 m.

Reduced fruit set occurred in the controls compared to the fertiliser treatments. On the other hand tree height and canopy diameter increased by 10-15% with N- fertiliser application. The average, over the six years of the experiment, yield per tree was 39.4, 63.08, 67.45 and 53.03 Kg of fruit for N_0, N_1, N_2 and N_3 respectively. Similar differences were obtained for the number of fruits per tree. Reduced fruit size was recorded in the controls but in the last two years only. Of the other parameters recorded, N application significantly affected the content of oil in the fruit but not the flesh/pit ratio or the (intense) alternate bearing pattern of Fuerte.

Leaf N as % d.m. increased with N fertiliser application (1.27, 1.52, 1.63, 1.80 for the levels N_0, N_1, N_2 and N_3 respectively). A variation of the content of N in the leaves was found between high and low yield years. Nitrogen fertiliser had a significant negative effect on the content of Zn and B in the leaves. Leaf contents for Zn and B varied between 25.0 and 20.6 (Zn) and 21.8 and 14.6 ppm (B) for the levels N_0 and N_3 respectively. The negative effect of N on the content of K in the' leaves was less pronounced (0.52 and 0.44 % leaf d.m. for the levels N_0 and N_3 respectively). The content of rest of the elements determined in the leaves seemed not to have been affected by N fertiliser application.

Additional index words: oil content, fruit-set, fruit weight

1. Introduction

Differences exist in the results of fertiliser experiment carried out in different parts of the world. In some places a marked increase in tree growth occurs with N application while there are reports that no response was observed. Thus avocado requirements for N fertilisation are reported to vary according to the type of soil or the cv (Oppenheimer and Kadman 1962, Young and Koo 1977, Gustafson 1979, Lahav and Kadman 1980, Androulakis and Loupassaki 1992). Studies with the cv Fuerte showed that yields could be limited with too low or too high level of nitrogen in the tree (Embleton and Jones, 1971. Koen and Langenegger, 1971. Loupassaki, 1995). On the other hand the relationship between the level of N in the leaves and the yield does not seem to be clear. For Fuerte the most productive range was found to be between 1.6 and 2% nitrogen in leaf dry matter.

The avocado in Crete is a new crop and the productivity of Fuerte is low. The present experiment was established to study the relationship between the level of N- fertiliser and the leaf N%, as well as to estimate the N-fertiliser requirements of Fuerte in Crete.

2. Material and methods

Four nitrogen fertiliser levels (N0=0, N1=0.5, N2=1.0, and N3=2.0 Kg of N per tree per year) in the form of urea, were applied to a young, 8 years old Fuerte orchard, in the area of Chania Crete, through the drip irrigation system. The trees in the orchard were grafted on the Topa - Topa rootstock and planted to 7 x 7m. Treatments were randomly allocated to 6 complete blocs comprising experimental plots of four trees with border rows. Half of the N- fertiliser was applied in March, 1/4 in July and the rest 1/4 in October. To evaluate the effect of the treatments leaf samples were collected in October (5-7 months old leaves) for leaf analysis (Androulakis and Loupassaki 1992). Besides the yield and the number of fruits per tree at harvest, fruit weight and oil content, the number of fruits set per 1000 flowers, tree height and canopy were recorded.

3. Results and discussion

The average, over the six last years of the experiment, yield per tree was 39.4, 63.08, 67.45 and 53.03 Kg of fruit for N_0, N_1, N_2 and N_3 respectively. Thus a sizeable drop of yield amounting to about 21% of the maximum was seen in the higher (N_3 = 2 Kg of N per tree) fertiliser level. The higher yields per tree, recorded in the period mentioned above, were 132.71 (N_1) and 131.00 (N_2 Kg/tree. In the same period, a strong alternate bearing pattern was observed (74.61, 28.60, 116.53, 3.20, 79.44, 32.21, Kg/tree for the last six, successive, years mentioned above); this alternating high and low yields pattern was not eased by nitrogen fertiliser application, but only in the last two years (6th and seventh, since the beginning of the experiment) when the moderate yields of the "on" yield year were followed by a substantial crop in the nitrogen treated plots only (Fig. 1). Similar differences were obtained for the number of fruits per tree.

The number of fruits per tree was directly related to the size of the yield and the alternation of high and low yields pattern. In the last four years of the experiment 543, 12.75, 388.5, 112.75 fruits per tree were counted, on average, at harvest. In the same period maximum numbers of fruits per tree (613 and 614) were found at the N, and N2 levels while a lower, by about 26% of the maximum number of fruits was recorded at the higher level of N. These data clearly suggest that N fertiliser affected fruit - setting and that the optimum fruit - set occurs at the levels N, and N_2 of nitrogen. Detailed observations on fruit - set confirmed that reduced fruit set occurred in the controls, compared to the fertiliser treatments (0.652, 1.025, 0.9, 0.86 fruits per 1000 flowers for N_0, N_1, N_2 and N_3 respectively). On the other hand tree height and canopy diameter increased by 10-15% with N-fertiliser application (Fig. 2). Fruit size, initially, was not affected. In the last two years of the experiment, however, reduced fruit size was recorded in the controls (Table 1). Of the other parameters recorded, N application significantly affected the content of oil in the fruit but not the flesh/pit ratio.

Leaf N as % d.m. increased with N fertiliser application (1.27, 1.52, 1.63, 1.80 for the levels N_0, N_1, N_2 and N_3 respectively). A variation of the content of N in the leaves was found between high and low yield years. Higher N contents in the leaves were found in the off year. (Fig. 3). As can be seen from Figure 4, nitrogen fertiliser had a significant negative effect on the content of Zn and B in the leaves. Leaf contents for Zn and B varied between 25.0 and 20.6 (Zn) and 21.8

and 14.6 ppm (B) for the levels No and N3 respectively. The negative effect of N on the content of K in the leaves was less pronounced (0.52 and 0.44 % leaf d.m. for the levels N0 and N3 respectively). The content of rest of the elements determined in the leaves seemed not to have been affected by N fertiliser application (Table 2).

4. References

Androulakis, I.I., and Loupassaki, M. H., 1992.Variation of mineral nutrient element contents of the leaves of four avocado cvs during the year. Proceedings of National Agr. Research Congress vol.1:467-481.

Davenport, T.L., 1982. Avocado growth and development. Proc. Fla. State Hort. Soc. 95:92-96. Embleton, T.W., and Jones, W.W., 1964. Avocado nutrition in California. Proc. Fla. State hort. Soc., 77:401-405.

Gustafson, C.D., 1979. Review of avocado fertiliser practices in San Diego County. Cal. Avoc. Society: 50-57.

Koen, T.J. and Ungenegger, W., 1971. Fertilisation of Fuerte avocados. Farming in South Africa, 30-32.

Koen, T.J., and Langenegger, W., 1981. Leaf analysis of the avocado. Farming in South Africa, E3

Lahav, E., and Kadman, A. 1980. Avocado Fertilisation. Bull. 6, Inter. Potash Institute, Berne.

Loupassaki, H.M., 1989. Studies on growth flowering and fruit set of avocado (Persea americana L.). Thesis for the degree of Master of science. CIREAM, PARIS, 9 1 pp.

Loupassaki, H.M., 1995. The effect of girdling, of germination of pollen and of genotype on the fruit set of avocado (Persea americana Miller).Ph.D. Thesis Aristotelian University of Thessaloniki.

Oppenheimer,C.H., and Kadman A., 1962. Normal nutrition and nutritional disturbances in the avocado. Final Rep. Nat. Univ. Inst. Agric., Rehovot, 43.

Young, T.W., Koo, R.C.J., 1977. Influence of soil and cultivar on mineral composition of avocado leaves in Florida. J. Amer. Soc. Hort. Sci., 102:308-311.

Table 1. Effect of N fertiliser application rate on several attributes of the avocado cv Fuerte

Attribute	N_0	N_1	N_2	N_3
Fruits per 1000 flowers	0.65	1.02	0.90	0.90
Fruit weight in grams	166.71	226.38	222.00	212.40
Content of oil in the fruit as % fresh weight	17.65	19.00	20.57	19.78

Table 2. Content of mineral elements in the leaves of Fuerte in relation to the level of N Fertiliser application.

Level of N	P	K	Ca	Mg	Fe	Mn	Cu
	as per cent leaf d.m.				in ppm		
N_0	0.10	0.52	1.83	0.67	54.00	113.00	7.00
N_1	0.09	0.41	1.87	0.72	58.00	112.00	6.00
N_2	0.10	0.45	1.69	0.66	55.00	103.00	8.00
N_3	0.10	0.44	1.82	0.63	54.00	123.00	8.00

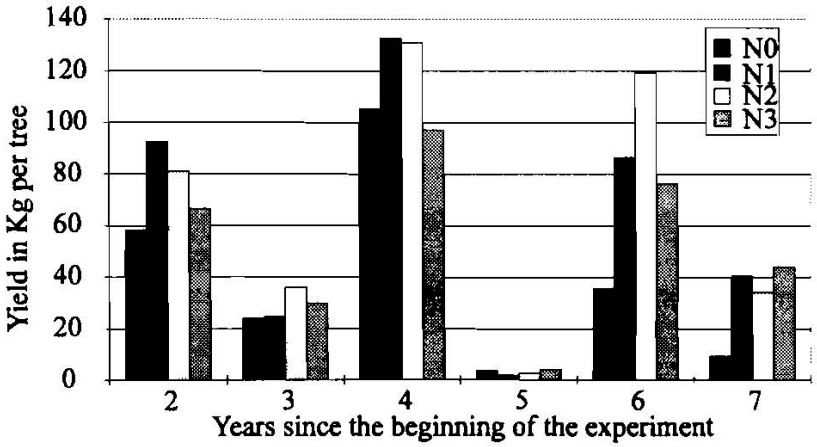

Fig. 1. Yield in Kg/tree of Fuerte in relation to the level of N fertiliser over six succesive years since the beggining of the experiment

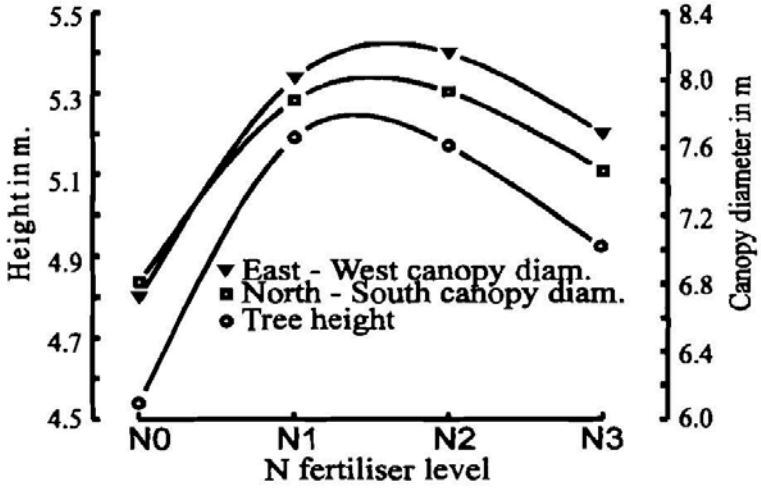

Fig. 2. Tree dimensions in relation to N fertiliser level

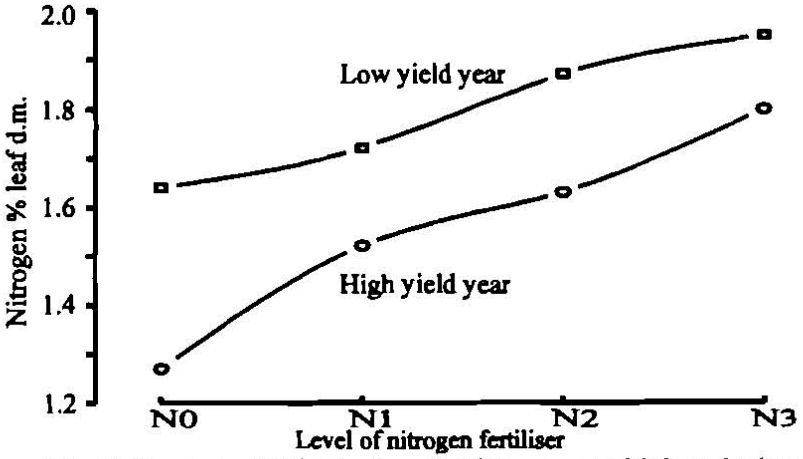

Fig. 3. Content of N in the leaves of Fuerte in a high and a low yield year in relation to the level of N fertiliser

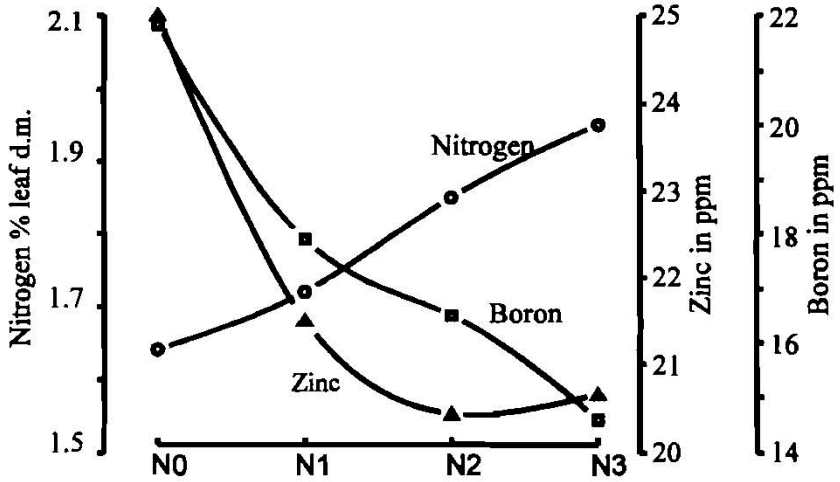

Fig. 4. Changes of the content of N, Zn and B in the leaves of Fuerte in relation to the level of N Fertiliser.