

## Influence of fertigation on seed quality coffee



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### ABSTRACT

Water availability and mineral nutrition are factors that affect the coffee crop and, when poorly managed, can cause excessive plant growth, delayed fruit maturation, leaching of soluble nutrients (mainly nitrogen), flower drop, higher occurrence of soil diseases and physiological disorders, higher energy costs and wear and tear of the irrigation system. This work was developed with the purpose of studying, among others, the effects of fertigation on the physical and physiological quality of coffee seeds produced in irrigated coffee plantations under different doses and installments of fertilization. In addition to the traditional system without irrigation and fertilized four times a year during the rainy season (control), five fertilization rates were studied, 70, 100, 130, 160 and 190% of the recommended for coffee fertigated by a drip system and two installments, twelve and four applications during the year. After harvesting the fruits at the cherry stage and drying, the seeds without parchment were submitted to analyses to evaluate the physiological quality, by means of the germination and vigor tests, and the physical quality, by the sieve retention test. It was concluded that the fertigation treatments used affect the physical quality of coffee seeds and do not affect the physiological quality.

**Keywords:** *Coffea arabica* L., Quality, Water.

## 1 INTRODUCTION

In areas where the dry season is well defined, such as the Brazilian Cerrado, the use of irrigation in coffee cultivation is essential, since in this region there are problems of water deficit (Silva et al., 2000). According to Santinato and Silva (2001), in order to obtain a crop formation with economic success, it is necessary to have an adequate formation of the seedlings, since it is a perennial crop where it will be conducted for many years. Nutrition is one of the determining factors in the development of coffee plants (Matiello et al., 2006). Water availability and mineral nutrition are vital factors during some phenological periods of the coffee plant, and can cause excessive plant growth, delayed fruit maturation, leaching of soluble nutrients (mainly nitrogen), flower drop, higher occurrence of soil



diseases and physiological disorders, higher energy costs and wear and tear of the irrigation system. Studies have shown, for example, that carbohydrate metabolism is very sensitive to changes in the water status of plants, and the accumulation of assimilates is affected by the availability of water and nutrients, among other factors.

Mengel & Kirkby (1982) observed that when an external water stress translates into an internal water deficit, there are a number of physiological and metabolic changes, reducing growth. Within this context, this work was developed with the purpose of studying, among others, the effects of fertigation on the physical and physiological quality of coffee seeds produced in irrigated coffee plantations under different doses and installments of fertilization.

## **2 MATERIAL AND METHODS**

The drip irrigation system was equipped with simultaneous control of fertilizer application in the three replications, and soil moisture was indirectly monitored by tensiometers installed at depths of 10, 25, 40 and 60 cm, whose readings were used to calculate water depths. In addition to the traditional system without irrigation and fertilized four times a year during the rainy season (control), five fertilization rates were studied, 70, 100, 130, 160 and 190% of the recommended for coffee fertigated by a drip system and two installments, twelve and four applications during the year.

To evaluate the quality of the seeds produced in this crop, after harvesting the fruits at the cherry stage, they were pulped and demucilated by submersion in water for 24 hours and washed in running water. After drying, the seeds without parchment were submitted to analyses to evaluate the physiological quality, by means of germination and vigor tests, and of the physical quality, by the sieve retention test. The experimental design was randomized blocks in a factorial scheme, with three replications.

## **3 RESULTS AND DISCUSSION**

It was found that the mean percentage of root protrusion was not influenced by fertilization levels (Table 1)



Table 1 – Average percentage of root protrusion of coffee seeds obtained from fruits harvested at different levels of fertilization in two installments

Doses	Installment	
	4 months	12 months
70 %	89.17 Aa α	90.50 Aa α
100 %	90.17 Aa α	89.67 Aa α
130 %	91.33 Aa α	87.83 Aa α
160 %	90.33 Aa α	87.67 Aa α
190 %	92.67 Aa α	83.83 From α
Test	87α	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by the Scott Knott test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

It was verified that these levels, even the lowest level of fertilization, did not affect the percentage of root protrusion of the seeds, not differing from the control. In the same table, it was observed that the 12-month installment at the 190% dose provided a lower percentage of root protrusion.

No effects of the treatments were found on the percentage of normal seedlings, strong normal seedlings, cotyledonary leaves and average root dry matter weight (Tables 2, 3, 4 and 5).

Table 2 – Average percentage of normal seedlings of coffee seeds obtained from fruits harvested at different levels of fertilization in two installments.

Doses	Installment	
	4 months	12 months
70 %	82.83 Aa α	81.50 Aa α
100 %	81.77 Aa α	80.83 Aa α
130 %	75.17 Aa α	77.33 Aa α
160 %	83.33 Aa α	75.50 Aa α
190 %	83.67 Aa α	76.00 Aa α
Test	76 α	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by the Scott Knott test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

Table 3 – Average percentage of strong normal seedlings of coffee seeds obtained from fruits harvested at different levels of fertilization in two installments.

Doses	Installment	
	4 months	12 months
70 %	36.33 Aa α	50.17 Aa α
100 %	27.67 Aa α	39.50 Aa α
130 %	28.33 Aa α	31.17 Aa α
160 %	52.83 Aa α	34.50 Aa α
190 %	35.50 Aa α	39.83 Aa α
Test	24 α	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by the Scott Knott test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

In general, it is observed in the average percentage of cotyledonary leaves a trend of higher averages in the 4th installment in the increasing doses.



Table 4 – Average percentage of cotyledonary leaves of coffee seeds obtained from fruits harvested at different levels of fertilization in two installments.

Doses	Installment	
	4 months	12 months
70 %	46.00 Aa $\alpha$	42.00 Aa $\alpha$
100 %	44.67 Aa $\alpha$	42.67 Aa $\alpha$
130 %	59.33 Aa $\alpha$	51.33 Aa $\alpha$
160 %	52.67 Aa $\alpha$	40.67 Aa $\alpha$
190 %	47.33 Aa $\alpha$	42.00 Aa $\alpha$
Test	42 $\alpha$	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by the Scott Knott test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

Table 5 – Average root dry matter weight of coffee seeds obtained from fruits harvested at different fertilization levels in two installments

Doses	Installment	
	4 months	12 months
70 %	0.53 Aa $\alpha$	0.53 Aa $\alpha$
100 %	0.49 Aa $\alpha$	0.55 Aa $\alpha$
130 %	0.59 Aa $\alpha$	0.51 Aa $\alpha$
160 %	0.53 Aa $\alpha$	0.46 Aa $\alpha$
190 %	0.48 Aa $\alpha$	0.55 Aa $\alpha$
Test	0,45 $\alpha$	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by Scott Knott's test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

These results differ from those found by Mauri et al. (2005), who found that a better mineral nutrition of the mother plants can positively influence the germination and vigor of the seeds and, consequently, provide more vigorous and better quality seedlings. However, they corroborate Lima et al. (2003) who did not observe the effect of fertilization on the physiological quality of coffee seeds.

Although no significant difference was observed in the percentage of normal seedlings (Table 2), there is a trend towards better results in the four-month installment plan and higher doses. It is also verified that for the 12-month installment plan, the higher the dosage, the lower the values of normal seedlings.

Differently from the other variables related to physiological quality, the mean hypocotyl dry matter weights (Table 6) showed significant differences between treatments. Higher mean hypocotyl dry matter weights were obtained using the 130% dose and 12-month installments. Laviola et al. (2007) found that coffee cultivars have statistically equal leaf dry matter weights, regardless of the level of fertilization to which the mother plants were submitted.



Table 6 – Average dry matter weight of the hypocotyl of coffee seeds obtained from fruits harvested at different levels of fertilization in two installments.

Doses	Installment	
	4 months	12 months
70 %	0.65Aa $\alpha$	0.65 A
100 %	0.63Aa $\alpha$	0.71No $\alpha$
130 %	0.68From $\alpha$	0.83Aa $\alpha$
160 %	0.69Aa $\alpha$	0.67The $\alpha$
190 %	0.51Bb $\alpha$	0.62Ba $\alpha$
Test	0,61 $\alpha$	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by the Scott Knott test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

All the variables studied related to the physiological quality of the seeds did not differ statistically from the control, unlike the variables related to the physical quality. It was found that, for sieve retention, there were significant differences between the treatments and the control (Tables 7 and 8). The control had a sieve percentage of 20 statistically higher than all the doses of the installment plan (Table 7). This indicates that, perhaps in this splitting, the higher doses may favor the obtaining of seeds from this sieve and not favor the physiological quality.

Sá (1994) commented that fertilization is one of the factors that can affect the size, weight and vigor of seeds, and, in many situations, these effects can be linked to the permeability and integrity of seed tissue membranes, since several nutrients act as enzymatic activators or as components of these membranes.

Table 7 – Average percentage of sieve retention 20 of coffee seeds obtained from fruits harvested at different levels of fertilization in two installments UFLA, Lavras - MG, 2011.

Doses	Installment	
	4 months	12 months
70 %	48.45Aa $\beta$	52.18Aa $\alpha$
100 %	40.60 Aa $\beta$	55.30Aa $\alpha$
130 %	47.17Aa $\beta$	55.21Aa $\alpha$
160 %	50.65Aa $\beta$	55.12Aa $\alpha$
190 %	53.72Aa $\beta$	54.18Aa ab
Test	63,74 $\alpha$	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by the Scott Knott test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

It was observed that in the 160% dose treatment, in addition to the sieve percentage values 20 not differing within the 4 and 12-month installments, they also did not differ statistically from the control (Table 8)



Table 8 – Average percentage of sieve retention 18 of coffee seeds obtained from fruits harvested at different levels of fertilization in two installments

Doses	Installment	
	4 months	12 months
70 %	36.96Aa $\alpha$	18.84From $\beta$
100 %	45.92Aa $\alpha$	24.52From $\beta$
130 %	32.15Aa $\beta$	25.32Aa $\beta$
160 %	34.65Aa $\alpha$	33.23Aa $\alpha$
190 %	22.04Aa $\beta$	31.31Aa $\alpha$
Test	20,16 $\beta$	

Averages followed by the same uppercase Arabic letter in the column and lowercase in the row do not differ from each other by the Scott Knott test at 5%. Treatment with the same Greek letter as the control in the spine does not differ from the same by the 5% Bonferroni t-test.

The results of this study showed the importance of adequate fertilization in the production of coffee seeds, since the results obtained so far are few and inconsistent, requiring further studies related to adequate doses and interference in seed production and quality (Imolesi et al., 2001). The recommendation of fertilizers for planting crops for seed production is generally similar to that used for grain production (Maeda et al., 1986).

#### 4 CONCLUSION

The fertigation treatments used affect the physical quality of coffee seeds and do not affect the physiological quality.



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