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Review of Arabica Coffee Nursery Management Research in Ethiopia

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Abstract
Forest soil or a mixture of top soils (TS), compost and sand (S) in 3 : 1: 0 and 2 : 1 : 1 ratios or blends of organic manure and TS in 1 : 4, 2 : 4 and 3 : 4 ratios resulted vigorous seedling growth. Applying 750 mg P or a combination of 2.31 g lime and 250 mg P pot^{-1} (2.5 kg sieved TS) ensured production of quality seedlings. Sowing coffee seeds at a depth of 1 cm with the grooved side placed down and embryo tip up had improved germination. Seedbeds covered with 3 - 5 cm thick mulch after seed sowing and watered at 2 days interval until hypocotyl emergence had higher germination percentage. After emergence, with the removal of mulch, nursery beds provided with 50% over head shade and irrigated twice a week until seedlings attained 2 to 4 pairs of leaves and then after at a week interval produced vigorous seedlings. Sowing clean coffee seeds after soaking in cold water for 24 hours hastened germination and seedling growth. Soft wood single node cuttings with one pair of leaves and blends of TS, S, and manure in 2 : 2 : 1 ratio was recommended for vegetative propagation of hybrid coffee.
Keywords: Arabica coffee, coffee nursery, seed germination, seedling growth, vegetative propagation

Introduction

Despite the existence of enormous genetic diversity of Arabica coffee and its importance in the national economy of Ethiopia, the per unit area national average yield of the crop is hardly exceeds 0.7 ton ha^{-1} clean coffee (Central Statistical Authority, 2012). This low productivity of the crop stems from a sundry of reasons. *Inter alia,* use of twisted, forked and whippy seedlings with undesirable shoot and root growth for field planting and erroneous management of the plant during the nursery period are the major constraints which accounts for low coffee yield in the country. These emanate from use of growing media not suitable for germination and seedling growth, improper depth of seed sowing and inadequate or excessive shading and watering during the nursery period (Institute of Agricultural Research, 1996; Yacob *et al.*, 1996; Tesfaye *et al.*, 2005; Anteneh *et al*., 2008).

Recognizing the problem several nursery management researches have been conducted aiming at promoting quality coffee seedling production for field planting in the country. Therefore, outstanding research achievements generated so far pertaining to coffee nursery management in Ethiopia are reviewed and briefly presented in this paper.

Research Findings

Nursery media

Coffee seedlings can be grown on raised beds (15 cm height) or in polythene tube (10 - 12 cm diameter and 22-25 cm height) filled with forest soil collected from the top 5 - 10 cm depth. However, in the absence of forest soil (FS), it was recommended to use blends of top soil (TS) and compost (C) only or TS, C and sand (S) following the order of 3TS : 1C : 0S > 2TS :1C 1S > 2TS : 1C : 0S > 6TS : 3C :2S (Figure 1). Likewise, Taye (1998) and Taye *et al*. (1999) revealed that a mixture of locally available organic manure and TS in 1 : 4, 2 : 4 and 3 : 4 ratios had promoted both shoot and root growth of coffee seedlings. However, if this media blends is suspected to be low in plant nutrients, addition of 2 g DAP/seedling after the seedling attain two pairs of true leaves would improved seedling growth (Taye *et al*., 1999).

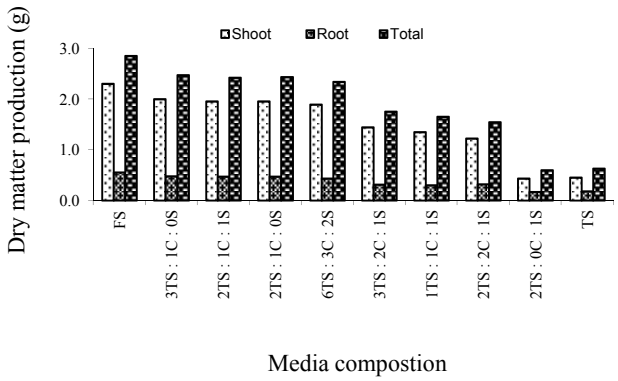

Figure 1. Effect of different media composition on dry matter production of coffee seedlings. TS = Top soil; C = Compost and S = Sand. *Source: Taye et al. (2002).*

Media amendment

It has been reported that application of 0 g lime and 750 mg P and 2.31 g lime and 250 mg P/pot (2.5 kg sieved top soil) produced seedlings with the higher dry matter yield (Figure 2). This was primarily associated to the rise in soil pH and precipitation of the exchangeable aluminum that fixes P and increase in solubility and availability of soil P to the seedlings (Anteneh and Heluf, 2007).

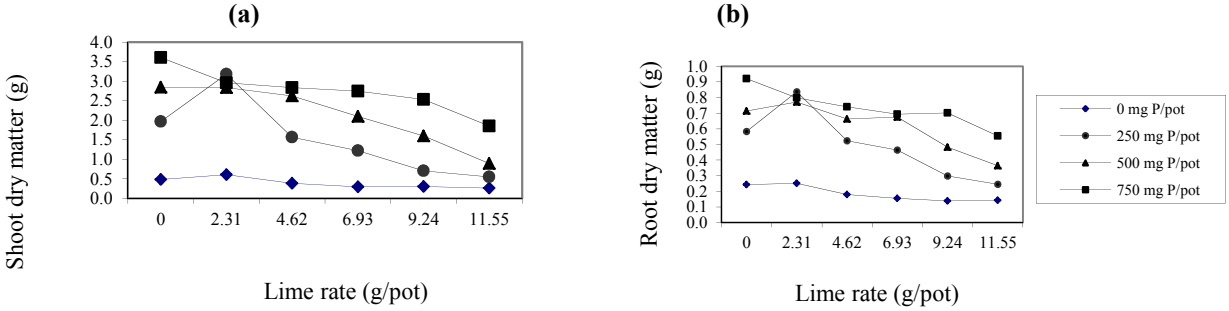

Figure 2. Effects of interaction of lime and P rates on shoot (a) and root (b) dry matter of coffee seedlings. *Source: Anteneh and Heluf (2007).*

Seed sowing

For maximum germination, coffee seeds should be sown at a depth of 1 cm with grooved side of the seed down and the embryo tip up. However, seed germination rapidly decline with sowing depth greater than 1 cm (Table 1).

Table 1. Effect of sowing depth and position of seeds on percent germination of coffee seeds.

Sowing depth (cm)	Seed position				**Mean**
	Grooved side		Embryo tip		
	up	down	up	down	
0	80.1	80.9	76.2	85.7	**80.7**
1	80.9	85.7	90.7	69.0	**81.6**
2	64.3	69.1	69.0	69.0	**67.9**
5	23.8	23.8	28.6	26.2	**25.7**

Source: Yacob (1986).

Watering seedbeds

It was observed that coffee seed beds covered with 3 - 5 cm thick mulch need to be watered at 2 days interval until seedling emergence during the dry season. After emergence by removing mulch and providing moderate overhead shade, watering seedbeds twice a week until seedlings attain 2 to 4 pairs of true leaves and then after at a week interval produced vigorous seedlings for field planting (Tesfaye *et al*., 2005).

Mulching seedbeds

Seedbeds covered with 3 - 5 cm thick mulch of straw or dried grass, banana or enset leaves etc., immediately

after sowing had resulted in significantly higher germination percentage than did mulch + shade and shade alone (Figure 3). Relatively higher germination response to mulch alone could be ascribed to regulation of the diurnal temperature in the nursery beds, which ensued from its insulating nature against fluctuations of diurnal soil temperature. However, the mulch should be removed and replaced by moderate (50 - 75%) overhead shade when the seedlings start to emerge.

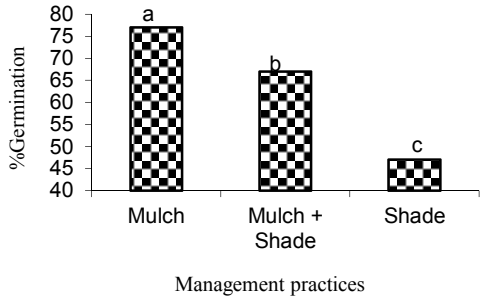

Figure 3. Germination percentage of coffee seeds as affected by mulch, shade and their combination. Bars capped with different letter(s) are significantly different at 0.01 probability level. *Source: Yacob (1986).*

Overhead shade

Provision of moderate level of over head shade (25 - 75%, but 50% is the best option) to coffee seedlings upon emergence and removal of mulch resulted vigorous seedling growth with the highest total dry matter yield and relative water content and improve moisture content of the rooting medium (Table 2). To harden the seedlings, it is recommended that the watering frequency and the overhead shade level should gradually be reduced one month ahead of transplanting to the field at a stage of six to eight pairs of true leaves (Tesfaye *et al*., 2005).

Table 2. Effect of shade level on growth and relative water content of seedlings (RWC) and media moisture content (MMC).

Shade level (%)	Plant height (cm)	Leaf number	TDM* (g) of seedling	RWC (%)	MMC (% by volume)
0	24.7^{c}	14.4^{c}	5.3^{c}	64.9^{b}	14.6^{b}
25	28.5^{b}	15.3^{b}	6.1^{b}	68.0^{a}	21.7^{a}
50	30.0^{a}	17.0^{a}	6.6^{a}	68.5^{a}	22.8^{a}
75	30.2^{a}	15.1^{b}	6.1^{b}	68.9^{a}	23.5^{a}

Means within a column followed by same superscript are not significantly different at 0.01 probability level. *TDM = Total dry matter. *Source: Yacob et al. (1996).*

Vegetative propagation

Research results showed that a combination of single node with soft wood cuttings with one pair of leaves taken from orthotropic shoot and rooting media composed of top soil, sand and manure in 2 : 2 : 1 ratio were recommended for propagation of hybrid coffee. It was observed that this practice resulted the highest rooting ability of stem cuttings (89.2%) and survival rate (63.3%) at hardening off stage (Behailu *et al*., 2006).

Conclusion and Recommendation

For maximum germination and seedling growth, coffee seeds should be sown in forest soil to a depth of 1 cm with the grooved side of the seed placed down. However, in the absence of forest soil, divers type of alternative potting media with ideal physical and chemical conditions like forest soil can be prepared by blending decomposed compost (C) and top soil (TS) or C + TS + sand in various proportions. Phosphorus at a rate of 750 mg P/pot (2.5 kg sieved top soil) and a combination of 2.31 g lime and 250 mg P/pot is also recommended for growing Arabica coffee seedlings at Jimma. Sowing coffee seeds at a depth of 1 cm with the grooved side placed down and embryo tip up had improved germination of coffee seeds. After sowing, seedbeds should be covered with 3 to 5 cm thick mulch (straw or other dried plant materials) and watered at two days interval until the seedling emergence. The mulch should be removed when the seedlings start to emerge. After emergence, the nursery beds should be provided with moderate (50%) overhead shade and watering frequency reduced to 4 and 8 days interval within a week until the seedlings attain 2 to 4 pairs of true leaves, respectively. Both watering frequency and shade level, however, should gradually be reduced one month before transplanting the seedlings to the field at the stage of six to eight pairs of true leaves. In the absence of micro propagation using tissue

culture, the practice of planting soft wood single node cuttings with one pair of leaves taken from orthotropic shoot in pot filed with a mixture of top soil , sand and manure in 2 : 2 : 1 ratio should be exploited for multiplication of hybrid coffee varieties using mist propagation.

References

Anteneh Netsere and Heluf Geberekidane. 2007. Response of Arabica coffee seedling to lime and phosphorus: II. Dry matter production and distribution. p. 1095-1100. *In:* International Conference on Coffee Science, 21st , Montpellier, 11th – 15th September 2007. ASIC, France.

Anteneh Netsere, Endale Taye, Tesfaye Shimber, Taye Kufa and Amanuale Asrat. 2008. Pre-planting Management of Arabica coffee in Ethiopia. Pp 178- 186. *In:* Proceedings of a National Workshop Four Decades of Coffee Research and Development in Ethiopia, 14-17 August 2007, Addis Ababa, Ethiopia.

Behailu Atero, Gibramu Temesegen and Bayetta Belachew. 2006. Effect of type of cutting and media mixture on rooting ability of Arabica coffee hybrid. Pp. 135-138. *In:* Proceedings of the Eleventh Conference of the Crop Science Society of Ethiopia, 26-28 April 2004, Addis Ababa, Ethiopia. Sebil Vol. 11.

Central Statistical Authority. 2012. Agricultural sample survey 2005/06 (September 2005 – February 2006). Volume I. Report on area and production of crops (private peasant holdings, Meher season). Statistical bulletin 361, Addis Ababa, Ethiopia.

Institute of Agricultural Research (IAR). 1996. Recommended production technologies for coffee and associated crops. Addis Ababa, Ethiopia.

Taye kufa 1998. Response of Arabica coffee (*Coffee Arabica* L.) to various soil fertility management. M.Sc. Thesis

Taye Kufa, Mesfin Abebe and Paulos Dubale. 1999. Effect of nitrogen, phosphorus and organic fertilizer on growth and development of coffee seedlings. Pp. 213-223. *In:* Proceedings of African Crop Science Conference. African Crop Science Society, Vol. 4, Kampala, Uganda.

Taye Kufa, Tesfaye Shimber and Alemseged Yilma. 2002. Influence of media mixture and watering frequency on seed germination and seedling growth of Arabica coffee in Ethiopia. *In:* International Conference in Coffee Science, 19th, Trieste, 14-18 May 2001. ASIC, Italy.

Tesfaye Shimber, Alemseged Yilma, Taye Kufa, Endale Taye and Anteneh Netsere. 2005. "Coffee seedlings management and production." Amharic version, Ethiopian Agricultural Research Organization, Addis Ababa, Ethiopia. 17pp.

Yacob Edjamo. 1986. Review of coffee nursery trial at Melko. Paper presented on the First National Coffee Symposium in Ethiopia, 21-26 August 1986, Addis Ababa, Ethiopia.

Yacob Edjamo, Tesfaye Shimber, Alemseged Yilma, Anteneh Netsere, Takele Negewo, Mohammednur Abachebsa and Bekele Bogale. 1996. Advances in coffee agronomy research in Ethiopia. p. 40-45. *In* Proceedings of Inter Africa Coffee organization (IACO) Workshop, 4-6 September 1995, Kampala, Uganda.

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