Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.9, 2015

Recommendation on Pre-sowing Arabica Coffee Seed Management in Ethiopia

Anteneh Netsere
Jimma Agricultural Research Center, P. 0. Box 192, Jimma, Ethiopia
E-mail: anetsere18@ygmail.com

Abstract
Pre-sowing seed management includes all operation involving seed collection, preparation and handling, and pre-germination seed treatment. With regard to this, research results show that seeds of red ripe cherries dried with intact parchment under shaded and ventilated condition showed enhanced germination. Coffee seeds with moisture content grater than 40% when stored in moisture vapor barrier containers, *viz.* glass jar and polythene bag had retained their viability and vigor for a longer period. However, sowing coffee seeds immediately after harvesting and processing was found to be the best option for higher germination rate and better seedling growth. Pre-germination is the primary cause of multiple and crooked tap roots and eventual tree death in the field. Sowing clean coffee seeds after soaking in cold water for 24 hours hastened germination and seedling growth.

Introduction

Despite the existence of enormous genetic diversity of Arabica coffee and its importance in the country's economy, productivity of the crop is very low (0.7 ton ha^{-1} green coffee) as compared to other coffee producing countries (Central Statistical Agency, CSA, 2012). Such low level of productivity of the crop stems from erroneous management of the plant during the initial stage of establishment in the field and the use of weak and whippy seedlings with undesirable shoot and root growth for field planting. This emanates mainly from poor seed preparation and handling, use of deteriorated seeds and growing media not suitable for germination and seedling growth, improper depth of seed sowing, and pre-germination practices (Wondyifraw, 1994; Tesfaye *et al.*, 2006; Anteneh *et al*., 2008).

In view of this, several pre-sowing seed management practices have been tested aiming at improving the viability and germination of seeds and production of quality coffee seedlings in the country. These include seed preparation and handling, pre-sowing seed treatment and pre-germination practices. Thus, available research findings and techniques generated so far in the aforementioned areas in Ethiopia are summarized and discussed in this paper.

Research Findings

Stage of fruit maturity and seed drying

Stage of harvest of the cherries, the condition of processing and drying affect germination of coffee seeds. In line with this, results revealed that red ripe cherries are the best stage of maturity for seed purpose (Figure 1a). After pulping the cherries and removing the floaters, drying parchment intact seeds in a well aerated, cool and shaded condition till they attained the desired moisture level before sowing/planting or further storage ensured higher germination percentage (Figure 1b).

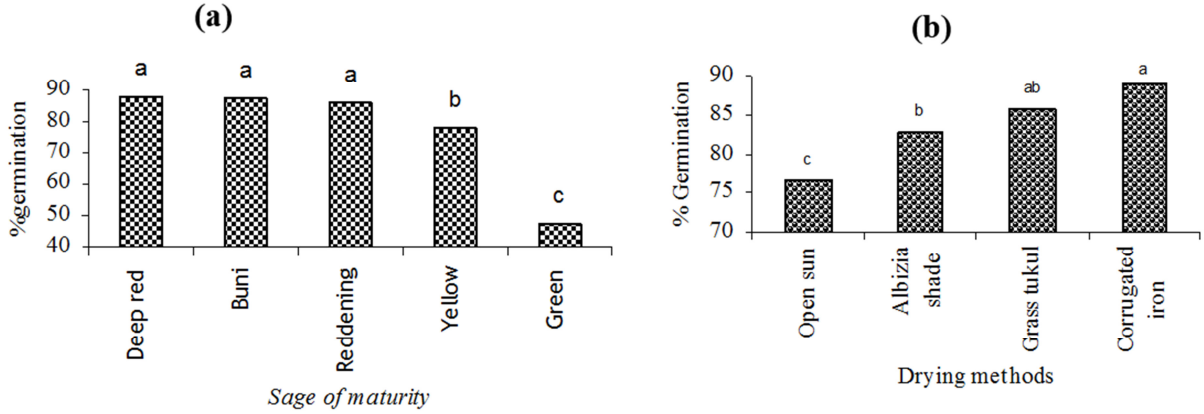

Figure 1. Germination of coffee seeds as affected by stage of fruit maturity (a) and drying condition (b). Bars capped with same letter(s) are not significantly different at 0.05 probability level. *Source: Anteneh et al. (2008*)

1.2. Seed storage time

Studies revealed that coffee seed germination percentage, percentage of seedling emergence (%E) and seedlings attained first true leaves (%FTL) decreased gradually since the second month and rapidly after the third month of storage (Figure 2 and Table 1). Besides, mean days to germination (MDG) and mean days to first true leaves (MDFTL) consistently delayed with prolonged storage time (Table 1). Thus immediate sowing after harvesting and processing is always the best option for higher germination and subsequent growth (Wondyifraw, 1994; Tesfaye *et al*., 1998).

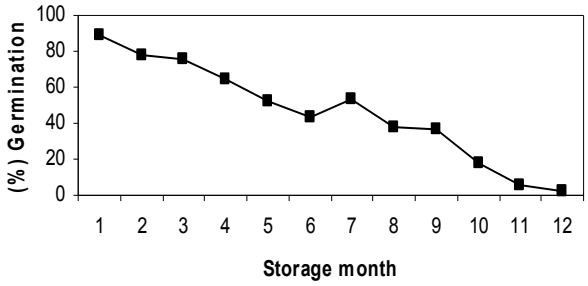

Figure 2. Effect of time of storage on germination of coffee seed. *Source: Tesfaye et al. (1998*)

Table 1. Effect of time of storage on coffee seed germination and subsequent growth performance of seedlings

Storage time in month	%E	%FTL	MDG	MDFTL
0*	93.9a	88.4[a]	32.2[f]	94.2[f]
1	84.4b	76.2[b]	39.6[e]	99.4[e]
2	81.0c	76.9[b]	41.6[d]	105.4[d]
3	78.0d	69.2[c]	44.[7c]	109.5[c]
4	55.5e	51.7[d]	52.1[b]	114.2[b]
5	51.0f	43.6[e]	59.9[a]	116.3[a]

Figures followed by same superscript letters within a column are not significantly different at 0.01 probability level. *The time just at the date of storage. %E = Percentage of seedling emergence; %FTL = percent age seedling attain first true leaves; MDG = Mean days to germination and MDFTL = mean days to first true leaves. *Source: Wondyifraw (1994)*

Seed moisture content and types of container

A combination of high initial seed moisture level (not less than 40%) and moisture vapor barrier containers relatively better preserved coffee seed viability longer and improve growth of coffee seedlings. Accordingly, Wondyifraw (1994) reported a combination of seeds with moisture content of 55.2% and glass jar resulted 97.5, 84.5 and 89.1% values for seed germination, seedling emergence and seedlings attain first true leaf stage after five months of storage. While seeds stored at 45.2% moisture content in plastic bag resulted 89.0, 82.0 and 86.3% values for the respective parameters (Figure 3 a, b and c).

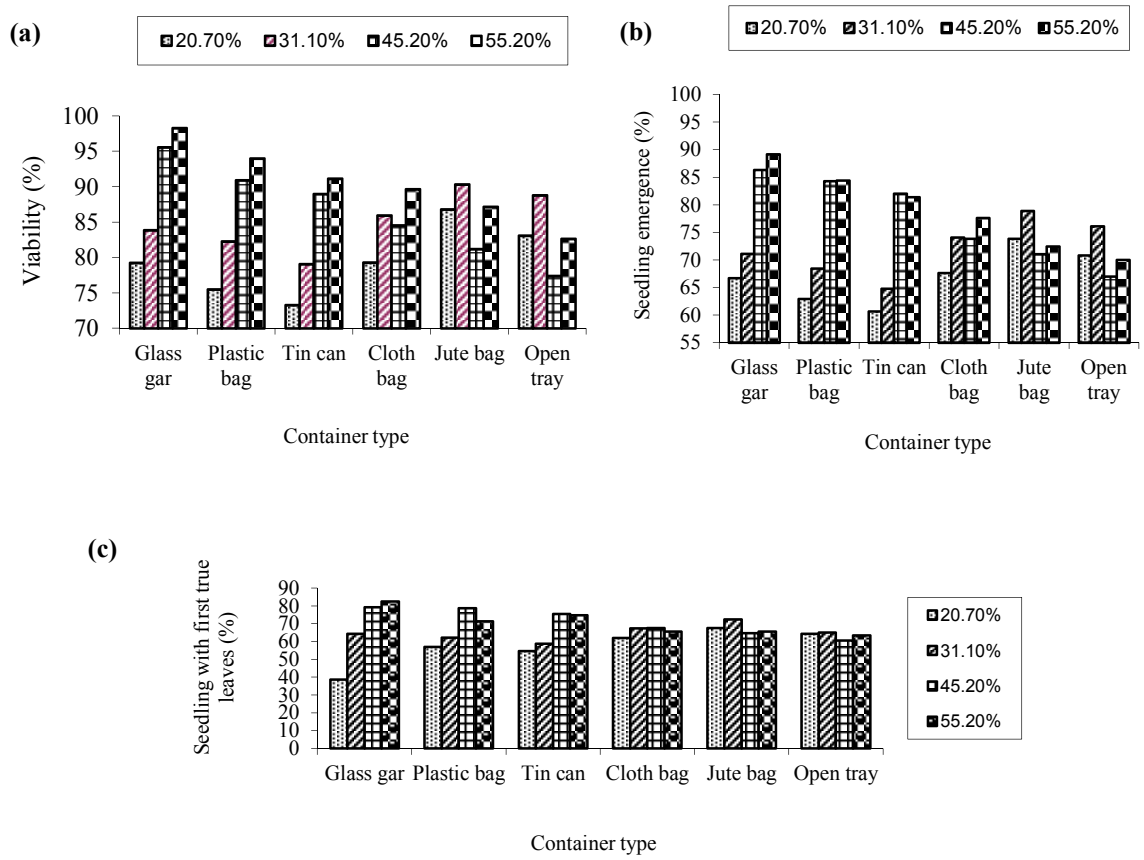

Figure 3. Effect of initial seed moisture level and type of container on coffee seed viability (a), seedling emergence (b) and seedling attain first true leaves growth stage (c). Source: *Wondyifraw (1994)*

Pre-germination practices

Available reports showed that pre-germinated and planted seeds had resulted large percentage of seedlings with deformed roots, *viz.* multiple and crooked tap roots (MTR and CTR, respectively) than sowing *in situ* in permanent bed (direct sowing) (Table 2). The practice can also delay the growth of seedlings and thus large percentage of cotyledon and first pair of true leaves was initiated much earlier from direct sowing than pre-germination practice (Fig. 4a and b). Hence, coffee seeds should be seeded directly in seedbeds or polythene tube for the production of seedlings with normal root system than following the pre-germination techniques.

Table 2. Effect of planting normal (not pre-germinated) and pre-germinated coffee seeds in conventional seedbed, and fine (sieved) and course (unsived) soils filled in polythene tube on percentage of multiple tap root (MTR) and crude tap root (CTR)

Treatments	Fine soil		Coarse soil		Conventional seedbed	
	MTR	CTR	MTR	CTR	MTR	CTR
PGS	31	66	32	70	20	66
DS	1	24	6	20	0	30
LSD $_{(0.05)}$	7.4	21.5	7.4	21.5	-	-
$_{(0.01)}$	10.1	29.5	10.11	29.5	-	-

PGS = Pre-germinated seed, DS = direct sowing (not pre-germinated seeds), MTR = Multiple tap root and CTR= Crooked tap root. *Source: Bayetta and Mesfin (2005*)

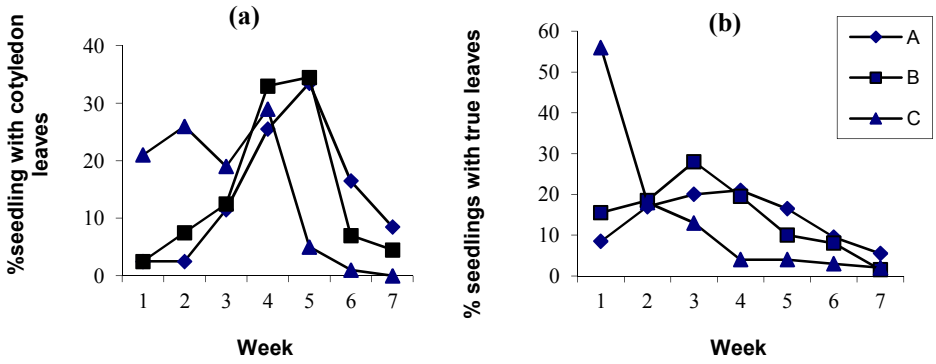

Figure 4. Weekly differences in the proportion of seedlings with cotyledon (a) and first pair of true leaves (b) for treatments A= Pre-germinated and planted in polythene tube, B = Pre-germinated and planted on conventional seedbed, and C= Direct sowing on seedbed. *Source: Bayetta and Mesfin (2005*)

2.2. Parchment removal and seed soaking

Sowing parchment removed coffee seeds had significantly promoted mean days to emergence as compared to parchment seeds (Figure 5). The practice could also enhance seedling growth (Table 3) and shortens the nursery period by about four weeks (data not presented) (Taye and Alemseged, 2007). Though the difference is not considerable, soaking coffee seeds in cold pure water for 24 hours immediately before sowing had improved rate of emergence, particularly during the early stage after sowing (Figure 5), and produced vigorous seedlings than unsoked seeds (Table 3).

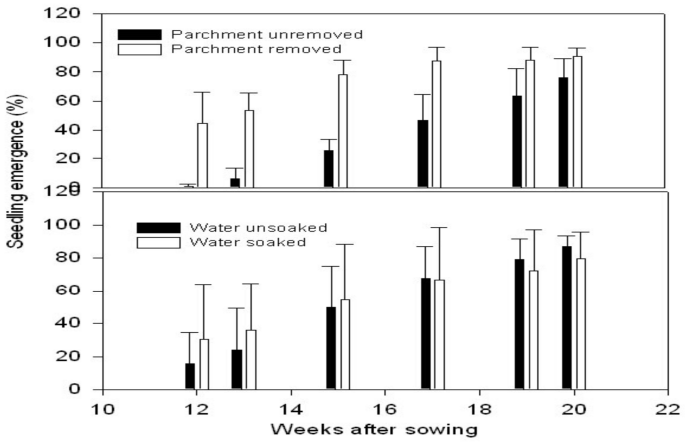

Figure 5. Effect of pre-sowing seed treatment on rate of seedling emergence of Arabica coffee seedlings. (*Source: Taye and Alemseged* (*2007)*

Table 3. Growth parameters (means ± SD) of coffee seedlings as influenced by pre-sowing seed treatments

Growth character	Parchment removal		Water soaking	
	Unremoved	Removed	Unsoaked	Soaked
Height (cm)	28.02 ± 6.16	28.77 ± 2.89	27.33 ± 3.24	29.46 ± 5.78
Stem diameter (cm)	0.46 ± 0.08	0.49 ± 0.05	0.46 ± 0.04	0.48 ± 0.08
No. of true leaf pair	7.00 ± 0.32	7.50 ± 0.89	7.00 ± 0.71	7.50 ± 0.63
Shoot dry matter (g)	2.88 ± 1.03	3.60 ± 0.86	3.15 ± 0.63	3.32 ± 1.30
Root dry matter (g)	0.70 ± 0.22	0.77 ± 0.16	0.72 ± 0.19	0.74 ± 0.20
Total dry matter (g)	3.58 ± 1.22	4.36 ± 1.01	3.88 ± 0.78	4.06 ± 1.50
RGR* (g month^{-1})	0.58 ± 0.26	0.74 ± 0.20	0.62 ± 0.21	0.70 ± 0.31

*RGR = Relative growth rate. (*Source: Taye and Alemseged (2007*)

Conclusion and Recommendations

Coffee seeds to be used as a seed material should be prepared from cherries picked at red ripe stage. Then, after pulping the cherries and removing the floaters, seeds with their parchment intact should be dried under shade and ventilated conditions as these reduces the drying temperature, which other wise can injure its germinability. Farmers who want to store coffee seed for sowing should store seeds having initial moisture content of >40% in

well sealed moisture proof containers, depending on their availability, cost incurred, durability and easiness for handling, under cool and dry condition. However, if condition forces to use pores or moisture-vapor permeable container, viz. cloth bags, fiber sacks, open tray, etc., the moisture content of the seed can be reduced to <32%.

Planting pre-germinated seeds should not be practiced by farmers as it results in large percentage of seedlings with malformed root system and eventual early (forth to fifth bearing) tree death in the field. Hence, coffee seeds should be seeded directly in seedbeds or polythene tube. However, if seed viability is doubtful, two seeds per hole should be seeded and then thinned to one plant. Furthermore, coffee seeds should be sown after removing the hard seed cover (parchment) and soaking the seeds in cold water for 24 hours as the practices enhance germination and seedling growth.. These can also be shorten the nursery period and reduce the associated costs.

References

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.

Bayetta Belachew and Mesfin Ameha. 2005. Effect of coffee seeds pre-germination practice on tap root development. p. 1004-1007. *In* Int. Conf. Coffee Science, 20th, Bangalore, 11-15 October 2004. ASIC, India.

Central Statistical Agency (CSA). 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.

Taye Kufa and Alemseged Yilma. 2007. Emergence and growth of Arabica coffee seedlings as influenced by some pre-sowing seed treatments. p. 1188-1195. *In* Int. Conf. Coffee Science, 21st , Montpellier, 11th – 15th September 2007. ASIC, France.

Tesfaye Shimber, Yacob Edjamo, Alemseged Yilma and Taye Kufa. 1998. Research achievements and transferable technology in coffee agronomy. P. 70-79. *In* Proceedings of the Third Technology Generation, Transfer and gap Analysis Workshop. 12-14 November 1996, Nekemet, Ethiopia.

Wondyifraw Tefera. 1994. The influence of duration of storage, initial moisture content and type of container on the viability of coffee (*Coffea arabica* L.) seeds. M. Sc. thesis, Alemaya University of Agriculture, Alemaya, Ethiopia.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar