Methodology Article

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An improved device for coconut embryo extraction

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The extraction of coconut embryos is essential for embryo culture, which is an invaluable tool for international germplasm exchange (Engelmann *et al*., 2011), cryopreservation (Sajini *et al.,* 2011) and rescue of non-germinating recessive mutants such as Makapuno (Rillo, 1999). The field collection of coconut embryos from exotic places requires fast and efficient embryo extraction method in a short available time. Further, the plumule culture technique that can be used for fast multiplication of elite coconut hybrids also requires the extraction of large numbers of coconut embryos. The commonly used tool for embryo extraction consists of a hollow metal tube with serrated margins at one end. The serrated end of the stainless steel tube is positioned around the embryo which is visible as a minor depression on the surface of the kernel and is pressed hard and turned to extract a cylinder of kernel. The cylinder of kernel is then washed/surface sterilized with sterilants and split open with a knife to extract the coconut embryo located inside the kernel. The stainless steel metallic tube currently used for embryo extraction cause reddening and injuries to palms as there is no specific protection mechanism. The grip is also very poor and often requires exertion of more pressure and hence not user friendly. Moreover, the extracted kernel often gets struck up inside the kernel and efforts are required to manually pull out the cylinder either through fingers or hooked forceps. Hence, an efficient tool was designed to overcome the above mentioned problems encountered by using the commonly used coconut embryo extraction device.

The improved coconut embryo extractor consists of a hollow metallic stainless tube of 25 mm in diameter; 150 mm in length and 1 mm in thickness with serrated margins of 10 mm deep at one end (Fig. 1A) and is similar to the currently used device. The teeth of the serration are cut with tapering cut in clockwise wise direction to provide a sharp edge to slice through the kernel while turning the extractor. The following three modifications were made in the currently used device that improves the embryo extraction device. Firstly, the top end of the extractor is fitted with a smooth and curved stainless dome (Part 3 in Fig. 1A) that protects the extracting person's palm from injuries and pain. Secondly, a 5 mm diameter stainless steel tube is fitted by drilling hole inside the tube and welded for better grip and handling (Part 4 in Fig. 1A). Thirdly an ejector mechanism is fitted inside the extractor and screwed from outside the tube (Parts 5 to 10 in Fig. 1A). The ejector consists of a shaft (Part 5 in Fig. 1A), the outer end of which is fitted with a curved round knob made of aluminium (Part 6 in Fig. 1A) of the size of the inner diameter of the tube. A spring is fitted between the knob and the trigger holder (Part 8 in Fig. 1A). An L-shaped slit was provided on the stainless steel tube of the extractor (Part 10 in Fig. 1A). The other end of the shaft is fitted with a trigger that can slide through the vertical L-shaped cut on the extractor (Part 9 in Fig. 1A) and the trigger gets struck or can be locked on the horizontal slit on the L-shaped cut. The trigger slit is positioned in such a way that the trigger can be

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operated easily by index finger while holding the extractor.

The coconut from which the embryo is to be extracted is first dehusked and the raw nut is split into two halves. The extractor is held in the right hand and the trigger is pulled back by index finger and locked in the slit (Fig. 1B and 1C). The one-half containing the coconut embryo (identified by three eyes like depression on the outer shell) is held on the left palm and the extractor held in the right palm is bored inside the region of the kernel where the embryo resides. The tapering edges of the serrated teeth slices through the kernel and a kernel cylinder piece detaches and remains inside the cylindrical tube. The cylinder is ejected by releasing the trigger by the index finger (Fig. 1D). The process is repeated for each coconut until the required number of kernel cylinders containing the

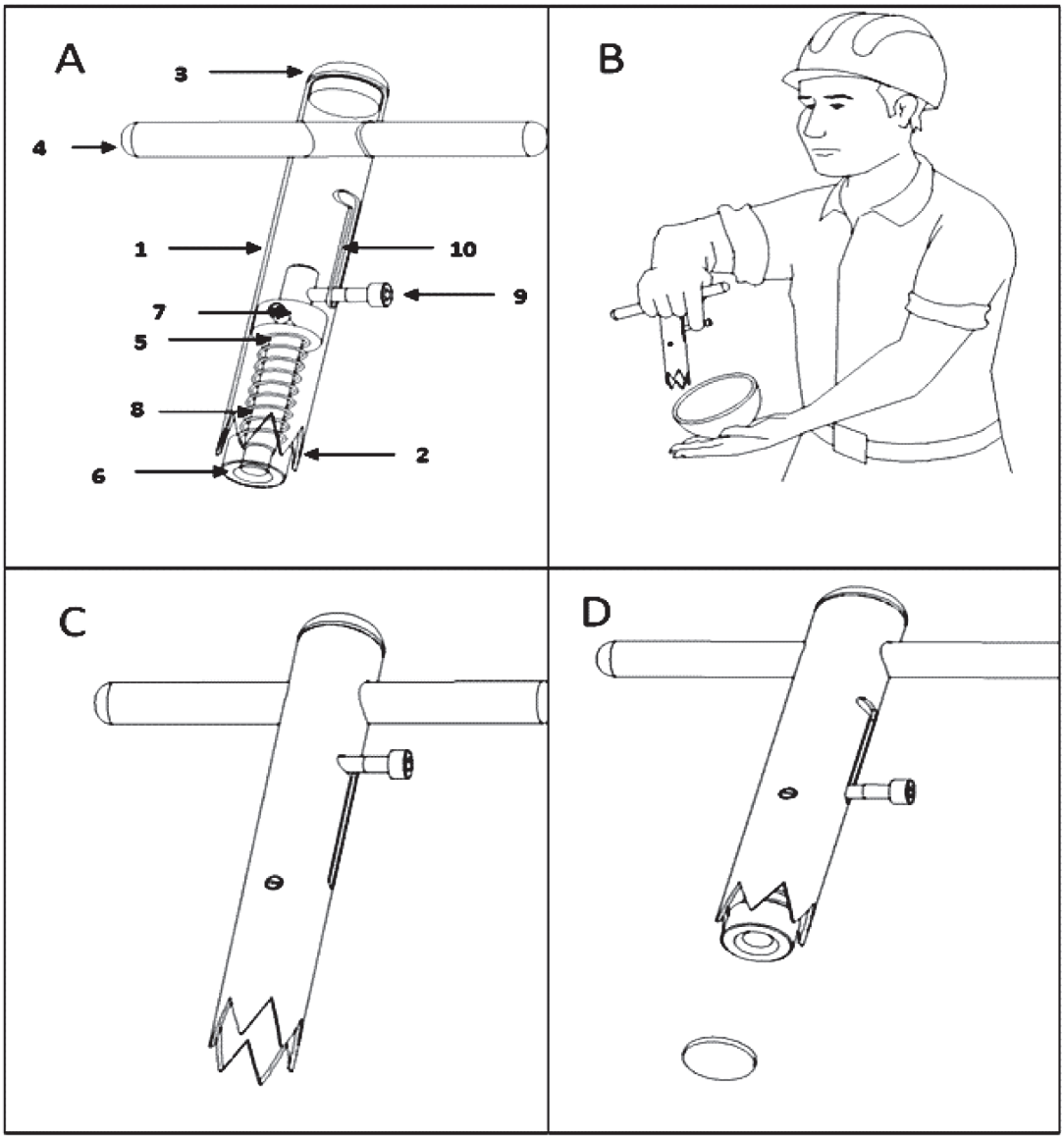

Fig. 1 A. Parts and detailed mechanism of the improved coconut embryo extractor (1) stainless steel tube (2) serrated edges (3) smooth stainless steel dome (4) hand grip (5) shaft (6) aluminium knob (7) ejector holder (8) spring (9) trigger (10) trigger movement slit. B. Coconut embryo extraction in process. C. Extractor (before embryo extraction). D. Extractor ejecting the coconut cylinder after release of the trigger

embryos is extracted. The embryos can then be extracted from the kernel cylinders by making an incision and splitting open to take out the embryo from inside.

The improved coconut embryo extractor weighs slightly heavier at 140 g as compared to the earlier model which has a weight of 95 g; but the new device is easy to handle. It provides a firm grip for twisting the device and churns out a neat one inch diameter kernel cylinder with embryo inside. The efficiency of embryo extraction can be increased due to increased palm protection and therefore relief from excruciating pain by the smooth dome provided in the modified tool and by saving time due to ease in removing the kernel cylinder from the tube. There is no necessity to use hand or forceps to remove the stuck-up kernel cylinder that will improves the overall hygiene and reduced microbial contamination. Ashburner *et al.* (1999) reported that, during germplasm collection from remote locations, higher contamination rate was observed and it affects the viability of the embryos. This simple extractor can reduce contamination due to its hands-free design to handle the coconut cylinders. The kernel scrapings clinging on to the sides of the inner region of the extractor is removed by the aluminium knob while pushing the kernel cylinder, keeping the extractor free from accumulating debris. This device will be useful for rapid collection of coconut zygotic embryos from field.

Embryo extraction is a prerequisite for embryo culture and plumule culture experiments in coconut. The current tools for embryo extraction suffer from deficiencies that affect the efficiency of embryo extraction. The improved device works like a metallic protective dome fitting for protecting extracting person's palm, has a handle for better grip and an ejector mechanism for expelling out the coconut cylinder and kernel waste scraps from the extraction tube. This new device improves the efficiency of embryo extraction and it would be a valuable tool for coconut embryo related experiments.

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