

MPOB AUTO LYSIMETER SYSTEM (AUTO LYS) FOR LEACHING STUDIES

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Fertilizer management practices are very important in oil palm cultivation for high yield production and to minimize negative impact on the environment. Nutrients applied as fertilizers are subjected to losses in the dissolved form via surface runoff, erosion, volatilization, leaching and fixation in the soil. For example, higher rates of fertilizer application per unit area (within the palm circle) encourage nutrient losses through leaching in an oil palm ecosystem (Corley and Tinker, 2003). Nutrients that are highly soluble and mobile such as nitrate and potassium salts are susceptible to leaching losses. The soils become more acidic if the base nutrients are leached out from the root zone. Leaching of soil nutrients leads to on-site nutrient depletion which can affect crop productivity (Oldeman, 1994). Losses of nutrients and agrochemicals through leaching down the soil profile increase groundwater contamination and may potentially threaten human and ecosystem health.

In an oil palm plantation, measuring nutrient losses through leaching requires the collection of leached water within the top 60 cm of the soil profile in a non-destructive manner. This requires high quantities of lysimeter tube samplers and efficient vacuum pumps. However, imported ready-made lysimeter tubes and vacuum pumps from a specialized soil-testing equipment supplier are expensive. Therefore, fabricating such devices from locally available materials at significantly lower cost is highly desirable to facilitate their use in nutrient leaching studies.

PRODUCT DESCRIPTION

The MPOB Auto Lysimeter System (Auto Lys) was designed for use in leaching studies under oil palm. It consists of a PVC lysimeter tube of 100 cm length and a battery-operated vacuum pump. Fabrication of the Auto Lys from locally available materials (with the exception of the porous ceramic cup) was done in-house by a laboratory technician. The assembled lysimeter tube (Figure 1) consists of a porous ceramic cup with an outside diameter of 22 mm which is bonded to a 100-cm long PVC pipe. Two holes are bored in the upper portion of

the lysimeter tube through which hollow stainless steel rods are fitted. A short stainless steel rod is used to create a vacuum to the lysimeter tube while a longer rod is connected to a PU tube (2.5 mm diameter) which reaches the bottom of the ceramic cup for sample retrieval.

The assembled lysimeter tube must be air-tight to ensure its effectiveness. An air-leak test can be done by completely immersing the assembled lysimeter tube in water with 15 psi air pressure. A leakage is detected when air bubbles form at any connecting part.

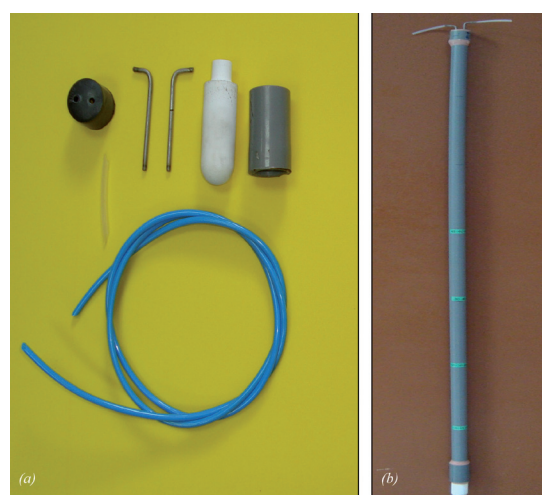


Figure 1. (a) Lysimeter tube parts to be fitted to the PVC tube; (b) Fully assembled lysimeter tube of 100 cm length.

The second component of the MPOB Auto Lysimeter System is the battery-operated vacuum pump (Figure 2). Lysimeter tubes are generally installed in the field where electricity supply is not available. This locally-fabricated vacuum pump is designed with four valves which are able to vacuum four lysimeter tubes simultaneously in the field. The battery-operated vacuum pump which weighs 12 kg draws enough of a vacuum (maximum vacuum: -76 cmHg or -1.01 bar) to extract pore water into the suction lysimeter tube.

A set of the lysimeter system per unit area consists of four tubes. These lysimeter tubes are installed at depths of 15, 30, 45 and 60 cm from the soil surface (Figure 3). To obtain leached water from





Figure 2. Battery-operated vacuum pump (which provides a vacuum of up to -76 cmHg or -1.01bar).

the lysimeter tube, -40 to -60 cmHg of vacuum pressure is applied to each tube. After a week, the leached water is drawn out from the lysimeter tube, without having to remove the tube, by using a plastic vial and the battery-operated vacuum pump at -40 cmHg of suction pressure.

The suction efficiency of the lysimeter tube was tested under saturated water conditions over 24 hours at three different vacuum pressures: -20, -40 and -60 cmHg. As shown in Table 1, the difference in vacuum pressure significantly affected the amount of leached water collected by each tube. The minimum requirement for chemical analysis of leached water is 100 ml. A standard vacuum pressure in the range of -40 to -60 cmHg was selected and applied to each tube in the field. Pressure lower than -40 cmHg was not sufficient to create enough of a vacuum to extract leached water of more than 100 ml into the lysimeter tube.



Figure 3. A set of lysimeter tubes installed in the palm circle at four soil depths: 15, 30, 45 and 60 cm.

TABLE 1. AMOUNT OF LEACHED WATER COLLECTED BY LYSIMETER TUBES AT DIFFERENT VACUUM PRESSURES

	Vacuum pressure		
	-20 cmHg	-40 cmHg	-60 cmHg
Leached water (ml)	62c ± 2.08	134b ± 10.60	203a ± 10.63

Note: Figures are means ± standard error of four replicates. Means bearing different alphabets are significantly different from one another at 1% probability level according to DMRT.

ADVANTAGES OF THE TECHNOLOGY

The advantages of using the Auto Lys as compared to the imported ready-made lysimeter systems are given in Table 2.

TABLE 2. ADVANTANGES OF AUTO LYS AS COMPARED TO IMPORTED READY-MADE LYSIMETER SYSTEMS

Imported ready-made lysimeter systems	Auto Lys (MPOB Auto Lysimeter System)
Difficult to operate	Simple and easy to operate, efficient and reduces sampling time significantly
Length of lysimeter tube is fixed by the manufacturers	Length of lysimeter tube is flexible; can be varied easily according to need
Expensive	Cheaper; costs 50% less than the imported lysimeter systems
Problem of acquiring spare parts for maintenance and repair	Easy to maintain and repairs can be done using locally available materials

CONCLUSION

The Auto Lys offers a viable and cost-effective lysimeter system for leaching studies over wide areas especially under oil palm. The system can reduce sampling time in leaching studies. It can also be used to monitor the groundwater quality status *in situ* so that appropriate remedial action can be taken.

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