Microcalorimeter as a biologic activity monitor for the study of *Brachiaria brizantha* seed germination process

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Introduction Calorimetry helps better understanding of biological processes (Calvet & Prat, 1963). Very sensitive thermal sensors and microcalorimeters allow real time investigation and monitoring heat production of seed germination but few experiments have been performed in this area (Sigstad & Prado, 1999). Moreover, experimental procedures correlating germination phenomena and chemical thermodynamics are exceptional (Barboza, 2002). One can detect calorimetrically the heat flow produced during seed germination and compare the results with data recorded using standard germination methodology (ISTA, 1985). Seed germination and the biomass increase respiration and determination of the energy involved aids understanding of the energetic cycle involved. This work analysed the germination of *Brachiaria brizantha* seeds, including the water uptake phase.

Materials and methods Experiment used intact and chemically scarified (sulphuric acid, 96%, 36N, 15') seeds of *B. brizantha* cultivar Marandu. Germination rates were 28 and 78%, respectively, evidencing seed dormancy. An isothermic conduction microcalorimeter TAM, Thermometrics 2277 was used, with a twin system of heat detection i.e. of sample and reference vessels. A homemade calorimetric vessel was developed to permit the water addition and gas flow control through the vessel and to retain the water vapour. The reference vessel was identical, without the gas flow attachment. Heat effect due to gas flow was considered in the standard deviation.

Results Figure 1 shows germination heat flow of 10 *B. brizantha* scarified seeds. Heat flow rose during 14d of germination. Water uptake (physical chemical part) occurred until d2; a latency period (low biological activity) occurred from d2-5; an exponential growth of heat production + radicle protrusion (visible germination) occurred from d5. Figure 2 shows the mass increase of seed water uptake. Figure 3 shows the correlation of the inverse tendency between mass increase and the heat flow. The exothermic tendency indicates that the system releases energy during anabolic and catabolic processes. The trend (Figure 2) was unexpected (intact seeds released most); release probably was caused by the seed coats (highly higroscopic), which were removed partially during acid scarification. Figure 4 shows that in phase 1 the water probably penetrates through seed coats, with a significant difference between scarified and intact seeds. In phase 2, we assume that water penetrates the endosperm, showing similar behaviour for both kinds of seeds, as the thermograms show.

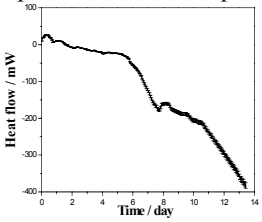

Figure 1 Typical thermogram of B. brizantha 10-seed germination; air flow 15 mL/h, error bar equivalent to 2 % of measured energy (232000 measurements)

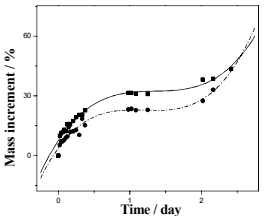

Figure 2 B. brizantha seed water uptake fitted by a 3rd degree polynomial curve for intact (dotted line) and scarified (straight line)

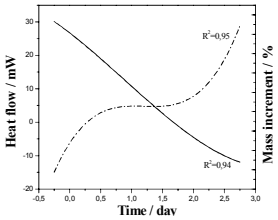

Figure 3 Typical trends observed on heat flow and mass increment in B. brizantha seeds, both fitted by a 3rd degree function and showing typical fisiological phases

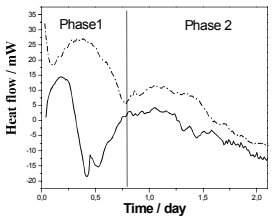

Figure 4 Thermograms of water uptake on intact (dotted line) and scarified (straight line) B. brizantha seeds, showing typical physiological phases

Conclusions Microcalorimetry showed important details of seed germination. Its use for biological studies on forage grasses is promising.

References

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