Smart roof: preliminary results of a multidisciplinary study on green roofs for rural buildings

Elisabetta Riva\*, Enrico Ferrari, Riccardo Guidetti, Antonio Ferrante.

Università degli Studi di Milano- Dipartimento di Scienze Agrarie e Ambientali  
Via Celoria 2, 20133 Milano, phone 02 50316856, fax 02 50316846 [elisabetta.riva@unimi.it](mailto:elisabetta.riva@unimi.it).

**Keywords.** Vegetated roof, thermal performance, insulation, air temperature

**Abstract.** Green roofs are widely used for homes and in the industrial sector. Few applications are reported for agriculture, mainly for wineries. Generally rural buildings are very simple from the structural point of view and have a limited load bearing capacity. For example, dairy cow barns have no walls and roofs with a slope which reaches up to 30%. Also, these roofs require a good thermal insulation and inertia to maintain adequate microclimatic conditions for the cows.

The use of lightweight green roofs in these types of buildings make it possible to improve the negative thermal effects of conventional buildings as in summer conditions they absorb a large part of the solar radiation and reduce the temperature of the roof while in winter they have a good efficiency in insulating the roof and consequently reduce the heat losses.

The aim of the project is to design an innovative low-cost and low-maintenance vegetated roofing covering, with limited permanent structural load, but with adequate thermal inertia, to be used in agricultural buildings. Therefore, a pilot structure for green roof assessment has been set-up and used to test the thermal effect of vegetation with different soil thickness. It consists of two independent pitches of 10 m x 1.2 m each placed on the ground with a slope of 25%. The two pitches are oriented North and South respectively.

On each pitch, 10 panels (80 cm x 100 cm) have been used to compare 3 substrate thickness, respectively 3, 5 and 7 cm, with 3 repetitions with a randomized block scheme and one control test panels (without soil). A mixture of Trifolium repens and Cynodon dactylon, were cultivated and production performances (yields and phenological state) were studied during the summer period. Temperatures above and below each panel were recorded continuously, and thermal images were periodically recorded in the growing period.

The effect of the vegetation on temperatures has been very clear, as expected. The temperature reduction below the panels due to the soil and vegetation was in average 3.4°C Among the different thicknesses the 7 cm layer always showed significant lower temperature in the vegetated side probably due to more vigorous vegetation. However, the temperatures below the panels were similar for all panels indicating that also a 3 cm layer can be suitable.

Thanks to a multidisciplinary approach, the first results of the study, that will be continued in the next years, are contributing to the design a smart roofs system to mitigate the heat transfers and the visual impact of the building.