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High quality compost

Towards a sustainable agro-industry in Morocco



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



KINGDOM OF MOROCCO

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High quality compost

Towards a sustainable agro-industry in Morocco



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 2013



CONTEXT

Ending agricultural dependence on methyl bromide in Morocco

While during the last decades the agro-industrial sector of Morocco has shown significant growth, this growth has been coupled with a dramatically higher consumption of chemicals such as fertilizers and pesticides, a heavier production of organic waste, and a number of strains on the environment, economy, and society at large.

To tackle these issues, Morocco and UNIDO have partnered to promote the use of compost technology, which reduces the amount of organic waste and naturally increases soil health. The adoption of compost technology also helps Morocco move away from the use of methyl bromide, a pesticide widely used in agriculture which depletes the ozone layer and is being phased out by the Montreal Protocol.

With the support of UNIDO, a state-of-the-art composting unit was set in Agadir that allows trainees to monitor the composting process in real-time, test the quality of the compost and optimize it.

The United Nations Industrial Development Organization (UNIDO) is the specialized agency of the United Nations that promotes industrial development for poverty reduction, inclusive globalization and environmental sustainability.

The Montreal Protocol on Substances that Deplete the Ozone Layer is an environmental treaty ratified by 197 countries that sets reduction goals for the use of ozone depleting substances, such as methyl bromide. Morocco ratified the Montreal Protocol in 1995.

ABOUT COMPOSTING

What is it?

Composting is a natural process that encourages the production of beneficial micro-organisms, mainly bacteria and fungi, which break down organic matter such as plant, yard or food processing waste, manure or bedding and create a useful end product called humus. Being rich in nutrients, humus returns carbon and organic matter to the soil and significantly improves its chemical, physical and biological characteristics. Furthermore, compost makes soil and plants healthier and leads to increased productivity, food safety and income security for farmers.



What is compost used for?

Compost has many uses. It is employed in agriculture for growing horticultural crops such as tomatoes and strawberries as well as ornamentals and for production of seedlings. It is often used in horticulture, gardens or landscaping as a conditioner, fertilizer, or a natural antagonist of soil borne pathogens. Other uses include: soil controlment; reclamation of land or streams; reverting land erosion; covering landfills, etc.

KEY BENEFITS OF USING COMPOST

- Easy to use and cost-effective
- Increases soil organic matter
- Improves soil structure, fertility, yields and plant health
- Improves soil drainage and reduces erosion
- Increases water- and nutrient- holding capacities of the soil
- Decreases need for chemical fertilizers (e.g. methyl bromide) and health issues related to their use
- Suppresses diseases and pathogens
- Decreases water consumption, water pollution and soil erosion
- Decreases waste production
- Saves landfill space
- Generates savings due to lower use of water and energy
- Generates employment opportunities
- Promotes sustainable agriculture by using a natural fertilizer and by optimizing resources such as water, waste and energy efficiently



RECYCLING AGRICULTURAL WASTE

Selection of raw materials

Since compost is the material derived from the decomposition of organic material such as plant waste, bio-solids, fish or other materials, almost any organic matter could be composted as long as the optimal carbon to nitrogen ratio of 30:1 per weight is maintained. Material rich in carbon includes leaves, barks, sawdust or wood, while food wastes, manure and sewage sludge provide a source of nitrogen. The material should be chopped or shredded to allow for good mix and aeration.

KEYS TO GOOD COMPOSTING

- Carbon to nitrogen ratio should be kept at C/N=30
- Presence of microorganisms (worms and fungi such as molds or yeasts, which break debris and allow bacteria to continue the decomposition process)
- Temperature must be monitored during composting
- Level of moisture at 40-60 %
- Level of oxygen at >10 %
- Size of waste should be around 5-20 cm

Composting methods

The most common method so far for on-farm production of compost is windrow or pile composting. This method, used in Morocco, involves piling organic materials, such as crop residues, into long piles of approximately 2-4 meters width. At the start of the composting process piles are commonly 1–2 meters high.

In Morocco, aeration of the windrow is achieved through active aeration (using mechanical systems such as fans or ventilators), which forces air into and out of the windrow. This is done by attaching fans to a system of perforated tubes or to a specific aerated floor under the centre of the windrow.



Other means of aeration include passive aeration (through the natural circulation of air) or turning (through mechanical agitation and mixing). The temperatures and moisture of the windrows are constantly monitored to determine the best time to turn the windrows or to activate the forced aeration for a quicker compost production.

Several composting systems exist such as those using bins, aerated static piles or in-vessel channels. The design of the appropriate system needs to be developed by professionals.

The process

In order to facilitate the process of decomposing, plant matter is usually shredded, water is added and the mixture is turned to ensure optimal aeration. Under these conditions, microorganisms break up the material more easily and aerobic bacteria convert the matter into heat, carbon dioxide (CO₂) and ammonium, which in turn breaks into nitrites and nitrates. Since the level of organic matter decomposition is closely connected to the suppression of diseases, compost should only be applied when mature (usually black or dark brown and with an earthy smell).

Composting phases		
Active (thermophilic)	Curing (mesophilic)	Maturing
The most rapid breakdown of material occurs. After the materials are mixed and the pile is created, temperature rises (> 45°C) and decomposition by aerobic organisms takes place. Lasts 1-2 or 3-8 months, depending on which composting method is used.	Temperatures are more stable (usually < 40°C) and organism populations' shift to those that prefer lower temperatures. Generally takes less than 3 months.	Indicates the degree of the conversion of organic compounds to organic substances resistant to microbial degradation, or humification. Compost needs to be stored before use.



Suppressiveness is the ability of the soil to suppress the development of diseases and several pathogens including Fusarium, Phytophthora, Phytium and partially Phizosconia solani.

Ways to increase compost suppressiveness:

- Cure the compost for more than 4 months
- Use the compost in the field soil a few months before planting
- Inoculate the compost with bio-control agents

Compost quality matters!

The effectiveness of compost depends, among other things, on certain parameters such as oxygen or moisture levels. The maturity of the compost can be assessed through agronomical tests, which also check its ability to suppress plant pathogens that harm the soil. Different compost qualities are suitable for different applications.

If improperly conducted, composting can result in the generation of methane, the presence of heavy metals in soil or the pollution and dispersion of particular pathogenic micro-organisms in the final product, all of which significantly decrease soil quality and usability. The optimization and regulation of the right technology and methods for the production of high quality compost are of paramount importance.

Key characteristics of high quality compost:

- High level of organic matter and nutrients
- Free from diseases and weeds
- Professionally prepared

Let the farmers handle it

The Ministry of Agriculture of Morocco has involved private sector institutions such as APEFEL (Association des Producteurs Exportateurs de Fruits et Legumes) as key actors in



the phasing-out of methyl bromide, its replacement with non-chemical alternatives that protect the ozone layer, and the promotion of sustainable resource management practices such as water conservation, optimal soil usage and waste reduction. By involving farmers in this process, farmers' interests are both protected and advanced.

Ensuring success: training and experience

At the Technology Transfer Center (TTC) set by UNIDO and the APEFEL in Agadir, farmers see technologies for pest management at work and learn how to use them. The center promotes new non-chemical technologies for crop production and conducts applied research towards the production of high quality compost. To this end, the center is equipped with a composting pilot unit, where the composting process can be monitored in real-time, and a laboratory equipped to test and optimize the quality of the compost.

Since success with any composting system requires skills and experience, UNIDO and APEFEL have trained a team in composting technology, techniques and process monitoring. More specifically, the team has been trained in the selection of materials, processing, traceability of the final product, quality control through inspecting the characterization, maturity and capacity of the compost to suppress soil-borne pathogens. The activities offered by the center have altogether raised the awareness of the producers on both the utility and advantages of composting.

Spreading the use of compost

The pilot project in Agadir is a great example of how composting technology could be implemented in other developing countries. It is relatively easy to replicate because compost production and monitoring facilities are far cheaper than landfills or incinerators and utilize less space. There is no need to invest in high level technologies, either: necessary inputs such as organic waste are readily available, while water, fuel and other energy resources are not necessary in large amounts. There are also no strict demands for storage and packaging.

The success of the Moroccan project has attracted a number of additional donors, mostly from the private sector and banks, who are interested in supporting the project, the composting technology and the business opportunities related to it.

Next steps

The activities promoted by UNIDO have given Moroccan farmers the opportunity to become more competitive in international markets while employing environmentally sustainable



methods and yielding higher quality products. They have also provided an alternative to using methyl bromide that improves the environmental sustainability of the local agro-industry.

The successful continuation of the project will be ensured through continuing the close collaboration with key stakeholders such as experts in waste management, community management, business and marketing and through the up-coming development of national standards on composting and sustainable agro-industry.

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