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NEW INVASIVE INSECT PEST DESTROYING CACTUS IN MOROCCO

Cactus pear (*Opuntia ficus indica* L.) is a plant that tolerates drought very well, and is largely grown in arid and semi- arid regions of the world. It's a crop that has very various and beneficial uses; both the fruits and the pads are used as food and feed. The fruit is used in human consumption, as a dye, and in cosmetic products. The pads are used as animal feed predominantly in the arid zones on degraded lands where shortages of water and feed resources are limiting factors for animal production. It is also used as fuel by poor farmers in many countries and has a very important role in soil and biodiversity conservation, and as an alternative source of flowers for bee keeping during droughts.

Cactus has most certainly been growing in Morocco for several centuries, but since the 80ies, area cropped to cactus was multiplied by 5 to 6 fold. Presently, cactus occupies 45,530 ha, representing 11.07% of fruit tree area of the country. 71.7% of this area is located in the regions of Sidi Ifni and El Kelaa, with 38.7% and 33%, respectively.

Severe damage on cactus by the Cochineal in Morocco

Cactus has always been a very clean crop, grown in a traditional way in most villages as fences surrounding fields and homesteads, or fruit orchards. It has never been reported to suffer from any major pest problem, thus does not get any particular crop management practices from farmers, and is very much dependent on climatic conditions of the season. Unfortunately, this very popular crop is now threatened by a new invasive insect pest, the wild cochineal species, *Dactylopius opuntiae* (Cockerell) (Hemiptera: Coccoidea: Dactylopiidae), that has been reported for the first time in Morocco in September 2014, in the area of Khémis Zemamra, region of Doukkala. This pest has now reached more than a hundred km radius around its first hot spot, and has even been observed

in a new region of the country. With such high speed of dissemination, the pest may completely wipe out cactus crops in the near future.

The insect is sap sucking; it can cause 100% losses of the crop under severe infestations. The epidemic and spatial rates of spread could be attributed to plant stresses and pest resilience associated with climate viability and change. Indeed, recent observed evidences on the ground shows that severe infestation seem to coincide with severe drought events in 2015/16 growing season in Morocco. Increased temperature with long dry spells seems to favor epidemics and outbreaks at rapid rates into new areas.

The most common symptoms of damage from attacks by this pest are chlorosis (yellowing), dehydration, and weakening of the plant. In a short period (less than 1 year), the cactus stand may die. This insect is well adapted to several habits and resides around the thorns in small colonies. When the temperature rises in spring, the population increases considerably and its biological cycle time is reduced. Once wild cochineal settles on a cactus pear plantations, it is very difficult to eradicate it. During the winter the insect is protected in the root area and stem bark of the plant, where it will emerge again to the surface in spring and begins its life cycle once again

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VIRGINIA TECH RESEARCH TEAM FIGHTS THE SPREAD OF DAMAGING INVASIVE PESTS

Right now, the tomato leafminer has caused the state of Kaduna in Nigera to declare a “tomato emergency.” It is now popularly called ‘Tomato Ebola’ in Nigeria. Already, this pest has raised the price for a basket of tomatoes in the country from around $1.00 to over $40.00. The relentless march and destruction of the pest has inspired a team of Virginia Tech researchers to apply new methods of modeling and simulation previously used in infectious disease research to halt their spread.

The tomato leafminer, *Tuta absoluta*, is an innocuous-looking moth, easily hidden by the burgeoning foliage of young tomato plants. But once the eggs of the moth hatch, the larvae tunnel through the plants’ leaves, quickly giving a once green, productive field a scorched appearance. In Europe, West and Central Africa, and the Middle East, these pests have caused 50 percent to 100 percent crop loss since their accidental introduction to Europe in 2006.

“Entomologists normally use CLIMEX, a software modeling program that estimates the geographical distribution of an insect, and insect life tables, an analysis of an insect’s life cycle, to

theorize how an insect will spread," said Muni Muniappan, entomologist and director of the agricultural development program that is managing the grant. "But the Biocomplexity Institute is introducing human movement into the equation. This is a new angle."

Managing these insects is not as simple as spraying insecticides. Virginia Tech's Feed the Future Integrated Pest Management Innovation Lab funded by USAID works to provide solutions to farmers of developing nations using integrated pest management techniques that take into account the long-term health of people and ecosystems, as well as sustainable agricultural productivity.

However, halting the incredibly fast spread of these pests can be very difficult. Thus, researchers are turning to computational modeling in an effort to better understand when and where the insects will appear next. Using agent-based models in a novel approach, the research team will incorporate multiple data sources and find the most significant factors in the spread of these insects.

In the tomato leafminer study, the research team will view pest dynamics as an integrated biological, informational, social, and technical system consisting of several interacting models. This interaction-based approach is aimed at capturing the complexity of pest dynamics.

A key feature of this approach is understanding how humans hasten the speed at which pests spread. This includes not only human mobility but also supply chain infrastructures used to move goods across continents. These systems can have unintended side effects, one of which is the spread of invasive pests. This study will lead to a much better understanding of how human systems contribute to the spread of pest infestation.

"Our model will be an extremely useful tool for risk analysts, domain experts, and policy makers to develop strategies to combat these pests. Further, the methodology will not be limited to studying the tomato leafminer, but can be applied to any agricultural invasive species," said Abjijin Adiga, research faculty member at the Biocomplexity Institute.

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It seeks to provide a global umbrella for the plant protection sciences to facilitate and promote the application of the Integrated Pest Management (IPM) approach to the world's crop and forest ecosystems.

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