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Soil Stewardship for High Cotton Yields

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GUEST COLUMN

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Introduction of the high yielding American cotton varieties and the hybrid cotton brought a sizeable yield increase in the 1970's. It caught the imagination of farmers and more than 40% of the cotton cultivated area came under the hybrids. Cotton farmers rapidly adopted and infused modern agronomic and crop protection technologies. The novel pesticides belonging to the pyrethroid group were introduced to control a wide range of pests in cotton. It revolutionised cotton production because of an effective control of the insect pests.

However, the technology was misused with an indiscriminate application of the synthetic pyrethroids. The widespread pest incidence especially of the whiteflies and then the bollworms made the farmers seek desperate measures. Excessive pesticide usage caused further resurgence of whitefly and insects, including the American boll worm, developed resistance to the insecticides used. Cotton farmers experienced widespread crop failures. As a result, there was a lull in the productivity during the late 1980's and the early 1990's.

World over there was research mulling around the development of an insect tolerant crop variety. The genetically modified cotton was the product that came into existence. Monsanto was successful in developing the GM cotton tolerant to the bollworms and this was commercially cultivated first in the USA, Australia, Brazil and China.

India finally took to this innovation much later in 2002. From meagre thousands of hectares, it started occupying millions of hectares and presently occupies more than 95% of the cotton cultivated area. Productivity jumped from ~300 kg lint/ha during 2000-2003 to more than 500 kg lint/ha achieving a high of 570 kg lint/ha in 2007. But in the last decade, it is seen that in spite of growing cotton with the best of the transgenic Bt cotton hybrids having tolerance to the boll worms, cotton productivity is hovering around 500 kg lint/ha. Thus, it appears that there is a technology fatigue.

Taking care of the soil – insures prosperity and productivity

So is it possible to break these yield barriers? Yes, we can, by doing the right things, and the right things in the right manner. One of the most basic of the management strategies is '*soil stewardship*'.

Soil Stewardship means careful and responsible management of the soil entrusted to one's care. Most often, we feel that we own the land, so we are stewards of the land. But this is not the case because we take it for granted. Classical textbooks of Soil Science and Agriculture define soil as '*soil is the unconsolidated inorganic and organic materials on the surface of the earth which support the growth of plants*'. With this approach, it is clear that we consider soil more as a medium of plant growth and nothing more. As a result, farmers used to apply fertilizers to correct any nutrient deficiency and they were rewarded with a bountiful crop. This was not only for cotton but for any crop that was cultivated. The era of the green revolution led to three main changes (i) use of the improved seed, (ii) application of fertilizers and irrigation and (iii) crop protection.

Nothing was wrong with this technology because it resulted in substantial yield gains and the need was to improve the productivity levels apart from improving the livelihoods of the millions tilling the land. But the not so good thing was the over reliance on the external inputs with the assumption that whatever we put into the soil, it would result in better crop yields and bigger profits. This did not happen. Soon it dawned that something was going wrong. A close check pointed out some of the glaring facts such as:

1. Moving away from the application of manure - farmyard manure and composts to the use of mineral fertilizers
2. Excessive use of pesticides
3. Heavy irrigation wherever water was available
4. Herbicide use to control weeds
5. Adopting mono-crop over the diversified cropping systems

Ironically and historically, we worship ***'Mother Earth'***, as is borne out through the several rituals and festivities, we follow traditionally. All these symbolise that we should live in harmony

with nature and the sense of togetherness. Yet, we have brought in discord. Thus, it is this, bond of togetherness and living in harmony that needs to be strengthened and not weakened, if we are to achieve self sufficiency. This is possible if and only if we develop and follow some strong scientific and ecological principles that guide us along the way.

Hardcore proponents of Soil Science and the other branches of Agriculture Science dealing with land management woke up when a staunch Soil Scientist, Daniel Hillel, described soil as a '*living entity*' in the book "*Out of the Earth*". This became one of the turning points in the manner in which we viewed soils from the classical definition itself.

If we consider soil as a living thing, then just like any living being, it can either be healthy or unhealthy. Through a proper soil stewardship (management), we can keep the soil healthy and more importantly create an ideal soil environment for growing a crop. If we do not do this, we are in effect killing our soils by polluting them with an overload of chemicals and fertilizers. This understanding culminated in giving greater importance to the soil and '2015 was the Year of the Soil'.

Soil stewardship aims at a larger picture of feeding the soil and not the plant, because soil is a '***habitat***' comprising of millions of organisms that include bacteria, fungi, nematodes, earthworms and so on. Most of these are beneficial to the ecosystem such as the bacteria fix nitrogen and make it available to the crop; earthworms burrow into the soil and make the soil porous; fungi form a mycelia network and make nutrients available to the plant in a more readily available form.

Arresting soil erosion and degradation

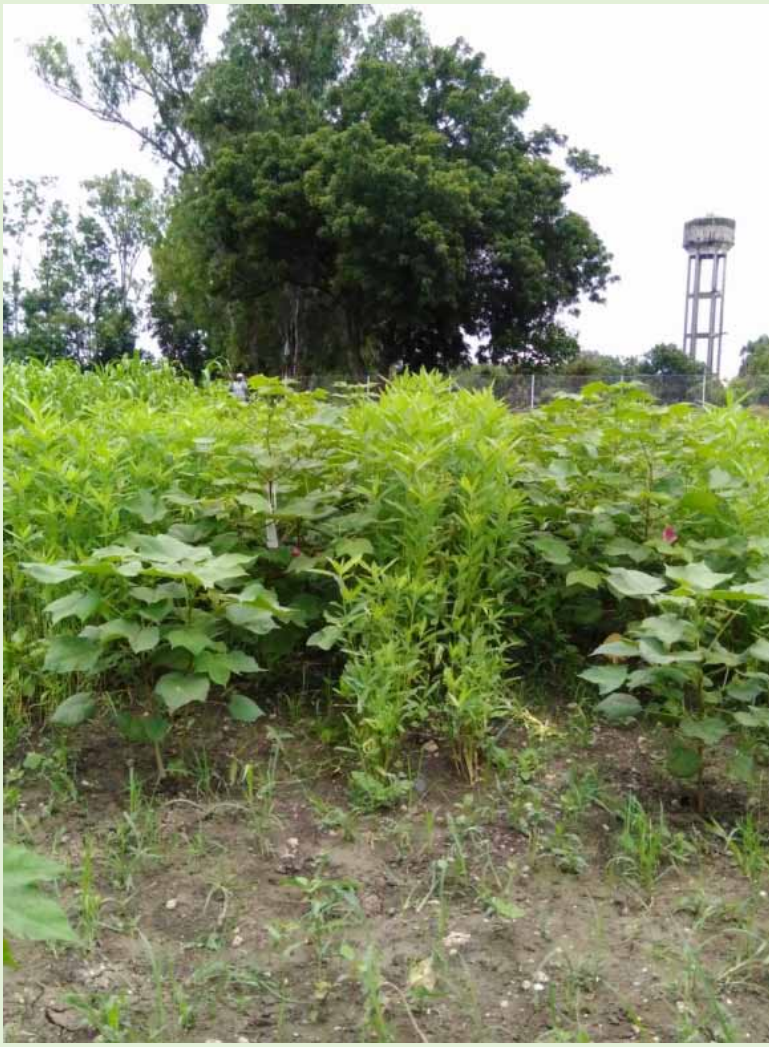
If we have lost the soil, then we have lost it forever because it takes several hundreds of years to build just a few millimetres. Soil erosion and land degradation is one of the main causes of declining crop productivity. Conservation agriculture is now thought of as a panacea for all the ills that modern agriculture has witnessed so far, for the simple reason that it takes a holistic view.

Conservation agriculture is essentially an integration of ecological management with scientific and modern techniques tempered with traditional knowledge gained from generations of successful farmers. Conservation Agriculture has at its core three interlinked principles, namely, (i) minimum soil disturbance, (ii) providing a soil cover (crop residue) and (iii) sound crop rotations and diversification. Because of the integration of several practices, we tend to reduce soil erosion and land degradation.

Improve soil quality

The conservation agriculture strategies outlined in the previous section also result in an improvement of the soil quality - physical, chemical and biological properties. We can also reduce dependence on nitrogenous fertilizer by following diversified cropping systems that include a legume. Growing crops in rotation will also circumvent the pest and disease problems.

Cotton is grown at wide row spacing (>60 cm) and is also slow growing initially. This inter-



Growing a nitrogen fixing crop, such as sunnhemp (in picture), moong, udid, soybean, groundnut in between cotton rows will help reduce dependence on fertilizer-N.

row space can be effectively used by growing a legume cover crop and later applying it as mulch. Legumes fix nitrogen from the air and will make it available to the crop at a later date. Thus, there is a potential to reduce dependency on fertilizer-N. Furthermore, cover crops offer protection to the soil against erosion and conserve the soil moisture. This can be adapted as per the location and the market demand, taking up a cover crop or a food legume. Farmers also stand to benefit from the extra income from the food legume grown.

Get soils tested and take care of it

Most often, we think that the soil is just a medium for plant growth and opine that adding nutrients to the soil will take care of the plant. In the short-term, this works; but not in the long-term. We can take good care of the soil, if we get the soils tested on a regular basis and realise what is happening to it.

At the end of the day, by careful stewardship of our natural resource 'the soil', we will get soils that are livelier, healthier and environmentally safer and restored to a healthy state. To achieve this end, we need to treat the soil as a long-term investment. All these will ultimately lead to more productivity of not only cotton but any crop that we grow.

"We owe it to ourselves and to the next generation to conserve the environment so that we can bequeath our children a sustainable world that benefits all." – Wangari Maathai

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(The views expressed in this column are of the author and not that of Cotton Association of India)