JUST AGRICULTURE
multidisciplinary e-Newsletter

Soil Biodiversity for Sustainable Agro-ecosystem Functioning

Tarun Sharma[1]* and Akashdeep Singh[1]
Department of Agronomy,
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur, HP
Corresponding author: tanuuu63@gmail.com
ARTICLE ID: 012

Introduction

Introduction Biodiversity is the presence of diverse groups of flora and fauna in a habitat, playing their part in the working of an ecosystem. Soil is the essential part of this ecosystem which sustains all living organism in any ecosystem. Soil biodiversity, hence, is important to sustain the environment, its ecosystems and the agro-based industries. Soil biodiversity is defined as the varied life forms existing in the soil which includes bacteria, earthworms, fungi etc. It is the most diverse group on the planet contributing to nutrient cycling, carbon sequestration, regulating organic matter and plant health etc. Sustainable agriculture is the production system wherein the demands of the present generation is met without comprising with the ability for future generations to meet their demands by understanding the ecosystem services, specifically the soil ecosystem. Soil is an important component of any ecosystem because it is where plants anchor to and support themselves. It nurtures the plants by providing them with essential nutrients, macro- and micronutrients. Soil stores, controls the release and cycles nutrients. During these biogeochemical reactions the elements are transformed into available forms (ionic forms) which are then available to plants for uptake or may be held by the soil colloids as the reserve and released slowly, or may be lost to the atmosphere by the volatilization. Sustainable agriculture directly depends on the biodiversity in the soil. Soil organisms are the key to the delivery of ecosystem services and are therefore at the heart of ecological intensification in agro-ecosystems. The abundance of these organisms thereby promotes soil health and resilience.

Ecological recycling Natural cycling of nutrients has occurred from the soil to plants and animals, and then back to the soil, primarily through decomposition of biomass. This cycling helps to maintain the essential nutrients required for plant growth in the soil. Complex

JUST AGRICULTURE
multidisciplinary e-Newsletter

nutrient cycles incorporate a range of physical, chemical, and most importantly, biological processes to trace the fate of specific plant nutrients (e.g., N, P, C, S) in the environment. Decomposition of organic matter by soil organisms (Nitrosomonas, Nitrobacter, PSBs, Mycorrhizae) are the heart of any transformation reaction and cycling of nutrients through the environment. This process releases carbon and nutrients from their complex forms back into circulation so they are readily available to plants. Fig 1.1 Different organisms present in soil ecosystem Sustainable agriculture and carbon sequestration Sustainable agriculture is an approach to farming that focuses on production of food in a manner that can be maintained with minimal degradation of ecosystems and natural resources. This sustainable approach to agriculture strives to protect environmental resources including soil, and provide economic profitability while maintaining social equity.

The concept of sustainable agriculture is often misinterpreted to mean that chemical fertilizers and pesticides should never be used. This notion is incorrect, as sustainable agriculture should embrace those practices that provide the most beneficial services for agro-ecosystems and encourage long-term production of food supplies in a cultural context of the region. It cannot be overstressed that sustainable practices should not only consider crop production and profit, but must include land management strategies that reduce soil erosion and protect water resources. Sustainable agriculture also delivers benefit in the form of carbon sequestration, where growth of agricultural and natural biomass actively removes carbon from the atmosphere and stores it in soil. The amount of carbon stored, however, depends on the crop plants, climate, topography and biological features. The soil organic carbon pool changes over time depending on photosynthetic carbon added and the rate of its decay controlled by the presence of microbial fauna.

The current trend of biomass burning, excessive fertilizer usage, residue removal etc. are the main cause of reduction in sequestration capacity of the soil due to declining organic matter content and population of soil microbes. Sustainable Practices Sustainability considerations mandate that alternatives to N fertilizers must be urgently sought. Biological nitrogen fixation (BNF), a microbiological process which converts atmospheric nitrogen into a plant-usable form, offers this alternative. Nitrogen-fixing systems offer an economically attractive and ecologically sound means of reducing external inputs and improving internal resources. Symbiotic systems such as that of legumes and Rhizobium can be a major source of N in

JUST AGRICULTURE
multidisciplinary e-Newsletter

most cropping systems and that of Azolla and Anabaena can be of particular value to flooded rice crop. Nitrogen fixation by associative and free-living microorganisms can also be important.

Sustainable cropping systems do not deplete the soil because of increased input of organic matter and therefore helps in improving the soil health. It promotes optimal crop rotation with the leguminous crops that help in increasing the microbial population besides enriching the soil with the available nitrogen. Sustainable farming also includes growing of green manuring crop which later on can be incorporated into the soil providing suitable organic matter for the microbial population. Management techniques like reduced tillage also help in developing a stable environment that encourages more biodiversity. Ultimately, soil biodiversity is sustained which influences the production system by improving the bulk density, water holding capacity, suppressing pests and diseases and providing resistance to erosion. Land management practices In order to keep soils healthy, land needs to be managed within its capability. Land management practices to increase levels of organic matter in soils and its biodiversity need to be encouraged.

Management practices include managing grazing pressure to retain and improve plant cover, using minimum tillage or no-till practices to maintain groundcover and improve soil structure, maintaining and increasing perennial plants (including pasture cropping), careful use of fertilisers and rehabilitation of soil through targeted earthworks, water management and seeding. Conclusion Soil biodiversity and sustainable agriculture are closely interlinked. A bi-directional interaction exists between the two wherein the soil micro-fauna supplements the soil with the nutrients and creates a favourable environment for the growth of crop plants while the crops due to their varied composition and interaction with the soil environment by releasing exudates and allele-chemicals improve the micro-flora and later form the soil biomass supporting the biodiversity. The process of land conversion and crop intensification are a significant cause of soil biodiversity loss. Changes in the soil biodiversity are often linked to the above ground factors such as urbanization, excessive fertilizer usage etc. Soil microorganisms are the primary sources of nutrient cycling and hence the food. The soil fauna plays a major part in modifying the in-situ soil structure thereby improving the water holding capacity. Hence, sustainable agriculture practices should be followed in order to promote the population of diverse soil microbes present in soil agro-ecosystem.