All India Coordinated Research Project
On
Long -Term Fertilizer Experiments to Study Changes in Soil Quality, Crop Productivity and Sustainability (AICRP on LTFE)

LONG-TERM FERTILIZER EXPERIMENTS have generated enormous and valuable information which could be used for sustainability of high input intensive agriculture. Changes in soil fertility, as a result of imbalanced fertilizer use and faulty management practices take few years for appearance of disorders in soil but needs more time for rejuvenation. Long-term fertilizer experiments provide the best possible platform to study the changes in crop productivity, soil properties and processes, identifying emerging nutrient imbalances and deficiencies and overall impact on quality and health of soil. Therefore, to study the impact of chemical fertilizer on productivity and soil quality, the Indian Council of Agricultural Research decided to launch the **"All India Coordinated Research Project on Long-Term Fertilizer Experiments (AICRP-LTFE)"** in September 1970 at 11 centres. The work carried out at different centres of LTFE was reviewed by QRT during 1997 and recommended to enlarge the mandate and objectives of the project and changed the title as **AICRP on "Long-Term Fertilizer Experiments to Study Changes in Soil Quality, Crop Productivity and Sustainability"**. The purpose of conducting long term fertilizer experiments at fixed sites in different agroecological zones (AEZ) with important cropping systems was not only to monitor the changes in soil properties and yield responses and soil environment due to continuous application of plant nutrient inputs through fertilizers and organic sources but also to develop strategies and policies for rational use and management of fertilizers to improve soil quality and to minimize environmental degradation. Thus, the thrust of AICRP-LTFE is on productivity, sustainability and environmental safety.

MISSION

Soil Fertility Management through Integrated Plant Nutrient Supply for Enhancing and Sustaining Crop Production and Maintaining Soil Quality

MANDATE

- To conduct coordinated long term fertilizer experiments in different soil types under diversified cropping systems
- To collate information on long term soil fertility trials

OBJECTIVES

- To study the effect of continuous application of plant nutrients, singly and in combination, in organic and inorganic forms including secondary and micronutrient elements (as per the need) on crop yield, nutrient composition and uptake in multiple cropping systems
- To work out the amount of nutrient removal by the crops

- To monitor the changes in soil properties as a result of continuous manuring and cropping with respect to the physical, chemical and microbiological characteristics of the soil in relation to its productivity
- To investigate the effect of intensive use of biocidal chemicals (weedicides and pesticides) on the build up of residues and soil productivity
- To make an assessment of the incidence of soil borne diseases and changes in pests and pathogens under the proposed manuring and cropping programme

TREATMENT DETAILS

T_1 : 50% optimal NPK

T_2 : 100% optimal NPK

T_3 : 150% optimal NPK

T_4 : 100% optimal NPK + hand weeding

T_5 : 100% optimal NPK + Zinc or lime

T_6 : 100% optimal NP

T_7 : 100% optimal N

T_8 : 100% optimal NPK + FYM

T_9 : 100% optimal NPK (Sulphur free source)

T_{10} : Unmanured (Control)

COORDINATING CENTRES OF AICRP-LTFE:

ICAR-Indian Institute of Soil Science, Bhopal is a headquarter and acts as Project Coordinating Unit for following centres of AICRP-LTFE.

S. No.	Location (State)	Year of start	Taxonomic Class	Existing cropping system
1.	CRIJAF Barrackpore (West Bengal)	1971	*Typic Eutrochrept*	Rice-wheat-jute fibre
2.	PAU Ludhiana (Punjab)	1971	*Typic Ustochrept*	Maize-wheat
3.	IARI New Delhi (Delhi)	1971	*Typic Ustochrept*	Maize-wheat
4.	TNAU Coimbatore (Tamil Nadu)	1971	*Vertic Ustopept*	Fingermillet-maize
5.	GBPUA&T Pantnagar (Uttarakhand)	1971	*Typic Hapludoll*	Rice-wheat
6.	JNKVV Jabalpur (Madhya Pradesh)	1972	*Typic Chromustert*	Soybean-wheat
7.	UAS GKVK Bangalore (Karnataka)	1972	*Kandic Paleustalf*	Fingermillet-maize
8.	BAU Ranchi (Jharkhand)	1972	*Typic Haplustalf*	Soybean-wheat
9.	CSKHPKV Palampur (Himachal Pradesh)	1972	*Typic Hapludalf*	Maize-wheat
10.	JAU Junagadh (Gujarat)	1996	*Vertic Ustochrept*	Groundnut-wheat
11.	Dr. PDKV Akola (Maharashtra)	1996	*Typic Haplustert*	Sorghum-wheat
12.	KAU Pattambi (Kerala)	1996	*Typic Haplustalf*	Rice-rice
13.	IGKV Raipur (Chhattisgarh)	1996	*Typic Haplusterts*	Rice-wheat
14.	MPUA&T Udaipur (Rajasthan)	1996	*Typic Ustochrept*	Maize-wheat
15.	MPKV Parbhani (Maharashtra)	1996	*Typic Chromustert*	Soybean -safflower
16.	PJTSAU RRS Jagtial (Telangana)	2000	*Typic Tropaquept*	Rice-rice
17.	OUAT Bhubaneswar (Odisha)	2002	*Aeric Haplustalf*	Rice - rice
B	**Voluntary centre**			
18.	IASRI New Delhi	1972	-	-

SALIENT ACHIEVEMENTS

THE LONG–TERM FERTILIZER EXPERIMENTS (LTFE) conducted across the country clearly brought out that balanced and integrated nutrient management sustained the crop productivity, soil quality and overall soil health.

- In Alfisols of Palampur, Ranchi and Bangalore, crop yield data indicated that soil amended with FYM found to be superior to lime as far as crop productivity is concerned. Application of organic manure helps in moderating soil condition in addition to supply nutrients whereas lime merely increases soil pH.
- Studies on assessment of impact of climate change on crop productivity predicted decline in productivity of wheat at Ludhiana in next 50-60 years but at the same time, increase in moisture availability due to increase in rainfall coupled with fertilizer N application not only offset the decline in yield but enhanced it by 15 to 20 percent from base line. On the contrary, climate change did not influence productivity at Delhi. However, strategy to increase N dose and advancement in sowing time of wheat may increase the yield at Delhi.
- In Vertisols of Raipur, yield can be sustained with balance application of fertilizer nutrients as well as integrated nutrient management (INM) in rice-wheat.
- In Vertisols of Akola, results indicated that exclusive application of nutrients through organic manure (FYM) even after 26 years could not keep the pace with 100% NPK. It is advised that there is need to increase the dose of organic manure (FYM) to optimize the yield and to keep the pace with inorganic nutrient application.
- In Alfisols, results indicated that application of urea alone (i.e. 100% N alone) had deleterious effect on crop productivity of maize and wheat at Palampur and other LTFE sites. This is due to decline in soil pH which reduces the availability of P and K to a large extent.
- Balance application of nutrients (fertilizers and manure) resulted in increase of the population of soil microorganisms. Increase in application of nutrient from 100 to 150% also had positive effect on soil microbial count and also enzymatic activities.
- Irrespective of soil and crop, incorporation of farm yard manure (FYM) or green manure not only resulted in increase in productivity but also increase microbial count and their enzymatic activities.
- Application of fertilizer increased the enzymatic activity in soil which resulted in evolution of more CO_2. Thus, observations clearly demonstrated that balance application of fertilizer is essential for not only sustaining the crop productivity but also to maintain or enhance microbial population in soil.
- Results revealed that decline in P dose to half in the plots/fields, wherein P accumulated as in case of soils of Ludhiana (Punjab), Bangalore (Karnataka) and Jabalpur (Madhya Pradesh) did not have any adverse effect on crop productivity. Thus, it can be inferred that P accumulated over the years can be reutilized.
- It has been demonstrated that FYM is better soil amendment than lime for sustaining productivity of acid soil and FYM can be used in place of lime in these soils (Alfisols).
- Yield data of rice at Pantnagar (Mollisols) indicated that combined application of S and Zn had additive effect. Thus, both the nutrients need to be supplied simultaneously for enhancing/maintaining crop productivity.
- Studies on crop response to K in Vertisols conducted at different places indicated that response of crop during kharif and rabi season found to be random.
- It was noted that at Akola, sorghum responded to applied K but subsequent wheat in same plot did not respond. It means total biomass of crop is responsible for K

response. The crop like sorghum may require more K because of its greater biomass.

- Saturation and threshold carbon limits depend on texture (clay), rainfall and temperature. it is well illustrated that carbon sequestration is governed by carbon added through residual biomass, thus more the productivity, higher will be the residual biomass and probability of carbon sequestration could be more.
- The increase in productivity on application of fertilizer resulted increase in carbon and microbial population in soil and thus ruled out assumption that chemical fertilizer deteriorate soil carbon and adversely affects the growth of microorganisms.
- Incubation studies on soil amended with bio-char revealed that increase in soil pH, exchangeable K and Ca in soil, declined exchangeable Al^{+3} and Fe^{+3} responsible for soil acidity. Thus, bio-char application found to be a solution for enhancing productivity of soil in long run.
- Balance nutrient application gives greater sustainable yield index (SYI) and integrated nutrient management (INM) had further improved SYI. In Alfisols, application of N alone gave lower values of SYI compared to balance and INM treatments.
- Soil quality index (SQI) derived from 30-35 soil parameters (chemical, physical and biological) indicated that SQI was higher in balanced nutrient application. Further, SQI improved with an application of NPK along with FYM/Lime.

AICRP-LTFE EXPERIMENTAL SITES:

The LTFE site at MPKV Parbani (Maharashtra) with soybean-safflower cropping system

LTFE site at PJTSAU RRS, Jagtial, Hyderabad (Telangana) with rice-rice cropping system