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भाकृअनुप—भारतीय मृदा विज्ञान संस्थान

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Application No. 302-1/IISS/RTI/2025

Dated 29/01/2025

To,

Miss Anju Chhillar
Arts Block III, Department of Public Administration
Panjab University, Chandigarh - 160014

Sub.: Reply to information under RTI Act, 2005- reg.

Dear Madam,

Please find enclosed herewith the information (three pages) in response to your RTI application No. 302-1/IISS/RTI/2025 dated 13/01/2025 (registration no IIOSS/R/T/25/00001 dated 10/01/2025) and transferred by ICAR (reference no ICARH/R/T/25/00022 dated 10/01/2025) received online. Kindly acknowledge the receipt of this reply letter along with enclosures.

Further it is informed that the Appellate Authority is Director, ICAR-IISS, Bhopal and his telephone no. is 0755-2730946.

Yours sincerely,

(R. Elanchezhian)

Encl: Information containing three pages

PS & Nodal Officer RTI cum-CPIO (Scientific)

ICAR – Indian Institute of Soil Science, Bhopal

Question No. (5) Impacts of the fertilizers on the crops in case of excessive use.

Reply: The AICRP on Long Term Fertilizer Experiments of ICAR-IISS, Bhopal has been carrying research on the effect of continuous application of fertilizers and manures on crop productivity and soil quality. The AICRP on LTFE aimed to study the impact of different nutrient options i.e. Imbalance, balance and integrated nutrient management (100% NPK+FYM) on crop productivity and soil health in major crops and soil types. The field experiments comprised of control (without manure & fertilizer), 100% N, 100% NP, 50% NPK, 100% NPK, 150% NPK, 100% NPK+FYM. The chemical fertilizers used to supply nitrogen (N), phosphorus (P), potassium (K) and Zn were urea, single-super phosphate/diammonium phosphate, muriate of potash and ZnSO_4 , respectively. Results from LTFE at different locations are given here under:

Impact on crop productivity: The long-term application of balanced (100% NPK) and integrated nutrient management (100% NPK+FYM) have significant effect on crop productivity. The 100% NPK + FYM gave the maximum yield compared to imbalance and balance nutrient application. The yield across studied locations with super optimal dose of fertilizer i.e., 150% NPK is second highest after INM (100% NPK+FYM). The yield trend at majority of LTFEs found to be in the order of 100% NPK + FYM > 150% NPK > 100% NPK > 100% N > Control for major crops.

Similarly, In Inceptisols of PAU, Ludhiana (Punjab), 150% NPK found to be second highest after INM (100% NPK+FYM). The NPK applied to maize and wheat was 125:26.2:25 kg ha⁻¹ and 125:27.3:25 kg ha⁻¹. The different nutrient management options showed the yield trend for maize and wheat as 100% NPK + FYM > 150% NPK > 100% NPK > 100% NP > 100% N > Control (**Table 1 & 2**).

Table 1. Effect of long-term application of fertilizer and manure on maize yield (q ha⁻¹) at AICRP LTFE PAU, Ludhiana (Punjab)

Treatment	Maize grain yield (q ha ⁻¹)					Mean
	2019	2020	2021	2022	2023	
Control	11.3	11.2	10.6	10.3	10.6	10.80
100% N	29.9	29.1	28.3	26.9	27.5	28.34
100% NP	39.8	38.4	37.0	36.1	36.6	37.58
50% NPK	30.8	29.7	28.1	25.6	26.2	28.08
100% NPK	46.0	45.4	43.3	42.7	41.7	43.82
100% NPK+Zn	48.1	47.6	44.6	43.9	42.0	45.24
150% NPK	48.7	46.8	45.0	45.0	43.8	45.86
100% NPK+FYM	54.9	54.8	52.9	50.6	51.3	52.90
CD (0.05)	2.07	6.27	2.14	3.85	2.71	-

Table 2. Effect of long-term application of fertilizer and manure on wheat yield (q ha⁻¹) under AICRP LTFE PAU, Ludhiana (Punjab)

Treatment	Wheat grain yield (q ha ⁻¹)					Mean
	2019-20	2020-21	2021-22	2022-23	2023-24	
Control	18.5	23.2	17.9	19.0	17.3	19.2
100% N	35.4	40.8	45.6	46.4	47.2	43.1
100% NP	46.3	49.2	50.0	51.7	50.4	49.5
50% NPK	38.3	40.2	46.3	42.0	43.4	42.0
100% NPK	49.6	51.4	54.7	54.2	55.8	53.1
100% NPK+Zn	50.1	54.8	55.6	55.0	56.3	54.4
150% NPK	55.7	60.1	56.3	57.4	58.1	57.5
100% NPK+FYM	58.7	63.0	61.1	62.8	61.2	61.4
CD (0.05)	2.75	5.84	4.50	4.94	3.83	4.4

Impact on Biological Activities:

- Various organic and inorganic nutrient management practices in a long-term fertilizer experiment significantly affected soil microbial biomass carbon (Table 3). Under these activities, the mean soil microbial biomass C ranged from 140mg kg⁻¹ in control to 392 mg kg⁻¹ in 100% NPK+FYM. Balanced doses (100% NPK) and super-optimal doses (150% NPK) of chemical fertilizers were equally impacted soil microbial biomass C; however, the imbalanced dosage of chemical fertilizers (100% N and 100% NP) resulted in significantly lower soil microbial biomass C than 100% NPK.
- Dehydrogenase activity varied under different management practices. Least activity was observed 3.55 µg TPF g⁻¹ soil hr⁻¹ in control and the highest was 7.12 µg TPF g⁻¹ soil hr⁻¹ in 100% NPK+FYM in maize-wheat cropping system (Table 3). The application of 100% NPK+FYM has increased soil dehydrogenase activity significantly (18%) higher over optimal (100% NPK) fertilizer level.
- The activity of alkaline phosphatases under these practices varied from 3.48 µg PNP g⁻¹ soil hr⁻¹ in control to 7.09 µg PNP g⁻¹ soil hr⁻¹ in 100% NPK+FYM (Table 3). Integrated application of chemical fertilizer and organic manure resulted in 31% higher alkaline phosphatase activity over the balanced fertilization application and further extended to 103% higher compared to the control.
- Urease activity under these practices varied from 254 µg urea hydrolyzed g⁻¹ soil hr⁻¹ in control to 355 µg urea hydrolyzed g⁻¹ soil hr⁻¹ in 100% NPK+FYM (Table 3). Applying the optimum dose of chemical fertilizer (100% NPK) increased urease activity by 5 to 10 per cent over imbalanced fertilization (100% NP and 100% N) and 19 per cent over control.
- Application of 100% NPK+FYM recorded the highest protease enzyme activity of 50.6 µg Tyr g⁻¹ soil h⁻¹ and 20.1 µg Tyr g⁻¹ soil hr⁻¹ in control (Table 3). Furthermore, the combined application of chemical fertilizer and FYM resulted in a 41% higher protease activity over the balanced fertilization than the 152% higher protease activity over the control.

Table 3. Impact of long-term fertilizer application on soil biological properties under maize-wheat cropping system

Treatment	MBC (mg kg ⁻¹)	Dehydrogenase (µg TPF g ⁻¹ soil hr ⁻¹)	Alkaline phosphatase (µg PNP g ⁻¹)	Urease urea hydrolysed (µg g ⁻¹ soil)	Protease (µg Tyr g ⁻¹ soil hr ⁻¹)
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			soil hr ⁻¹)	hr ⁻¹)	
Control	140 f	3.55 e	3.48 e	254 e	20.1 d
100% N	210 e	4.51 d	5.48 b	273 d	22.2 c
100% NP	240 d	5.00 d	4.27 d	286 c	22.3 c
100% NPK	294 c	6.06 c	4.95 c	301 b	35.9 b
150% NPK	311 b	6.15 b	5.43 b	306 b	36.1 b
100% NPK+FYM	392 a	7.12 a	7.09 a	355 a	50.6 a

Impact on Sustainability

The maximum sustainable yield index (SYI) was recorded with 100% NPK+FYM in both maize and wheat in LTFE at Ludhiana (Punjab). This may be attributed to the additional benefit of FYM in improvement in crop growth and productivity over 100% NPK. While, lower SYI was observed in 100% N alone and control (Table 4). Thus, the balanced use of fertilizer either alone or in combination with organic manure is necessary for sustaining soil fertility and productivity of crops.

Table 4. Impact of long-term fertilizer application on sustainability yield index (1971-2023)

Treatment	Maize	Wheat
Control	0.07	0.14
100% N	0.27	0.42
100% NP	0.35	0.61
50% NPK	0.33	0.45
100% NPK	0.49	0.69
150% NPK	0.47	0.72
100% NPK+Zn	0.51	0.70
100% NPK+FYM	0.61	0.74

The balance & INM (NPK+FYM) found to sustain crop productivity and soil biological health. However, fertilizer application at super-optimal dose (i.e. 150% NPK) also found equally good in terms of yield sustainability. The imbalance nutrient application adversely affected the crop yield and overall soil quality.
