

Doses of Fertilizer Application

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Maintaining soil fertility is essential to ensure successful crop production. In every season a large amount of plant nutrients either transformed to the crop plants or lost to the environments of become unavailable. Therefore, for further production the equivalent amount of lost nutrient elements should be returned back to the soil. It can only be ensured by supplying nutrients in proper doses and correct forms.

Types of fertilizer dose

On the basis of purpose of the dose of fertilizers are of three types:

1. Corrective dose
2. Maintenance dose
3. Productive dose

1. Corrective dose: If one or more nutrient become deficient in soil the productivity of crops may be declined drastically. In such the dose of deficient nutrient which are applied to prevent the yield and quality of crops is called corrective dose.

2. Maintenance dose: In course of time, the fertility of cultivated land decline gradually. The dose of fertilizer which are applied to maintain the normal fertility of soil is called maintenance dose.

3. Productive dose/ Recommended dose: to ensure more yield, a higher dose beyond the normal requirement need to be applied. The dose of fertilizer which are applied to obtain higher yield is called productive or recommended dose.

In general, corrective dose becomes higher than maintenance dose and productive dose becomes higher than corrective dose. i.e. Productive dose > Corrective dose > Maintenance dose. Among the essential plant nutrients, secondary nutrients (Ca, Mg, S) should be applied as maintenance dose. This dose may also be maintained by applying organic manures. However, it is noteworthy that no major elements (C, H, O, N, P, K, Ca, Mg, S) are expected to be deficient in soil.

Types of recommended dose of fertilizer

There are four types of recommended dose of fertilizer, viz.

- 1) Threshold recommended dose
- 2) Low recommended dose
- 3) Optimum recommended dose
- 4) Superior recommended dose

Table 1. Yield of rice as affected by different doses of nitrogen

N dose (kg ha ⁻¹)	Total yield (kg ha ⁻¹)	Physical yield (kg ha ⁻¹)	Average Physical yield (kg ha ⁻¹)	Marginal yield (kg ha ⁻¹)
0	1000	–	–	–
40	2000	1000	25.00	25.00
80	3200	2200	27.50	30.00
120	3500	2500	20.83	7.5
160	4000	3000	18.75	12.5
200	3300	2300	16.50	-17.5



1. Threshold recommended dose

The minimum amount of fertilizer applied to get positive response from crop production is 'threshold recommended dose'. The amount below this dose does not confer any economic return. For major plant nutrients this dose is usually 20 kg ha⁻¹.

2. Low recommended dose

The amount of fertilizer applied to get maximum return per unit fertilizer is the low recommended dose. From Table 1 it is observed that up to certain limit increase in fertilizer dose continue to increase yield. However, fertilizer at 80 kg ha⁻¹ results maximum (27.50 kg) yield per kg fertilizer. From the table it is also observed that the marginal yield is maximum with 80 kg ha⁻¹ which is the low recommended dose.

3. Optimum recommended dose

The amount of fertilizers which are applied to get maximum return per unit area is called 'optimum recommended dose'. In this case, economic yield are considered rather than the return per unit fertilizers and hence it is also called economic recommended dose.

In Table 1. It is observed that after 160 kg ha⁻¹ N application, the marginal yield becomes negative i.e. upon application of 200 kg ha⁻¹ N, the there is an economic loss. So, the fertilizer dose between 120 and 160 kg ha⁻¹ is the optimum recommended dose.

4. Superior recommended dose

The amount of fertilizer which is used to get maximum yield per unit area without considering economic profit is called 'superior recommended dose. In Table it is observed that from 160 kg ha⁻¹ N maximum physical yield (3000 kg ha⁻¹) is obtained from unit area. Primarily, it is the superior recommended dose. But it is sometimes expected that the yield may increase further upon increase in fertilizer dose. Therefore, when the yield curved reach at the maximum point is the superior recommended dose (Fig. 1). It lies in any point between 160 and 200 kg N ha⁻¹.

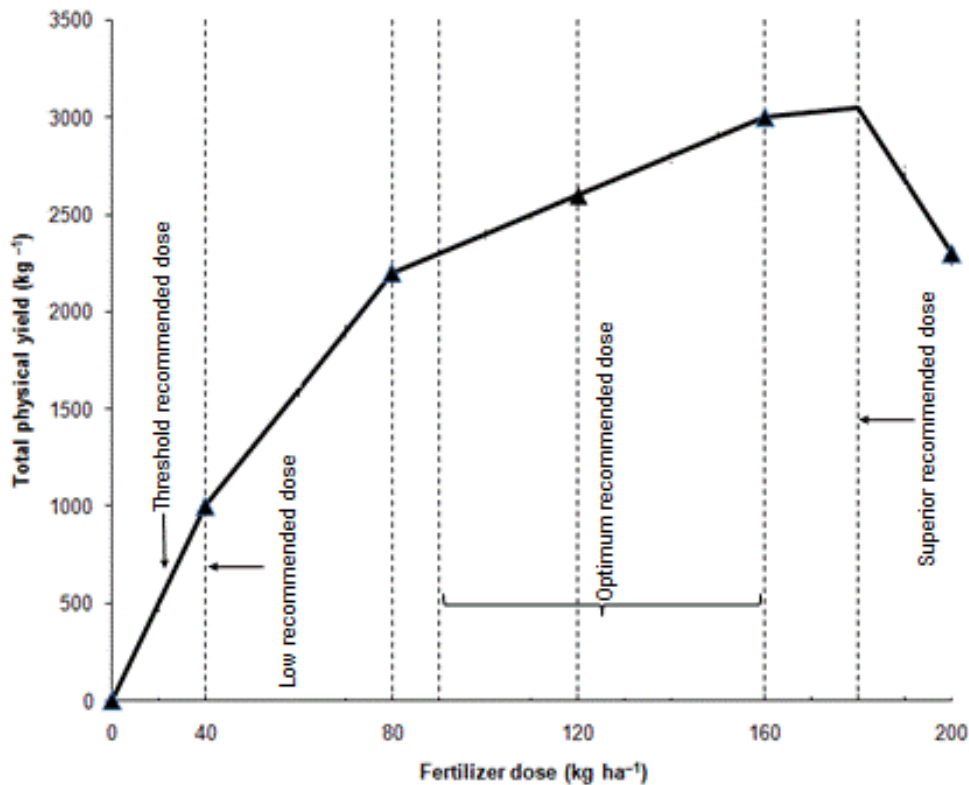


Fig. 1 Effect of N fertilizer on rice yield



Factors affecting the optimum dose of fertilizer

Initial soil fertility

The dose of fertilizer depends on initial soil fertility. The dose of fertilizer is higher in the soil having lower amount of available nutrients.

Soil properties

The physical chemical and biological properties greatly affect the dose of fertilizer. Soil texture, structure, moisture, temperature, chemical reaction, pH and biological properties affect on the availability of nutrient elements. Apart from these, nutrient fixation is also affected by those properties.

Degree of soil disturbance

Different natural causes and cultural practices sometimes disturb the soils. Extensive tillage followed by heavy rainfall may result in soil erosion and overgrowth of weeds which wash out or remove nutrients from soil. In such cases fertilizer dose may be higher.

Nutrient demand of crops

The demand of nutrient greatly varied from crop to crop. It is due to the morphological and physiological constituent of the crops and differences in agronomic practices. Generally, the crops which produces more dry matter or seeds require more nutrient and hence the fertilizer dose become higher (Table 2). Some crop plants contains nutrient elements in different ratios. For example, the ration of N, P and K in potato and rice is 1-1.2: 1: 1 and 1.2:0.8:0.6, respectively. This ratio further varied depending on varieties.

Table 2. Nutrient uptake pattern of some important crops

Crop	Yield (t ha ⁻¹)	Nutrient uptake (kg ha ⁻¹)			
		N	P	K	S
Rice (HYV)	6.0	108	18	120	11
Wheat (HYV)	5.0	148	28	123	21
Maize	6.0	120	22	100	21
Chickpea	1.5	91	6	47	13

Crop production technology

Fertilizer doses also varied due to crop cultivation technologies. Plant population, crop varieties or cultivars, use of organic matter, application of pesticides, tillage, irrigation and drainage, cropping seasons etc affect the fertilizer dose.

Fertilizer use efficiency

The fertilizer dose becomes lower if the fertilizer use efficiency is high. For instance, the fertilizer use efficiency for N, P and K in rice field is 37, 41 and 36%, respectively even under optimum soil moisture. Hence, the fertilizer dose if high for rice cultivation. Fertilizer use efficiency depends on several factors such as genetic constituents of crop plants, soil properties, fertilizer application methods, and other agronomic practices.

Methods of fertilizer application

Fertilizer application methods affect the fertilizer use efficiency and hence the dose of fertilizer varied. The dose of fertilizer is higher in case of broadcasting compared to band application or drilling. Fertilizer dose for foliar application is lower than soil application.

Crop residues

If crop residues are allowed to decompose in soil, it adds organic matter and nutrients to soil and hence fertilizer dosed become lower. Some of the exhaustive crops uptake higher amount of nutrient from soil. In such cases crop residues must incorporate into soil to restore some nutrients.

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Type of fertilizer

Application of slow released fertilizer such as sulfur-coated urea or urea supergranules (USG) prevents loss of fertilizer. In such cases, fertilizer use efficiencies may increase by 65% and 36-41%, respectively and hence fertilizer doses become lower.

Soil management

Different soil management practices such as liming, organic manuring, alternate wetting and drying (AWD) methods of irrigation may increase the availability of nutrients and decrease the dose of fertilizer.

Types of crop

Fertilizer doses differs in different crop types and varieties. Fertilizer dose also depends on root structure, branching types, leaf numbers, crop canopy, dry matter productivity etc.

Table 3. Nutrient demand of some important crops

Crop	Nutrient demand (kg ha ⁻¹)		
	N	P	K
Boro rice (HYV)	17-32	5-8	14-26
Boro rice (Local)	33-64	8-14	21-40
Wheat (HYV)	29-56	9-16	20-38
Maize (HYV)	29-56	9-16	21-40
Lentil	4-8	7-12	6-10
Mustard	28-56	8-14	14-26

Productivity

The crop which has high yield potential require high dose of fertilizer.

Soil moisture

Soil moisture affect the solubility and uptake of nutrients which influence the dose of fertilizer. Under irrigated condition higher dose of fertilizer facilitate better growth and productivity of crops. Therefore fertilizer dose is higher under irrigated condition than non-irrigated condition.

Table 4 fertilizer dose (kg ha⁻¹) for wheat under irrigated and non-irrigated condition

Fertilizer	Irrigated condition	Non-irrigated condition
Urea	180-200	140-180
Triple superphosphate	140-180	140-180
Muriate of potash	40-50	30-40
Zinc sulfate	110-120	70-90

