STUDY ON MANURES AND FERTILIZERS

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Manures

Manures may also be called as 'Organic manure'. Some of the organic wastes or by-products (extracts of animals and birds, litter, crop refuses, and other by-products) either decomposed or treated or fresh are used to enrich soil fertility. These are called manures.

Manures may be bulky (nutrient contents are very low per unit area) such as farm yard manures (FYM), and compost or concentrated (containing a higher per cent of nutrients) such as oilcakes, meals of blood, meat, bone, fish, horns and hooves.

Fertilizers

Broadly, a fertilizer may be defined as any substance (chemical, organic and microbial) that is added to the soil supply element (s) required for the nutrition of plants (BARC, 2018).

In a specific sense, fertilizers are chemicals that occur naturally or are produced in the factory and when added to the soil, supply nutrient elements required for better plant growth.

Differences between manures and fertilizer

Sl. No.	Manures	Fertilizers
1.	Naturally occurring substance.	Artificially made.
2.	Generally bulky in nature. i.e. concentration of plant nutrient is low.	Concentration of plant nutrient is high.
3.	Obtaining from organic sources.	Obtaining from inorganic sources.
4.	Easy to prepare.	Preparation is complex.
5.	Excess application is not harmful to soil.	Excess application may cause harmful effect to soil.
6.	Release plant nutrient in available form slowly.	Release plant nutrient in available forms quickly.
7.	Residual effect is high.	Residual effect is low.
9.	Improves the physical properties of soil.	Does not improve the physical properties of soil, but sometimes it may cause negative effect on soil properties.
10.	Cost of preparation is low.	Cost of production is high.
11	They have no definite chemical formula.	They have definite chemical formula.

List of manures

The followings are some important organic manures

a. Cowdung
b. Farm yard manures
c. Compost
d. Poultry manures
e. Oil cakes
f. Blood meal
g. Meat meal
h. Fish meal
i. Green manures etc.
j. Vermicompost

List of fertilizers

Nitrogenous fertilizer: Sodium nitrate, Calcium nitrate, Ammonium chloride, Ammonium sulphate, Anhydrous ammonia, Ammonium nitrate, calcium ammonium nitrate (CAN), Ammonium sulphate nitrate (ASN), Urea, Calcium cyanamide

Phosphatic fertilizer: Single super phosphate (SSP), Triple super phosphate (TSP), Ammonium phosphate, Dicalcium phosphate, Basic slag, Rock phosphate. Tricalcium phosphates

Potassic fertilizer: Muriate of potash (MOP), Potassium sulphate, Potassium nitrate, Potassium magnesium nitrate

Properties of some manures and fertilizers

A. Properties of manures

Name of the manures	Physical properties			Nutrient content
	Colour	Solubility	State	
Cowdung	Blackish	Water soluble	Solid	% N = 0.5-1.5 % P_2O_5 = 0.4-0.8 % K_2O = 0.5-1.9
Compost	Blackish	Water soluble	Solid	% N = 0.4-0.8 % P_2O_5 = 0.3-0.6 % K_2O = 0.7-1.0
Farm yard manure (FYM)	Light green or blackish	Water soluble	Solid	% N = 0.5-1.5 % P_2O_5 = 0.4-0.8 % K_2O = 0.5-1.9
Mustard oil cake (MOC)	Brownish	Water soluble	Solid	% N = 5.1-5.2 % P_2O_5 = 1.8-1.9 % K_2O = 1.1-1.3
Til oil cake	Blackish	Water soluble	Solid	% N = 6.2-6.3 % P_2O_5 = 2.0-2.1 % K_2O = 1.2-1.3
Wood ash	Blakish or grayish	Water soluble	Solid	% N = Trace % P_2O_5 = 2.0 % K_2O = 2.3-12

B. Properties of fertilizers

Name of the fertilizers	Properties						
	Physical properties			Chemical properties			
	Colour	Solubility	Structure	Reaction	Chemical formula	Nutrient content	Available form (s)
Urea	White	Highly soluble in water	Granular	Acidic	$CO(NH_2)_2$	N= 46%	NH_4^+ NO_3^-
Diammonium phosphate	Brownish	Highly soluble in water	Granular	Alkaline	$(NH_4)_2HPO_4$	N= 18% P_2O_5= 46%	NH_4^+ $H_2PO_4^-$ HPO_4^{2-} PO_4^{3-}
SSP	Grayish	Highly soluble in water	Dust	Neutral	$Ca(H_2PO_4)_2.H_2O$. $CaSO_4$	P_2O_5 = **16**-18% S = 10-14% Ca: 18-21%	$H_2PO_4^-$ HPO_4^{2-} PO_4^{3-} SO_4^{2-}
TSP	Grayish or blackish	Easily soluble in water	Granular	Neutral	$Ca(H_2PO_4)_2.H_2O$	P_2O_5 = 48% Ca: 15%	$H_2PO_4^-$ HPO_4^{2-} PO_4^{3-}
MOP	Brick red	Easily soluble in water	Granular	Acidic	KCl	K_2O = 60%	K^+
Gypsum	Whitish	Easily soluble in water	Dust	Acidic	$CaSO_4.2H_2O$	S = 18% Ca = 33%	SO_4^{2-} Ca^{2+}
Zinc sulphate	Whitish	Easily soluble in water	Granular	Acidic	$ZnSO_4$	Zn = 36% S = 18%	Zn^{2+} SO_4^{2-}

Calculations on fertilizers and manures

Problem 1: Calculate the quantity of urea, single superphosphate (SSP) and muriate of potash (MOP) required for one hectare of rice with the N, P_2O_5 and K_2O 100-50-50 kg ha^{-1}.

Solution:

We know,
In urea, %N = 46,
In SSP, % P_2O_5 = 16 and
In MOP, % K_2O = 60

$$\text{The required amount of fertilizer} = \frac{100 \times \text{Dose of nutrient}}{\text{Nutrient content in the applied fertilizer (\%)}}$$

Therefore,

$$\text{The required amount of urea} = \frac{100 \times 100}{46} = 217.4 \text{ kg ha}^{-1}$$

$$\text{The required amount of SSP} = \frac{100 \times 50}{16} = 312.5 \text{ kg ha}^{-1}$$

$$\text{The required amount of MOP} = \frac{100 \times 50}{60} = 83..33 \text{ kg ha}^{-1}$$

Answer: The required amount of urea, SSP and MOP for one hectare of rice field is 217.4, 312.5 and 83.33 kg, respectively.

Problem 2: Recommended rate of urea, TSP and MOP for wheat is 120, 60 and 60 kg ha^{-1}, respectively. Calculate the amount of N, P and K required for two hectares of land.

Solution:

We know,
In urea, %N = 46,
In SSP, % P_2O_5 = 16 and
In MOP, % K_2O = 60

P_2O_5 content × 0.43 = P content

K_2O × 0.83 = K content

$$\text{The required amount of nutrient} = \frac{\text{Nutrient content in the applied fertilizer} \times \text{Dose of fertilizer}}{100}$$

Therefore,

$$\text{The required amount of N for 2 hectare} = \frac{46 \times 120}{100} \times 2 = 110.4 \text{ kg}$$

$$\text{The required amount of P for 2 hectare} = \frac{48 \times 60}{100} \times 2 \times 0.43 = 24.77 \text{ kg}$$

$$\text{The required amount of K for 2 hectare} = \frac{60 \times 60}{100} \times 2 \times 0.83 = 59.76 \text{ kg}$$

Answer: The required amount of N, P and K for two hectares of land is 110.4, 24.77 and 59.76 kg, respectively.

Problem 3: Calculate the quantity of DAP, urea and MOP required for one hectare of rice to meet the nutrient requirement of N, P_2O_5 and K_2O at 100-50-50 kg.

We know,

In DAP, %N = 18 and % P_2O_5 = 46
In urea, %N = 46,
In MOP, % K_2O = 60

Solution:

As DAP supply both P_2O_5 and N, we have to calculate the amount of DAP first. At first we calculate the amount of P_2O_5 as it presents in higher quantity (see note).

According to the formula,

The required amount of DAP to supply 50 kg P_2O_5 $= \frac{100 \times 50}{46}$ = 108.69 kg

The amount of N present in 108.69 kg of DAP $= \frac{18 \times 108.69}{100}$ = 19.56 kg

The rest amount of N that will be supplied from urea = 100−19.56 = 80.43 kg

Therefore,

The requirement of urea $= \frac{100 \times 80.43}{46}$ = 174.84 kg ha^{-1}

The required amount of MOP $= \frac{100 \times 50}{60}$ = 83.33 kg ha^{-1}

Answer: The required quantity of DAP, urea and MOP is 108.69, 174.84 and 83.33 kg, respectively.

[**Note:** Whenever compound fertilizer is involved, calculate first for the contribution of that fertilizer for the nutrient for the nutrient that is present in higher quantity. For example, in the case of DAP, first calculate for P as DAP contains higher quantity of P. Then calculate the quantity of the next highest quantity of nutrient, in this case N, contributed by that of the fertilizer.]

Problem 4: Calculate the amount of nutrient from 3-2-1graded 1 ton fertilizer.

Solution:

Here, sum of ratio (3+2+1) = 6

We know, 1 ton = 1000 kg

Amount of N $= \frac{3 \times 1 \text{ ton}}{6}$ or $\frac{3 \times 1000 \text{ kg}}{6}$ = 500 kg

Amount of P_2O_5 $= \frac{2 \times 1 \text{ ton}}{6}$ or $\frac{2 \times 1000 \text{ kg}}{6}$ = 333.33 kg

Amount of K_2O $= \frac{1 \times 1 \text{ ton}}{6}$ or $\frac{1 \times 1000 \text{ kg}}{6}$ = 166.67 kg

Answer: The content of N, P_2O_5 and K_2O is 500, 333.33 and 166.67 kg, respectively.

Problem 5: Recommended rate of N, P_2O_5 and K_2O for wheat is 120, 80 and 70 kg ha^{-1}, respectively. If the land (2 ha) is supplemented with 10 tones of farm yard manure (FYM), calculate the amount of urea, TSP and MOP to meet the requirement.

Solution:

Let, in FYM %N ≈ 0.5, %P_2O_5 ≈ 0.4 and % K_2O ≈ 0.5

The supplied amount of N from FYM $= \frac{0.5 \times 10000}{100}$ = 50 kg

The supplied amount of P_2O_5 from FYM $= \frac{0.4 \times 10000}{100}$ = 40 kg

The supplied amount of K_2O from FYM $= \frac{0.5 \times 10000}{100}$ = 50 kg

Recommended rates of nutrient for 2 hectare of wheat field are:

N = 120 × 2 = 240 kg; P_2O_5 = 80 × 2 = 160 kg; and K_2O = 70 × 2 = 140 kg

From FYM application, we get 50, 40 and 50 kg of N, P_2O_5 and K_2O, respectively.

So,

The amount of N to be supplied from urea = 240−50 = 190 kg
The amount of P_2O_5 to be supplied from TSP = 160−40 = 120 kg
The amount of K_2O to be supplied from MOP = 140−50 = 90 kg

We know,
In urea, %N = 46,
In TSP, % P_2O_5 = 48 and
In MOP, % K_2O = 60

The required amount of urea $= \frac{100 \times 190}{46}$ = 413 kg

The required amount of TSP $= \frac{100 \times 120}{48}$ = 250 kg

The required amount of MOP $= \frac{100 \times 90}{60}$ = 150 kg

Answer: The amount of urea, TSP and MOP for two hectare of wheat field is 413, 250 and 150 kg, respectively.

Useful Chemical Conversion Factors

P × 2.29 = P_2O_5
P_2O_5 × 0.43 = P
H_3PO4 × 0.32 = P
K × 1.20 = K_2O
K_2O × 0.83 = K
KCl × 0.52 = K
K_2SO_4 × 0.45 = K

Some other useful conversions

1 acre = 100 decimal = 3.025 *bigha*
1 hectare = 1 ha = 10,000 m^2 = 2.47 acre = 7.47 bigha
1 *katha* = 1.67 decimal
1 *bigha* = 20 katha = 33.33 decimal

1 kg = 2.2046 pounds
1 lb = 0.4535 kg

Fertilizer/Nutrient Ratio
Urea: N = **2.17**: 1
TSP: P = **5.00**: 1
MOP:K = **2.00**: 1
Gypsum:S = **5.56**: 1
$ZnSO_4$:Zn: **2.79**: 1

Suggested Reading:

1. Balasubramaniyan, P. and Palaniappan, S.P. 2004. *Principles and Practices of Agronomy*. 2nd Edn. Agrobios (India).p. 228-229.

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4. De, G. C. 1989. *Fundamentals of Agronomy*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

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