NUTRIENT MANAGEMENT IN FLOWERS

A survey report on current fertilizer use pattern and guide to nutrient management in major flowers in Nepal

FLORICULTURE ASSOCIATION OF NEPAL

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Patron and Advisor

Dr. Umed Pun

Dilip Bade

Author and Reviewer

Ganesh Lamsal

Survey Team

Sabin Karki, Arjun Chapagain

and Salikram Ghimire

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Introduction to Essential Plant Nutrients

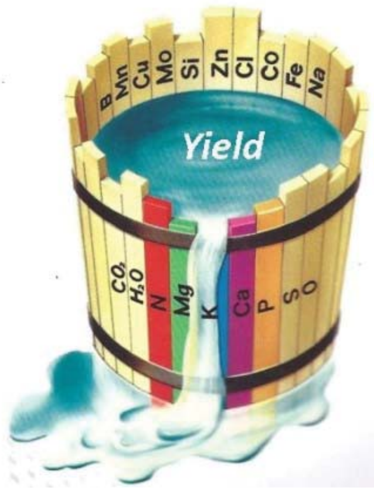
There are 16 elements considered essential for the growth of higher plants. Some are needed in relatively large quantities (major elements) where as others in small amounts (minor/trace/micro-nutrients). However, all the elements are equally important for the growth of the plant.

The essential elements can also be classifieds into:

1. Structural elements: C, H, O
2. Primary elements: N, P, K [needed in relatively large quantity]
3. Secondary elements: Ca, Mg,S [needed in relatively medium amount]
4. Micronutrient elements: Mn, Mo, Zn, Cl, Fe, Cu, B [trace amount]

Beneficial elements: Essential for crop, but not for all crops. They are Sodium, Cobalt, Silicon, Vanadium, Nickel and Selenium. Sometimes, they can compensate for toxic effect of other elements.

Plant frequently contains unnecessary high and sometimes toxic concentrations of essential or **non-essential elements**. E.g. Na+ and Cl- (in saline soils), B and Cu in alkaline soil, Al and Mn in acid soils.



Concept of limiting factor

It is also called law of minimum given by Justus Von Liebig. Plant growth is constrained by the essential element that is most limiting. The level of water in the barrel represents the level of plant production. When any nutrient is deficient, it becomes the limiting factor. Even though the other elements are present in more than the adequate amounts, plant production cannot be increased until the limiting nutrient is fulfilled i.e. maximum production can be obtained when all the essential nutrients are available to plant.

Classification of plant nutrients according to mobility

Mobility in soil	Mobility in plant
Mobile nutrients N, P, K, Mg, Cl, Mo	Mobile nutrients N, P, K, Mg, Zn Deficiency is shown in older parts of the plant
Immobile nutrients Ca, B, Fe, Mn, Cu, Zn, S	
Semi-mobile nutrients Mo and S are also regarded as semi-mobile element by some soil scientists. P becomes semi-mobile in cold season.	Immobile nutrients S, Ca, B, Fe, Mn, Mo, Cu, Cl Deficiency is shown in younger parts of the plant.

NUTRIENT MANAGEMENT IN FLOWERS

Essential plant nutrients and their forms absorbed by plants

Elements	Form absorbed	Concentration in plants	Soil pH availability	Primary sources
Structural mutrients				
Carbon(C)	CO_2	45%	-	Carbon dioxide in air
Hydrogen (H)	H_2o	6%	-	Water
Oxygen (O)	CO_2 , O_2, H_2o	43%	-	Water, air
Primary nutrients				
Nitrogen (N)	NO_3^-, NH_4^+	1-6%	6-8	Organic matter, atmosphere
Phosphorus (P)	$H_2PO_4^-$, HPO_4^{2-}	0.05-1.0%	6.5-7.5 & 8.5-10	Soil minerals , organic matter
Potassium (K)	K^+	0.3-6%	6-10	Soil minerals
Secondary nutrients				
Calcium (Ca)	Ca^{2+}	0.1-3%	7-10	Soil minerals, limestone
Magnesium (Mg)	Mg^{2+}	0.05-1.5%	7-10	Soil minerals, limestone
Sulfur (S)	So_4^{2-}	0.05-1.5%	6-10	Organic matter, rain water
Micronutrients				
Iron (Fe)	Fe^{2+}, fe^{3+}	100-1000 Ppm	Less than 6	Soil minerals
Manganese (Mn)	Mn^{2+}	5-500 Ppm	Less than 6.5	Soil minerals
Copper(Cu)	Cu^{2+}	2-75 Ppm	5-7	Soil minerals , organic matter
Zinc (Zn)	Zn^{2+}	5-1000 Ppm	5-7	Soil minerals, organic matter
Boron (B)	H_3B_{o3}	2-75 Ppm	5-7	Organic matter , tourmaline
Molybdenum (Mo)	$M_oO_4^{2-}$	0.01-10 Ppm	7-10	Soil minerals, organic matter
Chlorine (Cl)	Cl^-	0.05-3%	-	Rain water

Role of different elements in plant growth

Nutrients	Role in plant growth
Primary nutrients	
Nitrogen(N)	Imparts vegetative growth, dark green color, integral part of chlorophyll needed for photosynthesis, constituent of proteins, enzymes and co-enzymes.
Phosphorus(P)	Stimulate early vegetative growth, root growth, better exploitation of water and nutrients, tolerance to root rot disease, constituent of enzymes, important for transformation of energy and metabolism, constituents of nucleic acid and phospholipids.
Potassium(K)	enzyme activation, transformation of sugars and starch, imparts disease resistance and winter hardiness, improves quality of final product, water uptake and stomata regulation, intake and regulation of N and P.
Secondary nutrients	
Calcium(Ca)	Constituent of cell wall, helps in cell division, enhances uptake of nitrate-N, increases Mo availability.
Magnesium(Mg)	Constituent of chlorophyll and chromosome, protein synthesis, activates enzymes
Sulphur(S)	synthesis of Sulphur containing amino acids, synthesis of metabolites and coenzyme A, part of ferrodoxin (a protein in chloroplast)
Micro-nutrients	
Iron (Fe)	part of enzyme responsible for reduction of nitrate nitrogen, component of ferrodoxin, found in enzyme system, helps formation of chlorophyll
Manganese(Mn)	Supports for movement of iron in plant, takes part in oxidation reduction reaction in cell, involves in electron transport system in photosynthesis, acceleration of germination and maturity.
Copper(Cu)	Acts as electron carrier in many oxidation reduction reaction, activator of several enzymes, important at reproductive stage.
Zinc(Zn)	regulates auxin concentration in plants, activator of enzymatic reaction like carbonic anhydrase, alcohol dehydrogenase
Boron(B)	role in growth of new cells in plant meristem, helps in pollination, helps absorption of N, acts as regulator of K / Ca ratio in the plants, keeps Ca soluble & increase its mobility in plant.
Molybdenum(Mo)	Component of enzyme nitrate reductase and nitrogenase, iron absorption and translocation in plants.
Chlorine(Cl)	essential in the transfer of electron from water to photo oxidized chlorophyll in photosynthesis, imparts turger of leaves, required for root growth.

Deficiency and toxicity symptoms of plant nutrients

Nutrient	Deficiency symptoms	Toxicity/excess effects
Primary nutrients		
Nitrogen	Yellowing of old leaves at first, yellowing starts at the tip of leaves and proceeds towards base primarily central portion rather then margin, poor vegetative growth	Produces succulence, sensitive to water and temperature stress, susceptible to lodging, susceptible to diseases and pests, delay crop maturity,
Phosphorus	restricted growth of root and shoot, purple and defoliation of older leaves combined with bronze discoloration of margin, delayed maturity, poor final product	Leads to iron chlorosis and deficiency of Zinc
Potassium	leaves burn along the edges and curling starting from tip of older leaves, weak plants decreased resistance to diseases and pests,	Toxicity causes deficiency of Magnesium and calcium
Secondary nutrients		
Calcium	it is immobile in plant so, terminal bud and root tips retarded, chromosome abnormality, abnormal dark green foliage	Leads to iron chlorosis in plant
Magnesium	Interveinal chlorosis of older leaves and spread towards younger leaves, only leaf vein remain green	toxicity is observed in alkali soil, higher concentration unbalances Ca and K
Sulphur	yellowing of leaves on new growth, orange reddish tints on older leaves	Prematured dropping of leaves, interveinal yellowing and burning
Micro-nutrients		
Iron	Chlorosis of young leaves, creamy white on severe deficit, deficiency is more on calcareous and alkaline soils	reduction in growth, browning of roots as well as leaves with tiny brown spots
Manganese	Margin of young and middle leaves become pale green, chlorosis extends between the lateral veins towards the mid-rib.	Toxicity observed in highly acidic soils, older leaves have brown spots surrounded by yellow circle
Copper	young and expanding leaves become twisted, curved and dead, irregular margin, in advance stage shoot apex dies back, leaves detach easily, deficiency is prominent under peat and muck soils	Excess copper decreases iron concentration in leaves

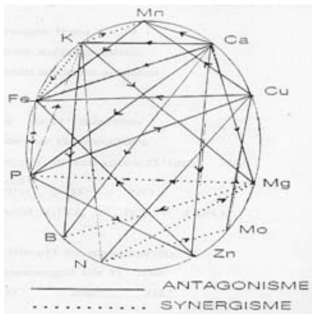
Zinc	Interveinal yellowing or whitening of young leaves, dead spot develops all over the leaf, leaf size and length of stem is reduced, crowed leaves and stems	Cause iron deficiency, rolling of leaves, clustering of leaves at the top
Boron	Deficiency occurs on young leaves at apical growth, loosening more color at the base of leaves, finally death of growing point leading to multiple lateral branches	chlorosis in young leaves between veins, leaf tip become yellow
Molybdenum	Chlorosis occurs in young and middle leaves, curved (cupped) margins, dead spot all over the leaf area except veins, affected area extruded resinous gum through lower leaves	toxicity develops brilliant tints
Chlorine	Wilting of leaves, curling and chlorosis observed, leaf bronzing on severe deficiency	Burning of leaf tip margin, pre-matured yellowing, leaf fall

Conditions conductive to nutrient deficiency

Nutrient	Conditionfor deficiency	Nutrient	Condition for deficiency
Primary nutrients		**Secondary nutrients**	
Nitrogen	Low organic matter, water logging, when large amount of residues are ploughed (temporary deficiency), loss through leaching, denitrification, volatilization and soil erosion	Calcium	very low pH, sandy soils, excess K and Mg
Phosphorus	new lands, very low or high pH, cold/ very dry/very wet condition, high N and K, rock phosphate creates P deficiency in the year of its application	Magnesium	low pH, high Ca, leached acid sandy soils, high K and Ca
Potassium	Highly leached sandy soils, high Mg and Ca, low k originally, soils with heavily cropped with legumes	Sulphur	Low organic matter, highly leached and sandy soils, cold/wet soils, highly eroded soils
Micronutrients			
Boron	pH <5 or >7, sandy soils, high lime application, dry soil, low organic matter		
Molybdenum	Low pH, High iron, leached acid soils and weathered soils, low organic matter		

Iron	high pH >7, cold/wet/poor aerated soil, high lime application
Manganese	high pH, high organic matter, well drained neutral or calcareous soil, high lime
Copper	High pH, High organic matter, poorly drained peat and muck soils weathered and leached soils, high lime, high Fe, Mn and Ca.
Zinc	Acid/alkaline, leached and sandy soils, eroded soil, low/ very high(muck soil) organic matter, high phosphorus band placement
Chlorine	Very sandy soils

Antagonism and synergism of Nutrients

Antagonism	Synergism	Pictorial view
High levels of one specific element decreases the uptake of another element Example: K and Mg	High levels of one specific element increases the uptake of another element Example: K in relation to Fe + Mn	

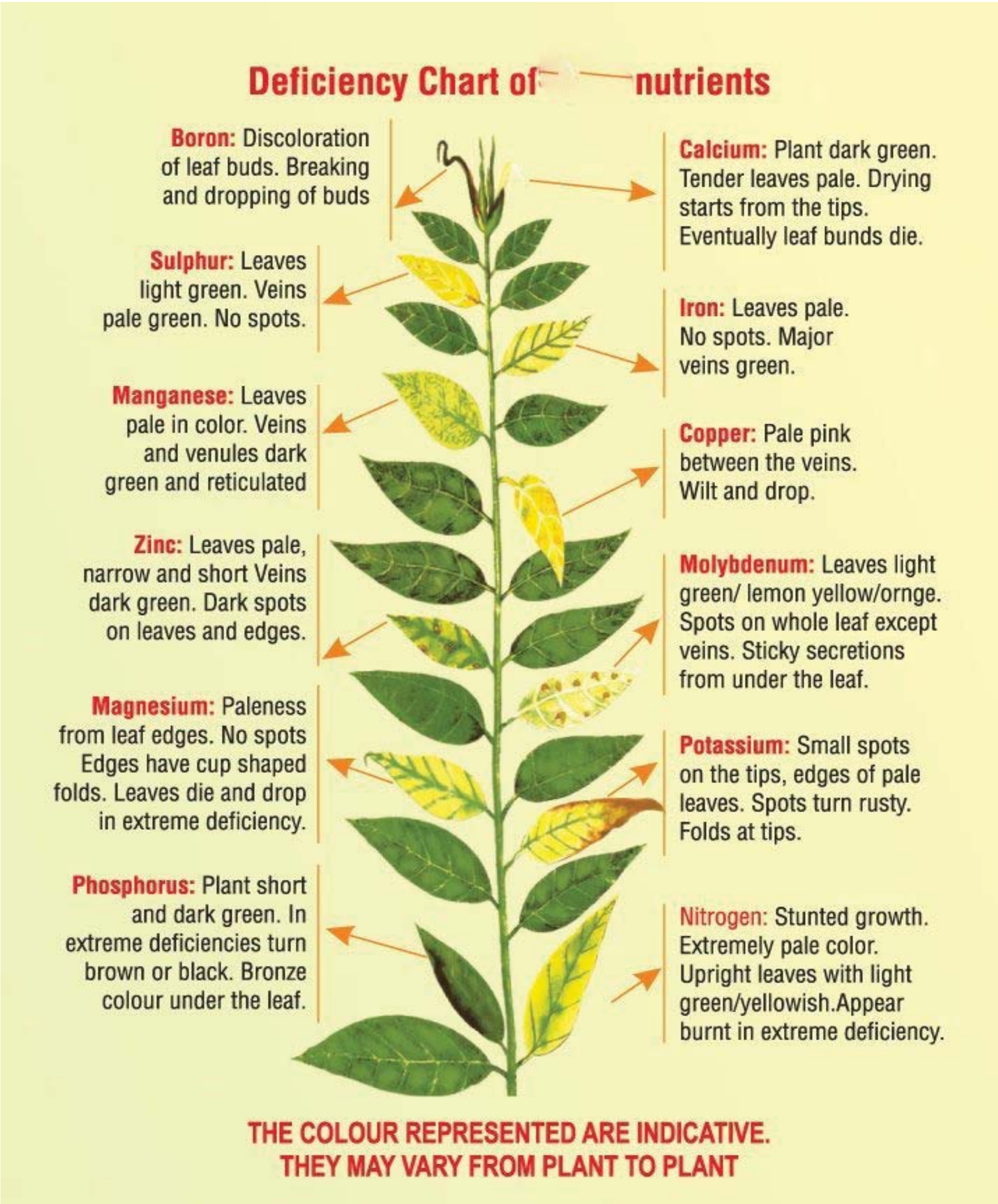
Key to Nutrient Deficiencies

Base of plant – mobile (N, P, K, Mg)

Whole (mid) plant – partially mobile (S, Mo)

Top of plant – immobile (Ca, Fe, Mn, Zn, Cu, B)

- Chlorosis (Mn, Fe)
  - Interveinal chlorosis with tan flecks (Mn)
  - Interveinal chlorosis – yellow - necrosis (Fe)
- Necrosis & distortion (Ca, B)



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Soil testing

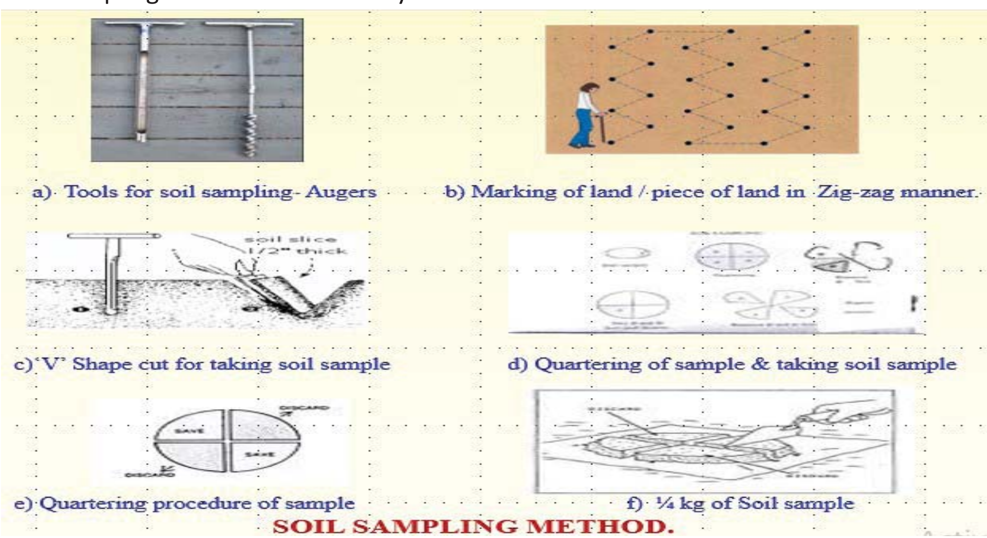
It is important to determine fertility, pH and EC levels of soil before planting of crops so that the necessary lime or acidifier can be applied to the soil. Standards for each nutrient in soil are given below:

Nutrient	Rating		
	Low	Medium	High
Available N (kg/ha)	<250	250-500	>500
Available P (kg/ha)	<10	10-25	>25
Available K (kg/ha)	<140	140-280	>280
Calcium (ppm)	<500	500-1000	>1000
Magnesium (ppm)	<250	250-500	>500
Sulfur (ppm)	<10	10-20	>20
Iron (ppm)	<5.0	5-10	>10
Manganese (ppm)	<5.0	5-10	>10
Zinc (ppm)	<0.5	0.5-1.0	>1.0
Copper (ppm)	<0.2	0.2-0.4	>0.4
Boron (ppm)	<0.1	0.1-0.5	>0.5
Molybdenum (ppm)	<0.05	0.05-0.1	>0.1

Source: Soil science Directorate, Hariharbhawan

Soil sampling method for testing

For flowers soil sample is taken from 15-20 cm depth. 20-25 spots are selected in zig-zag manner. Dig 'V' shaped hole and cut thin slice (1 inch) from one side of the hole. Collect all these sample and mix thoroughly. Make circle of sample and divide into 4 quarters, discard two alternate quarters and Mix the remaining quarters. Repeat the process until sample reaches ½ kg. This sample is dried under shade/ overnight before taking to soil test lab. While within the greenhouse different spots in the beds are selected and sampling is done in similar way.

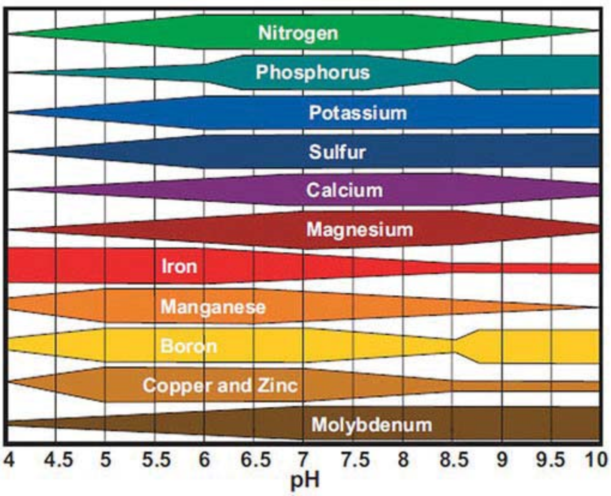


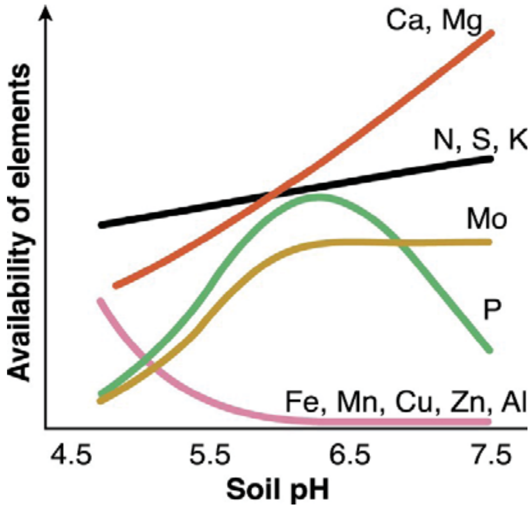
a) Tools for soil sampling- Augers
b) Marking of land / piece of land in Zig-zag manner.
c) 'V' Shape cut for taking soil sample
d) Quartering of sample & taking soil sample
e) Quartering procedure of sample
f) ¼ kg of Soil sample

SOIL SAMPLING METHOD.

Soil EC and pH in relation to nutrient availability

Soil pH: Soil pH is directly related to nutrient availability to plants and health of root systems. pH 7 is neutral soil, pH less then 7 is acidic soil whereas pH greater than 7 is called alkaline soil. Most of the nutrients are available to plants at pH 6.5 to 7. Phosphorus is mostly available in neutral soil, in acid soil P tends to be fixed by Fe and Al whereas in alkaline soil it is fixed by Ca. Micronutrients are available in neutral to slightly acidic soil whereas above pH 7 their availability is decreased. pH 6.5 is preferred for most of the cut flowers. However, cut flowers can be successfully grown under pH range 5.5 to 6.5 [rose, gladiolus, carnation, gerbera, chrysanthemum, marigold].





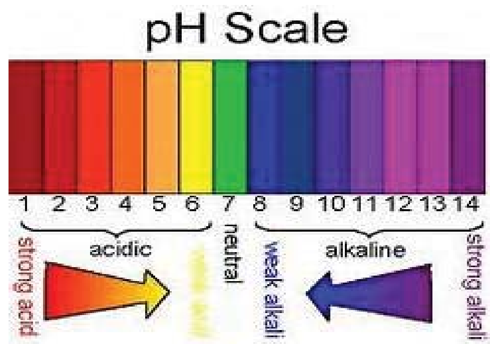
Effect of pH

At high pH values (pH > 7):

1. Some nutrients are less soluble and may precipitate.
2. The uptake of Fe, P, Mn, B and Zn may be blocked.

At low pH values (pH < 5):

1. The uptake of Mg, Ca and Mo will be difficult
2. The uptake of Fe and Mn increases because the solubility is higher and may cause Fe, Mn-toxicity.



Electrical Conductivity (EC): EC is the measure of salt in soil solution. Use of fertilizers add salts to the soil and increases EC value. This provides a rough idea of fertilizer content in soil and irrigation water. Hence, EC indicates amount of fertilizer already present in soil. Adding fertilizer to the soil with already high EC builds up salts and affects root growth, water and nutrient uptake. Measuring EC before fertilizer application is therefore important to know the background mineral content of soil and plan for how much fertilizer to add not to let salts build up. EC of soil should be 0.8 to 1.0 mS/cm. EC of water should be 0.3 to 0.5 mS/cm. EC of water containing fertilizer should be 1.2 to 1.5 mS/cm. Nursery seedlings can tolerate EC less than 1 mS/cm while most of the matured plants can tolerate EC of 1.5 or sometimes upto 4 mS/cm by some plants. EC greater than 4 mS/cm is undesirable for most of the plants and need to leach salts by flooding the field.

Soil pH rating	**Soil EC rating** (dS/m) in 2:1 water to soil suspension
<4.5 : extremely acidic	<0.15 : very low (add fertilizer)
4.6-5.2 : strongly acidic	0.15-0.5 : low ok (may need fertilizer)
5.3-6.0 : moderately acidic	0.5-1 : satisfactory (maintain level)
6.1-6.5 : slightly acidic (good for cut flowers)	1-1.8 : high (may need to leach)
6.6-7.0 : neutral	1.8-2.25 : very high (need to leach)
7.1-7.5 : slightly alkaline	
7.6-8.3 : moderately alkaline	
8.4-9.0 : strongly alkaline	
>9 : extremely alkaline	

Effect of increasing EC:

How EC value is changed??

* **High EC** by: water uptake by the plant, evaporation of water on the soil surface and watering (with fertilizer) by the grower.
* **Low EC** by: mineral uptake by the plant, flushing to the underground (by watering too much) , watering (without fertilizer) by the grower or rainwater.
* **Salt:** Sodium (Na) in high concentration is toxic.

Soil pH management

Management of low pH Soils

Most of the floriculture crops donot respond to fertilization when pH is very low (<5) or very high (>7.5). Agricultural grade limestone ($CaCO_3$) is generally recommended to correct soil acidity. Lime should be applied at land preparation and should not be applied within 1 week of applying nitrogen fertilizer or manure. The high soil pH that occurs shortly after liming will increase the loss of ammonia. Lime does not move through the soil, it must be incorporated. Some soils limed heavily over a period of years may not require further applications. Some light-textured soils that have an adequate pH occasionally test very low in calcium, and therefore require lime. If calcium levels are low, gypsum or fertilizers such as calcium nitrate may also be used to supply calcium, rather than using lime. Gypsum (calcium sulphate) is not a liming agent. It will not increase soil pH, and under certain conditions it is used to lower soil pH. The use of sone dolomite limestone is recommended since it contains a significant quantity of magnesium, an essential and often deficient plant nutrient. Growers need to be careful when applying lime. If applied at too high a rate (above 5 tonnes per ha), lime may tie up some micronutrients (e.g. boron) or cause nutrient imbalances. Lime application may aggravate magnesium deficiencies, especially in sandy soil. Where this is a problem, some dolomitic lime should be used. Liming can also increase the rate of organic matter depletion and encourage the germination of some weeds. Lime should always be used in conjugation with a planned soil testing and fertilizer program.

Table: Amount of limestone in Kg needed per 100 square feet to raise the pH to 6.5 in the top 6 inches of soil.

Present soil pH	Sandy loam soil	Loam soil	Clay loam soil
5	3.632	4.54	6.81
5.5	2.724	3.632	4.54
6.0	1.362	1.816	2.724

Source: Iowa State University, Extension and Outreach

Management of high pH soils

"Acid loving" plants like Azaleas, succeed only in acidic soils. So, if the soil is high in pH (>7), we can lower the pH or make it more acidic by using several products. These include sphagnum peat, elemental sulfur, aluminum sulfate, iron sulfate, acidifying nitrogen and organic mulches. pH of sphagnum peat is 3 to 4.5. It is effective for small plots and potted plants but may not be cost effective for larger areas. Granular sulfur is safest, least expensive but slowest acting product to lower pH.

Table: Amount of sulfur in gram (g) to lower pH per 10 square feet

Present pH	Desired pH				
	6.5	6.0	5.5	5.0	4.5
8	136.2	181.6	227	272.4	317.8
7.5	90.8	136.2	181.6	227	272.4
7.0	45.4	90.8	136.2	181.6	227
6.5	-	45.4	90.8	136.2	181.6
6.0	-	-	45.4	90.8	136.2

Source: Iowa State University, Extension and Outreach

Aluminum sulfate and iron sulfate react more quickly with soil than elemental sulfur. However, they should be applied at greater rate than elemental sulfur. Do not apply more than 2.3 kg per 100 square feet. Some type of fertilizers can also help to acidify the soil. Acidifying fertilizers include ammonium sulfate, diammonium phosphate, mono-ammonium phosphate, urea and ammonium nitrate.

Water quality

Well and tap water should be checked before fertilizers are added to determine any background levels of EC and the initial pH. If the water shows any substantial salt content (0.5mS or above), an irrigation water quality analysis should be performed by a testing laboratory to determine the background mineral content. The report should include the elemental content, including the level of bicarbonates. Once the background EC is known, it must then be taken into account when measuring fertilizer content with salt meter. For instance, if your water has an initial EC of 0.8mS, then you will need to subtract this amount from your fertilizer solution readings to determine the actual fertilizer content of your nutrient solutions.

Table: irrigation water quality guidelines

Parameter	Level	Comments
PH	5.5-7.0 <5.0 >7.2	Suits most irrigation types Corrosive, phytotoxic, expect nutritional problems later in crop cycle if Ph not corrected Build up of deposits in irrigation equipment, on plants, pots, plastics problems with chlorine use, nutrient imbalance in plants
Electrical conductivity (EC) (dS/m) Note: These figures do NOT apply to fertigated water	<0.3 <0.6* 0.8**	Suits all irrigation condition Suits most conditions but limiting in subirrigation systems and low –leaching situations Reduced growth and/or marginal leaf burns end of scale
Chlorine(mg/L)	<70-90 >200**	Suits most situations and slow downward pH drift Tip and marginal burns to lower foliage in low leaching situations controlled leaching may alleviate problems at lower end of scale
Sodium (mg/L)	<60 >120**	Usually no problems Feeding program needs to be modified to include increased amounts of calcium, magnesium and potassium. Leaching required
Alkalinity (mg/L CaCO3)	60 >125	Good May cause in crop Ph to raise to unacceptable levels in later crop cycles.
Bicarbonate (mg/L)	60 >125	Suitable. Increasing problems with plant growth and foliage/container staining. Adjust rate of liming material accordingly Unsuitable
Flouride (mg/L)	<1.0	Higher will damage sensitive plants
Aluminium (mg/L)	<5.0	Higher will damage sensitive plants

Iron (mg/L)	<0.3 >0.3 >1.0** >3.5	No problem expected Problems increase with trickle irrigation systems Staining of foliage, pots, plastics Treatment required
Boron (mg/L)	<0.3 >0.5** 2.0**	Generally suitable Increasing problems, particularly in poorly leached situations Unsuitable
Manganese (mg/L)	<0.2 >0.05* >0.2	Suitable in most situations Increasing problems Upper limit for plants already supplied with P at moderate levels
Copper (mg/L)	<0.02 >0.05 >0.2	Generally suitable Becoming excessive Increasingly toxic
Ammonium –N (mg/L)	<10 50	Generally suitable Probably excessive-leading to direct toxicity and downward pH drift
Zinc (mg/L)	0.2* >2.0	Generally suitable Increasingly toxic
NOTE: *take extra care if trickle and subirrigation are used. Expect problems in rainout situations if precautions are not observed ** Unsuitable for trickle and sub-irrigation of containers and rainout situations		

Problems due to poor water quality: The potential for dipper plugging problems come from irrigation water. Algae and bacteria growth are associated with surface water. They even pass through filters and from aggregates that plug dippers whereas ground water may contain high levels of minerals. Chemical precipitation is more common with deep wells containing calcium, magnesium, iron or manganese. Plugging problem is more pronounced when pH of water is greater than 7. Increase in pH and temperature reduces solubility of calcium and results precipitation as calcium bicarbonate. Iron when exposed to air oxidizes and precipitates referred to as ‘red water’. Similarly, non-fertilizer salts that come from the irrigation water are not used by plants and they accumulate in soil as a result such soil may require heavy leaching by flooding.

Treatment of irrigation water: Irrigation water can be used after filtration and chemical treatment.

(i) Chlorination: To control algal and bacterial growth. However, the irrigation water should not be already high in chlorine. Liquid sodium hypochloride (NaOCl) – laundry bleach is available, that can be injected once at the end of each irrigation cycle. Chlorination for bacterial control is ineffective above pH 7.5. So, acid addition may be needed to lower pH. Direct contact of chlorine and fertilizer can create thermo reaction. This is extremely dangerous !!!

Chlorination objective	Application method	Required concentration (ppm)	
		At system head	At system end
Prevent sedimentation	Continuous chlorination	3-5	0.5-1
	Intermitant chlorination	10	1-2
System cleaning	Continuous chlorination	5-10	1-2
	Intermitant chlorination	15-50	4-5

Source: NETAFIM USA

(ii) Acid injection: Acid can be used to lower the pH of irrigation water. It can also reduce chemical precipitation and enhance effectiveness of chlorine injection. Sulphuric, hydrochloric and phosphoric acid are used for this purpose. If acid is injected on a continuous basis to prevent calcium and magnesium precipitation, the injection rate should be adjusted until the pH of the irrigation water is just below 7.0. If the intent of the acid infection is to remove existing scale buildup within the micro-irrigation system, the pH will have to be lowered more. The release of water into the soil should be minimized during this to prevent root damage. (follow the direction of authorities).

(iii) Iron control system: Iron control system (brown reddish slime) clogging in drip irrigation. Control methods: (a) Sedimentation -filtration: A sand filter is most appropriate, larger units with slower water velocity will allow oxidized iron to settle. (b)Scale inhibitors: Sodium hexametaphosphate is not only effective against alkaline scale, but also forms complexes with iron and manganese and can prevent deposition of these materials.

(iv) Pond treatment: Algae problems occur in surface water sources like pond. It can be treated with 1-2 ppm copper sulfate. Treatment may be repeated at two to four-week interval. However, repeated use of copper sulfate results its toxic levels for plants.

Use of fertilizers in floriculture

The fertilizer to be used to supply the required nutrients for the crop depends on the existing levels of nutrients in the soil, the soil pH, and the soluble salt content of the irrigation water and the soil. Testing of soil and water is the initial step of any fertilization program. There are different formulations of fertilizers. Some are soluble in water which are readily available to the plant. Soluble fertilizers are available in granular, powder or liquid form. Slow release fertilizers are granular for example, urea formaldehyde (low solubility), sulfur coated urea, osmocote (resin coated). Organic fertilizers are often variable in nutrient content.

A note of caution. Text and home gardening books typically recommend nitrogen, phosphorous and potassium to be added as fertilizers in a 1-1-1 or a 1-2-2 ratio. Most fertilizers packaged for flowers will be in a similar ratio. This is the correct general ratio of the requirement of each nutrient for the production of flowers. However, this does not mean that fertilizer should be added in this ratio-it means that the nutrients should be available to the plant in this ratio. Depending upon the soil test results, the nutrient need to be added in a different ratio. Often, phosphorous and potassium is present in the sufficient quantities and only nitrogen may need to be added.

Introduction to fertilizers

Organic manures:

Practices of using farmyard manure (FYM), compost, green manure etc., are the most common technologies available to improve the physical, chemical and biological properties of soil.

FYM : Studies have shown that the application of FYM to the land can correct deficiencies of most of the micro-nutrients however, only the well decomposed FYM should be applied to the field at the time of land preparation at least 20 days before planting. Some of the examples of FYM are cattle manure, goat and sheep manure, poultry manure etc.

Compost: Compost is the product of organic residues that has been piled, moistened and allowed to decompose. It is broken down by the action of micro-organism. It can be made from plant materials such as: straw, leaves, weeds, grasses, forest litter, animal beddings, dung etc. banmara can be utilized by composting. For better quality compost making and faster decomposition lime, phosphate, nitrogen, EM etc could be added on various layers of compost.

Green manuring: Green manuring consists of legumes or other species which are grown and incorporated into the soil just before flowering. The common green manure crops are dhaicha, sunhemp, berseem, cowpea, horsegram, lentil, titaepati, anshuro, banmara etc.

Bio-fertilizers: a number of organism that have ability to fix gases nitrogen to plant useable forms have been identified. When these microorganisms are incorporated with seed, seedling or soil application , they increase crop production by way of Biological Nitrogen Fixation, solubilization of fixed phosphate, uptake of P & other mineral nutrients and synthesis of growth promoting substances, Release of vitamins, hormones like auxins and gibberellins etc.

Methods of use: 1. Seed Treatment 25-30 g per 1.0 kg seeds. 2. Seedling Treatment 1-2 kg per ha 3. Soil Treatment 2-3 kg per ha. 4. Sets Treatment 2-3 kg per quintal of sets. Preserve the biofertilizers away from sunlight, heat and moisture and Store them in cool and dry place. Chemical fertilizers and biofertilizers should not be applied together as there possibilities of the microorganisms being killed by them.Some of the examples of biofertilizers are:

1. Rhizobium
2. Azotobacter: Species : A. chroococcum A. paspali A. vinelandii A. beijerinckii A. agilis . used in flowers like: marigold, rose, gladiolus, chrysanthemum and dahlia.
3. Phosphate solubilizing bacteria: Species :- Pseudomonas putida Bacillus subtilis , B. megaterium , B. coagualns . Aspergillus niger Penicillium digitatum Functions :- Convert insoluble soil phosphate into soluble forms . Increase 10-20% yield of crops. Used in All flowers like rose, China aster, anthurium, gaillardia and tuberose.
4. Blue green algae (nostoc)
5. Azospirillium: Species : A. llipoferum A. brasilense A. amazonese A. seropedicae. Used in Flowers like marigold, rose, tuberose, gladiolus, chrysanthemum and dahalia.
6. Azolla
7. Mycorrhiza: Species :- Glomus fasciculatum, Gigaspora nigra, Acaulospora scrobiculata . Sclerocystis clavispora, Endogene increseta . Functions :- Promotes more uniform crop, increases growth and

yield. Enhances uptake of P, Zn, S and water. Enhance resistance to root disease and helps drought stressed plant. Improves hardiness of transplant stock. Reduces stunting on fumigated soil. Used in crops :- Cereal crops, Leguminous crops, Horticultural crops. Flower crops like China aster, marigold, gerbera, crossandra , gladiolus, tuberose, chrysanthemum etc.

The application of biofertilizers like Azotobacter, Azospirillum and PSM @ 2-3 kg/ha.and VAM @ 2g/plant and it's combination found effective. Marigold : Combine application of PSB, Azotobacter and Azospirillum increased growth, 66 % yield and saving 50 kg N/ha. Gaillardia : Application of Azotobacter, Azospirillum and PSB improved growth, quality, increased 25% yield and saving 50 kg N/ha. China aster : Application of Azotobacter, Azospirillum, improve growth, quality, increased 40% yield, and saving 30 kg N/ha. Chrysanthemum : Application of Azospirillum and Azotobacter improved growth, increased 21% yield and saving 25 kg N/ha. Rose Inoculation with Azotobacter increased 15% yield and PSB improve quality of flowers. Tuberose Application of Azospirillum and PB increase 30% yield and quality of flowers. *Source: http://www.authorstream.com/Presentation/Agriadda-2057546-role-biofertilizers-flower-crops/*

Vermicompost: The effects of vermicomposts on plants are not solely attributed to the quality of mineral nutrition provided but also to its other growth regulating components such as plant growth hormones and humic acids. It is scientifically proving as 'miracle growth promoter & also plant protector' from pests and diseases.

Inorganic fertilizers:

Nitrogen: The most common form of nitrogen fertilizer are nitrate and ammonium. Ammonium form of nitrogen is adsorb to clay minerals and organic matter and is not easily lost form the soil but sometimes it may be converted to ammonia gas and escape to atmosphere. Ammonia losses are reduced by well incorporation of fertilizer with moist soil. Nitrate form of nitrogen fertilizer is not held by the soil so leaching occurs with water mainly in sandy soils. Therefore, split dose of nitrogen is always recommended.

Phosphorous: Phosphorous fertilizers are phosphate salts and are water soluble. But they tend to form insoluble compound in the soil. Unlike nitrogen and potassium, phosphorous doesnot easily move in the soil and very little leaching occurs therefore, we often recommend the band placement of the phosphorous in the rooting zone. Surface application without incorporation is the least efficient way to use phosphorous fertilizers. In some soils, phosphorous become ''tied-up'' if the pH is below 6.0 or above 7.5.

Potassium: Potassium fertilisers are all simple potassium salts, such as potassium chloride, potassium sulphate, potassium-magnesium sulphate or potassium nitrate. All are readiliy water-soluble. Potassium is often subjected to leaching especially in sandy soils.

Secondary nutrients: Magnesium, calcium and sulphur are called secondary nutrients of which calium is often applied as lime. Secondary nutrients are required in intermediate amount.

Micro-nutrients: Iron, manganese, copper, zinc and boron are often deficient in soil. They are required in very small amount and should be applied at the correct rate because high level of micro-nutrients is toxic to plants. Micro-nutrients can be added to Fertigation system, can be incorporated into the soil or can also be applied as foliar spray.

1. Sources of primary nutrients

Nutrient	Name of solid fertilizer	Content			
		N	P	K	Others
Nitrogen	Ammonium chloride	26 %			66% Cl
	Ammonium sulphate	21 %			24 % S
	Ammonium nitrate	34 %			
	Ammonium thiosulphate	12 %			26 % S
	Anhydrous ammonium	82 %			
	Diammonium phosphate (DAP)	18 %	46 %		
	Calcium Nitrate	15 %			34 % Ca
	Potassium Nitrate	13 %		44 %	0.5 % Ca, Mg, S &Cl respectively
	Urea	46 %			
	Urea phosphate	17 %	44 %		
Phosphorous	Single super phosphate (SSP)		16 %		11 % S, 12 % Ca
	Diammonium phosphate (DAP)	18 %	46 %		
	Diapotassium phosphate		41 %	54 %	
Potassium	Murate of potash (MOP)/KCl			60 %	47 % Cl
	Potassium sulphate (SOP)/K_2SO_4			42 %	17 % S
	Potassium Nitrate	13 %		44 %	0.5% Ca, Mg, S &Cl respectively
	Potassium magnesium sulphate			18 %	11%Mg, 22% S
	Potassium hydroxide			83 %	

2. Sources of secondary nutrients

Nutrient	Name of solid fertilizer	Content	N	P	K	Others
Calcium	Single super phosphate (SSP)	12 % Ca		16 %		11 % S
	Gypsum ($CaSO_4$)	32.6 % CaO				18.6 % S
	Calcium Nitrate	34 % Ca	15 %			
	Chelated Ca (EDTA)	3-5 % Ca				
Magnesium	Magnesium nitrate	16 % Mg				
	Magnesium silicate	3-4 % Mg				
	Magnesium sulphate	9.8 % Mg				13 % S
	Chelated Mg (EDTA)	3-4 % Mg				
Sulphur	Ammonium sulphate	24 % S	21 %			
	Gypsum (CaSO4)	18.6 % S				32.6 % CaO

	Magnesium sulphate	13 % S				9.8 % Mg
	Potassium sulphate (SOP)	17 % S				
	Zinc sulphate	17.8 % S				36.4 % Zn
	Sulfur	100 % S				

3. Sources of micro-nutrients

Nutrient	Name of fertilizer	Content	other
Iron	Ferrous sulphate	19 % Fe	
	Ferric sulphate	23 % Fe	
	Chelated Fe (EDTA)	5-14 % Fe	
Manganese	Manganese sulphate	26-28 % Mn	
	Manganese chloride	17 % Mn	
	Chelated Mn (EDTA)	12 % Mn	
Zinc	Zinc sulphate	36.4 % Zn	17.8 % S
	Zinc phosphate	51 % Zn	
	Zinc oxide	78 % Zn	
	Chelated Zn (EDTA)	14 % Zn	
Copper	Copper sulphate	25 % Cu	
	Copper acetate	32 % Cu	
	Copper oxide	89 % Cu	
	Chelated Cu (EDTA)	13 % Cu	
Boron	Borax	11 % B	
	Boric acid	17 % B	
	Borate 65	20 % B	
	Solubar	20 % B	
Molybdenum	Ammonium molybdate	54 % Mo	
	Sodium molybdate	39 % Mo	
Chlorine	Ammonium chloride	66 % Cl	
	Potassium chloride	47 % Cl	60 % K
	Magnesium chloride	65 % Cl	

Methods of application of inorganic fertilizers

a. **Broadcasting:** Fertilizer is spread evenly over the entire field. Often the broadcasted fertilizer is mixed into soil during tillage. It is appropriate when large amount of fertilizer is to be applied aiming to improve fertility for a long period of time. It is followed for close-growing vegetation and turf grass (lawn, pastures). However, it is less efficient method of application. Broad casting as top dress may cause salt burn in contact with foliage. Nitrogen when left on soil surface is lost by volatilization and is more troublesome for urea and ammonium fertilizers in high pH soils.

b. **Localized/row placement:** Localized placement minimizes the fixation and enhances uptake of Phosphorus. So, starter fertilizer is often applied in bands on either side of seed during planting. Fertilizer should be placed 5cm below and 5cm away to the side of seed row. This placement eliminates the danger of fertilizer burn, yet concentrates the nutrients near the seed, where crop can uptake shortly after root formation. Similarly, for ornamental trees fertilizers are applied within the spread of the branches, approximately 1m away from trunk.

c. **Side dress application:** Nitrogen fertilizer, applied pre-planting, often leaches or washes out of the crop root zone. This is most common in sandy soil or heavy rainfall. So, side dressing of N is usually done when the first flowers of annual crops begin to bloom or when the crop exhibits nitrogen deficiency symptoms. Nitrogen is placed alongside of the crop row and care should be taken not to damage foliage and roots due to fertilizer contact

d. **Foliar application:** It is a method of spraying dilute nutrient solutions directly on to the plant leaves as a remedy of nutrient deficiency or prevent hidden hunger (deficient but do not show symptom). Foliar application results high nutrients and micronutrient response, correct deficiency, can be combined with pesticides. However, solution concentration is small and requires repeated application. Since urea is uncharged, its application is effective for micronutrients. However, excessive foliar nutrient application can cause leaf ''burning''. Rapid drying of leaves decreases absorption, application when leaves are wet (morning or late evening) increases absorption. With increasing plant age, foliar application becomes less effective (due to thick cuticle). Absorption is decreased due to droplet runoff from leaf and rainfall after application. Nutrient concentration <1-2% in product solution are used to avoid foliar injury. Surfactants are often added to the foliar nutrient solutions to reduce surface tension, increasing wetting of the leaf surface, which increases absorption. Non-ionic surfactants are generally more effective. Foliar application of nitrogen is often performed while foliar application of P is not recommended because most phosphorous with nitrogen cause leaf damage.

Recommended solution concentration in foliar application		
Nutrient	Source	Solution concentration Gram (g)/litre
N	UAN	6-9
	NH_4NO_3, $(NH_4)_2SO_4$, NH_4Cl	4-6
P	APP	4-5
K	KNO_3, K_2SO_4	8-12
	KCl, $K_2S_2O_3$	3-5
Ca	$CaCl_2$, $Ca(NO_3)_2$	8-12
Mg	$MgSO_4.7H_2O$, $Mg(NO_3)_2$	10-12
Fe	$FeSO_4.7H_2O$	5-12
Mn	$MnSO_4.H_2O$	5-8

Zn	$ZnSO_4$. $7H_2O$	4-6
Cu	$CuSO_4.5H_2O$	0.6-1.5
B	Sodium borate- $Na_2B_4O_7.10H_2O$	0.6-2.5
Mo	Sodium molybdate – $Na_2MoO_7.2H_2O$	0.3-0.4

e. **Fertigation:** Application of nutrients, primarily N, P, K and S through irrigation is called Fertigation. Fertigation is utilized in furrow, overhead sprinkler and micro-irrigation (drip). Fertigation enables uniform nutrient application, reduces cost and nutrient loss. Nutrient sources most be water soluble. Granular sources must be first completely dissolved prior to injection. Injection of anhydrous NH3, UAN or other free NH3 containing N sources to irrigation water high in calcium, magnesium and bicarbonate ion may precipitate calcium carbonate or magnesium carbonate causing plugging problem. This plugging can be prevented by addition of H_2SO_4, $(NH_4)_2S_2O_3$ or other acid solutions Fertigation of phosphorous is common, although APP combine with irrigation water containing >300ppm Ca or Mg will cause calcium or magnesium phosphate to precipitate and plug the irrigation system. Solution grade K sources are water soluble and can be mixed with N and P sources. The exception is K_2SO_4 which is less soluble than KCl or KNO3, thus, most used $K_2S_2O_3$ (liquid) or dissolve KCl. Many of the N and K sources contain S and Cl^- or SO_4^{-2} salts are commonly used for most micronutrients. Special equipment is needed to dissolve and agitate the less soluble SO_4^{-2} salts.

Table: Fertilizers commonly used in Fertigation system

Source	Common name	Precautions
$NH_4NO_3.H_2O$	AN-20	Do not mix with urea-H_2SO_4 or other concentrated acids
$(NH_2)_2CO.NH_4NO_3$	UAN-32/28	Do not mix with CAN-17 or other Ca sources
$Ca(NO_3)_2.NH_4NO_3$	CAN-17	Do not mix with SO_4^{-2} or $S_2O_3^{-2}$ Sources, mix with NO_3^- and Cl^- salts
$(NH_2)_2CO.H_2SO_4$		Do not mix with AN-20
$(NH_4)_2S_2O_3$	ATS	Do not mix with CAN-17 or other Ca sources
$(NH_4)_2S_x$	APS	S can precipitate if mixed with aqua NH_3
K_2SO_4		Can cause some precipitates
$K_2S_2O_3$	PTS	
KCl		Cl toxicity
H_3PO_4		
$(NH_4)_3HP_2O_7.NH_4H_2PO_4$	APP	Do not mix with >300ppm Ca/Mg H_2O

Table: Water soluble fertilizers used as primary nutrients

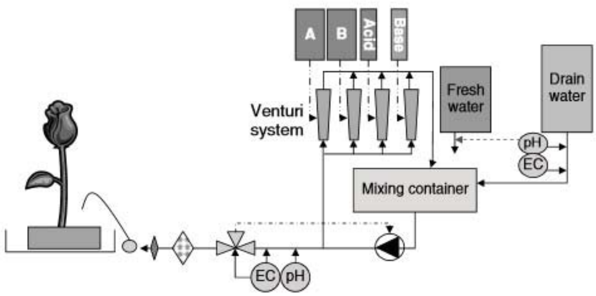
Name of liquid fertilizer	N	P	K	Comments
Mono-ammonium phosphate	12 %	61 %	0 %	
19:19:19	19 %	19 %	19 %	

12:6:18	12 %	6 %	18 %	
13:0:46	13 %	0 %	46 %	
0:52:34 (MKP)	0 %	52 %	34 %	
0:0:50 (SOP)	0 %	0 %	50 %	

TANK A-B-C FERTIGATION SYSTEM

Generally, two fertilizer tanks that contain the concentrated fertilizer solutions are used to separate those fertilizers that can interact. A possible combination is: a tank "A" containing calcium nitrate, potassium nitrate ammonium nitrate and microelements, whereas tank "B" contains magnesium sulfate, phosphoric acid and nitric acid; in this way Ca and P /Mg are in different tanks to avoid their precipitation. A third tank "C" contains an acid solution to control the pH of the fertilizer solution and to wash the irrigation system to avoid drippers clogging.

- **A tank**
  - ⇨ Calcium Nitrate
  - ⇨ KNO3
  - ⇨ NH4NO3
  - ⇨ Fe (Chelated)
- **B tank**
  - ⇨ KNO3
  - ⇨ MgNO3
  - ⇨ MgSO4
  - ⇨ K2SO4 (0:0:52)
  - ⇨ MKP (0:52:34)
  - ⇨ MAP (12:0:61)



Timing of Inorganic Fertilizer application

<u>Period of need:</u> Timing of fertilizer application should coincide with the nutritional need of the crop. Fertilizer should be applied slightly ahead of the need so that it is available on the on demand of the crop. For summer annuals, provide starter dose at planting and split nitrogen during rapid growth. For winter annuals, nitrogen is applied with onset of spring "green up". For perennials best time is when new leaves start to form.

<u>In high rainfall condition and permeable soils,</u> dividing large dose of fertilizer into two or more split application may avoid leaching loss.

<u>Physiologically appropriate timing:</u> Good supply of potassium in the fall enables plants to improve winter hardiness. Band placement of phosphorous during planting brings good results. Too much nitrogen in the summer may stress a cool season turf grasses.

<u>Nature of fertilizer:</u> Highly soluble fertilizers may be applied on demand of the crop. Generally half dose of N, P and K are applied at planting while remaining dose of nitrogen are given at 2-3 splits before flowering.

<u>Nature of the crop:</u> For annuals, lighter and frequent application of nitrogen may be necessary for good vegetative growth before flower is produced. Keep nitrogen level significantly high before flowering but excessive nitrogen leads to lush growth and delays flowering. For perennials, fertilizer needs to be applied so that it is available for early spring growth i.e. provide a late fall application of fertilizer (after

dormancy) to feed roots for spring vegetative growth. A second application may be applied at emergence of new growth.

Fertilizer calculation:

Different fertilizer contains different level of nutrients. For example urea contains 46% nitrogen, DAP contains 18% nitrogen and 46% phosphorus, Murate of Potash (MOP) contains 60% potassium. So, we have to calculate how much fertilizer we need based on recommended dose of nutrients. It should be noted that nitrogen is obtained both from urea and DAP so, if we are using both fertilizers, first amount of nitrogen obtained from DAP to be applied is calculated and then remaining nitrogen is fulfilled through urea.

$$\text{Amount of fertilizer(kg)} = \frac{\textit{area of fertilizer use in hactre} \times \textit{recommended dose of nutrient per ha}}{\textit{percentage of nutrient in fertilizer}} \times 100$$

For example, if recommended dose of NPK per ha is 120:60:80 kg, then amount of DAP and MOP to be applied is directly obtained from above formula. But in case of nitrogen, amount of nitrogen obtained from DAP is calculated and remaining nitrogen is fulfilled through urea.

Practical Nutrient management in major flowers in Nepal

Nutrient Management in Carnation

Soil: Sandy loam soils rich in organic matter content with pH of 5.5-6.5 are most ideal for carnation cultivation. Clay and silt soil can be improved by incorporating organic matter or compost. A soil EC of 0.8 - 1.2 dSm-1 during the vegetative stage and 1.2 - 1.5 dSm-1 during the generative stage is most ideal for carnation cultivation. The soil must be well drained because the crop is highly susceptible to fusarium wilt.

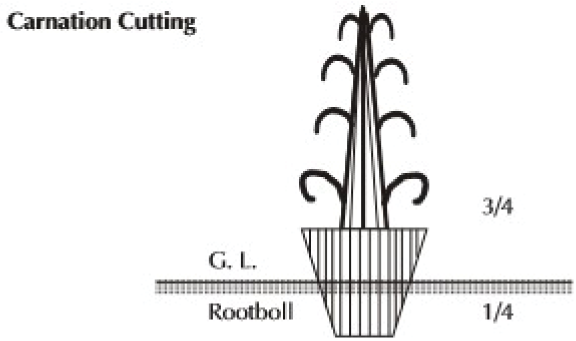
Fertilizer requirement at land preparation:

Compost	15-20 kg/m^2
DAP	3kg/100m^2
Potash	1kg/100m^2
Biozyme	1kg/100m^2
Calcium nitrate	2.5kg/100m^2
Magnesium sulphate	2.5kg/100m^2
Boron	250gram/100m^2
Zinc	250/100m2

Source: carnation cultivation technology, FAN

Planting:

- Fumigation procedure is absolutely necessary to prevent the infestation of soil borne diseases.
- The FYM added into the beds should be completely decomposed and uniformly mixed.
- Check the EC and pH of the soil after application of basal dose and before plantation. EC should be less than 1mS/cm
- Be ready; get the soil prepared in good time. Moisten the planting substrate evenly. Shallow planting is essential in tropical areas. Put the netting on the beds before planting. Ideal conditions for planting- warm, humid and fairly bright day.
- Do not actually 'plant' the cuttings, make a small depression with your fingers and 'stand' the cuttings as shallow as possible. Do not firm it in and do not move soil or peat around the base of the cutting. After planting, the white perlite in the root ball should still be visible.



Irrigation: During the first three weeks after planting you will need overhead sprinklers to prevent young plants from drying out. Prevent the cuttings from drying out just after planting. Depending on weather conditions; you may need to start giving overhead watering for 5 minutes. Do not water too much during the first week. Maintain high air humidity. Spray the path as well, not just the plants. During intense sunshine it is necessary to shade the plants slightly, until new roots are visible. Afterwards, it is possible to gradually change to drip irrigation. Do not give any top showering. Practice only surface watering and avoid splashing water onto foliage. To ensure even distribution of water the drippers should be placed at a distance of 30 cm with 2 lph discharge. When a carnation crop is fully grown and healthy; it absorbs 6 to 7 liters of water per m2 per day

Method of Fertigation in carnation:

Leaf fertilizers are not useful, because carnation plants are covered by a sort of wax that hinders absorption. We suggest to apply nutrients in two different batches:

1. First batch with all nutrients except Ca
2. Second batch with Ca (preferred calcium nitrate)

The reason for it is that the ability of uptake of Ca is much less than for the other nutrients. So, if we fertilize with all the nutrients at the same time the plants will take very little Ca. Fertigation should be given early in the morning at 6 am for better utilization by plants. If pH of plain water is higher than reduce it by adding acid. It should be added to the water at least 12 hours before use. It is necessary to give fertilizers with recommended quantity of water to maintain EC of soil. Hence, operate drip system for recommended period of time. After every Fertigation, open flush valve to drain off water from laterals and sub mains. Periodically clean the fertilization system to avoid any type of malfunctioning.

Method-1: Fertigation scheduling per m^2 basis. It is given by Tamil Nadu Agricultural University. In this method, they suggest a fertilization with N, P, K, Mg on Monday and Thursday, calcium nitrate on Tuesday and Friday, whereas plain water on Wednesday and Sunday. Fungicide drench on Saturday are recommended.

Fertigation schedule for carnation		
Stage of carnation	Nutrients	Quantity in gm/m2/week
Till Bud Formation	**Tank –A** (Monday and Thursday)	
	Ammonium nitrate	3.0
	Potassium nitrate	5.0
	Monoammonium phosphate/ monopotassium phosphate	2.0
	Magnesium nitrate (11:0:0:16 of N:P:K:Mg)	2.5
	Boron	1.0
	Trace elements/ micronutrients	1.0
	Tank-B (Tuesday and Friday)	
	Potassium nitrate	5.0
	Calcium nitrate	8.0
Bud formation to harvest	**Tank-A** (Monday and Thursday)	
	19:19:19	2.0
	Potassium nitrate	7.5
	Monoammonium phosphate or monopotassium phosphate	2.0
	Magnesium nitrate (11:0:0:16 of N: P: K: Mg)	2.5
	Boron	0.1
	Trace elements/ micronutrients	1.0
	Tank-B (Tuesday and Friday)	
	Potassium nitrate	5.0
	Calcium nitrate	9.0

Source: A technical guide on carnation, Tamil Nadu Agricultural University

Method-2: Fertigation scheduling per 100m2 basis. It is given by KF Bioplantspvt ltd, A Kumar-Florist (Holland) joint venture.

1. Make soil analysis before planting
2. If there are no big excesses or shortness, apply a base dressing to the soil per 100m2 of :

If soil is acidic		If soil is alkaline	
2 Kg	Biozyme granules	2 kg	Biozyme granules
2.5 kg	12:61:0	2.5 kg	12:61:0
3.75 kg	16:8:24	5 kg	12:6:18
2.2 kg	$Ca(NO_3)_2$	2.2 kg	$Ca(NO_3)_2$
2.5 kg	$MgSO_4$	2.5 kg	$MgSO_4$
0.250 kg	Borax	0.250 kg	Borax

3. Right after planting: 3 weeks clean water (no fertilizers). The root are not able yet to absorb any nutrition.
4. From 4th week onwards till 8th week (per 100m^2 per day) : Every Monday, Wednesday and Friday.

	If soil is acidic		If soil is alkaline	
Monday Wednesday Friday	100 gm	19:19:19	107 g	12:6:18
	54 gm	0:52:34	40 g	$MgSO_4$
	36 gm	13:0:45	20 g	Borax
	36 gm	$MgNO_3$	10 g	Micro sole B
	18 gm	Borax	30 g	19:19:19
	15 gm	Fertilon Combi -ll		
Tuesday Thursday saturday	154 gm	$Ca(NO)_3$	115g	$Ca(NO)_3$

5. Nitrogen stimulates the vegetative growth, growth of young shoots. The ideal water-EC during vegetative growth should be around 1.2 mS/Cm.
   Note that small amount on a frequent basis is better than large amounts of fertilizers. Try to give something every day.
6. Fertilization from 8th week onwards till 12th week (per 100m^2 per day)

	If soil is acidic		If soil is alkaline	
Monday Wednesday Friday	100 gm	19:19:19	107 g	0:0:50
	25 gm	0:52:34	20 g	$MgSO_4$
	128 gm	13:0:45	20 g	Borax
	36 gm	$MgNO_3$	10 g	Micro sole B
	18 gm	Borax	30 g	19:19:19
	15 gm	Fertilon Combi -ll		

Tuesday Thursday saturday	113 gm	$Ca(NO)_3$	75g	$Ca(NO)_3$

7. If possible, have the soil analyzed every 2 or 3 months to decide whether it is necessary to change the fertilization schedule
8. Fertilization from 12th week onwards till end of flush: (per 100m2 per day)

	If soil is acidic		If soil is alkaline	
Monday Wednesday Friday	116 gm	19:19:19	107 g	13:0:46
	48 gm	0:52:34		
	215 gm	13:0:45	35 g	12:6:18
	29 gm	Borax	25 g	Borax
	15 gm	Fertilon Combi-ll	10 g	Micro sole B
			30g	19:19:19
Tuesday Thursday saturday	113 gm	$Ca(NO)_3$	75g	$Ca(NO_{)3}$

Note: if soil is acidic 13:0:46 and magnesium nitrate are used, instead of 0:0:50 and Magnesium sulphate. The ideal water EC during generative generative growth (flowering) should be around 1.6 mS/Cm the first flower production peak. Then clean water for 1 full week, no fertilizer wash the soil and get rid of excess nutrients.

9. For re-growth of new shoots, nitrogen is required. Start fertilizing again as given in No.4. then see in what stage most of the plants are: vegetative growth (more nitrogen) or bud development (more potash)

Nutrient management in Gerbera

Soil: Soil pH should be in between 5.5 to 6.5. The salinity level of soil should not be more than 1 mS/cm. The soil should be highly porous and well drained to have better root growth and better penetration of roots. The roots of Gerbera go as deep as 50 - 70 cm.

Basal fertilizer dose (After bed preparation)

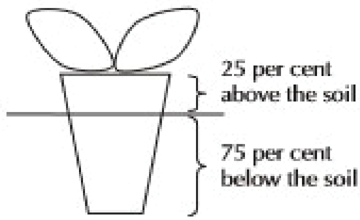
Area	Fertilizer	Quantity
$10m^2$	Single superphosphate	2.50 Kg
$10m^2$	Magnesium sulphate	0.50 Kg
$10m^2$	Biozyme granules	200 gm
$10m^2$	Humiguard granules	200 gm

Source: KF Bioplants

Mix it well in upper 6" soil layer, apply water and at vapsa condition (field capacity level) check EC and pH of soil before plantation.

Planting:

- Fumigation procedure is absolutely necessary to prevent the infestation of soil borne diseases.
- After the application of the basal dose, the soil pH and EC should be tested. Ensure that the soil and water EC and pH are well within the prescribed limits.
- The FYM added into the beds should be completely decomposed. At the time of bed preparation (After fumigation) neemcake (@1kg/m) is added as prevention against nematode. All material should be mixed thoroughly for optimum results.
- At the time of planting, the crown portion should be well above the soil (25%). This is to prevent soil and water accumulation at the crown portion. While planting Gerbera plants, the crown of plants should be 1 - 2 cm above soil level. As the root system establishes; the plants are pulled down. Therefore, the crown must be above the ground level at planting and also throughout the life cycle. Plant the seedlings without disturbing the root ball.
- Ensure that the crown is allowed to dry out between each watering. In other words, the beds should always be in 'vapsa' condition.
- After plantation, maintain the humidity at 80 - 90 % for 4 - 6 weeks to avoid desiccation of plants. Rake the soil surrounding the plant every fortnight for aeration.



Irrigation:

1. Water quality should be as follows: Ph- 6.5-7.0, EC- < 0.7mS/Cm
2. Immediately after plantation, irrigate the plant with overhead irrigation for three weeks to enable uniform root development. Thereafter gradually change to drip irrigation. Drip irrigation is mainly for correct doses of fertilizer.
3. Generally, one drip per plant is required. The aim is to provide sufficient irrigation in the 2nd year for extra foliage. The water requirement of the gerbera plant is approximately 300-700ml per plant per day depending upon the season. In hot summer fogger, can be used to maintain the humidity of the air.
4. Before irrigation, observe the soil column and visually check the soil moisture content. Then decide on the quantity of irrigation required.
5. During summer season, apply water to the edges of the beds frequently by using shower to minimize the evaporation losses and to maintain micro-climate. For this purpose, provision for water outlets (1" diameter pipe) should be made inside the polyhouse. Number of outlets depends on size of the polyhouse.
6. Always water the plants before 12 noon
7. The relative humidity of air should not exceed 90-92 percent, as it will lead to deformity of flowers.

8. As a thumb rule, the soil should be moderately moist, however never having excessive water
9. Always use fresh water for irrigation i.e. do not store water for more than 4 to 5 days.

Source: KF Bioplants

Fertilization:

- After three weeks of plantation apply N:P:K 1:1:1 (e.g. 19:19:19) @ 0.4 gm/plant every alternate day with EC 1.5 mS/Cm for the first three months during the vegetative phase to have better foliage.
- Once flowering commences apply N:P:K 2:1:4 (e.g. 15:8:35) @ 0.4 gm/plant ever alternate day with EC 1.5 mS/ Cm for more flowers and better flower quality.
- Irrigate and fertilize frequently in small quantities for optimum results. However, always take care to fulfill the crop requirement.
- Micronutrients (e.g. fertilon Combi ll, Microsole B, Rexolin, Sequel and Mahabrexil @ 40 gm per 1000 litre of water) should be given daily or weekly as per the deficiency symptoms.
- Add organic manures if EC is less than 2 mS/cm at every 3 months interval to maintain proper C:N Ratio
- Always do the detail soil analysis every 2-3 months to decide specific nutrient schedule.
- As a layman, whenever you enter the green-house the plants should look very healthy and glossy.

Source: KF Bioplants

Method of giving Fertigation:

Fertigation should be given early in the morning at 6 am for better utilization by plants. Take recommended quantity of fertilizers and dissolve them on sufficient quantity of water. If pH of plain water to be used is on higher side then lower it to 6 to 6.5 by using acid. It should be added to the water at least 12 hours before use. It is necessary to give fertilizers with recommended quantity of water to maintain EC of soil. Hence, operate drip system for recommended period of time. After every fertigation, open flush valve to drain off water from the laterals and sub mains. Periodically clean the fertigation system to avoid any type of malfunctioning.

Nutrient management in Gladiolus

Soil: Gladiolus can be grown in a wide range of soil varying from light sandy to clay loam soils. However deep (at least 30 cm), well drained, friable soils rich in organic matter and nutrients are suitable for its cultivation. The pH should be slightly acidic in the range of 5.5-6.5. If the soil is light and sandy, adequate amount of well rotten organic manure should be applied whereas in heavy soils, sandy soil could be added to improve the soil texture.

Nutrition: Gladiolus responds well to externally applied organic manures and inorganic fertilizers. Application of chemical fertilizers should be as per the requirement which can be known only through analysis of soil. Nutrient requirement depends on the nature of soil, weather conditions and corm size. Judicious and balanced application of manures and fertilizers is the most important and crucial practice in gladiolus production. Plants produced from large corms need lesser quantity of fertilizers than plants from small size corms. Farm yard manure@ 3t/ 1000sq.m can be applied at the time of land preparation. Application of overdose of manures should be avoided as it tends to produce tall and slender spikes which may lead to lodging of plants.

Growth and yield of gladiolus were found better when manure was applied in furrows rather than whole area. When the field is ready for planting, open the furrows to a depth of 15 cm, apply mixture of fertilizers and manure in furrows and mix them with soil. So, cattle manure/ FYM @ 2t/l000 sq.m can be applied in furrows along with fertilizers at the time of planting rather than applying prior to ploughing of the land. It saves lot of manure and provides ideal environment to plants in the rhizosphere. This practice increases the spike length, number of florets/spike, corm weight, corm size and cormel production as compared to broadcasting. However, care should be taken to use the well decomposed manure.

A field experiment was carried out to find out the effect of various organic manures (Table 8) over growth and yield of gladiolus variety White Prosperity. Results revealed that significant variation was noticed among the treatments for major yield attributes like spike length, rachis length and no of florets/ spike. The maximum spike length and highest number of florets/ spike were observed in goat and pig manure as compared to control (no manure). In addition to farm yard manure, farmers can use locally available pig manure, vermi compost, poultry and goat manure.

Table: Effect of manures on flowering and yield parameters of gladiolus cv. White Prosperity

Treatment	Plane height (cm)	Spike Length (cm)	Stalk girth (cm)	Florets/s pike	Shelf life of spikes (days)	Corm soze (cm)	Corm weight (g)	Cormels/ plant
Pig manure	129.83	108.50	2.51	12.03	10.06	4.37	23.20	69.16
Poultry manure	124.40	103.30	2.65	12.00	10.83	4.17	20.40	95.36
Vermi compost	122.06	102.40	2.61	11.80	10.33	4.33	22.96	81.13
Goat maure	130.46	111.16	2.64	12.16	10.66	4.27	20.53	89.83
Cattle manure	119.86	100.06	2.56	11.40	10.53	4.34	23.10	73.53
Mixture*	123.60	103.40	2.80	12.00	10.76	4.16	20.90	84.33
Control	107.26	86.43	2.37	9.80	9.66	4.25	22.53	51.63
NPK	118.60	100.93	2.84	12.20	9.90	4.57	28.83	80.50
CD (P=0.05)	3.95	2.70	0.09	0.83	0.60	0.18	2.83	7.27

**Mixture: Cattle manure+goat manure+vermi compost+poultry manure (1:1:1:1)*

Source: production technology of gladiolus in Goa (technical bulletin no 20), ICAR, 2009.

Inorganic fertilizers: NPK in the form of urea, single super phosphate and murate of potash can be used. The quantity of fertilizers required for 1000 m2 is 25kg urea, 90kg single super phosphate (SSP) and 25kg murate of potash (MOP). Full dose of phosphorus and potassium and l/3rd of nitrogen can be applied as a basal dose at the time of planting of corms. Remaining dose of nitrogen can be applied 30 days after planting of corms. In late varieties, it is better to apply nitrogen in three equal splits basal, 30 and 60 days after planting. Cattle urine being rich in nutrients and growth hormones like auxins has been found as good substitute for chemical fertilizers (Table 9) in gladiolus. It enhances the plant height, spike length, number of florets/spike. Liquid manure prepared with water did not show much impact as compared to liquid manure prepared with cattle urine. Cattle urine lOO% fermented for a week can be applied twice (3-4 liter/sq.) to the soil. First dose can be given at the time of planting and second dose after a month of planting. Significant improvement in corm size and corm weight was noticed with application of fertilizers.

Table: Effect of cattle urine, liquid manure and fertilizers on growth and yeild parameters of gladiolus cv. White Prosperity

Treatment	Plane height (cm)	Spike Length (cm)	Stalk girth (cm)	Florets/spike	Shelf life of spikes (days)	Corm soze (cm)	Corm weight (g)	Cormels/ plant
Cattle urine	124.82	102.32	12.50	11.65	2.68	4.12	21.72	69.87
Liquid Manure-1*	114.12	93.10	11.82	11.40	2.72	3.74	17.47	84.25
Liquid Manure-2**	125.15	104.15	12.67	11.22	2.80	4.16	20.30	89.82
NPK	117.85	98.90	12.15	11.35	2.86	4.56	28.60	77.27
Control	107.35	85.55	9.65	10.65	2.35	4.20	23.02	52.70
CD (P=0.05)	4.09	4.34	0.68	0.30	0.18	0.26	3.35	9.79

*Liquid manure-1 : Prepared with water, ** Liquid manure-2: Prepared with cattle urine.

Source: production technology of gladiolus in Goa (technical bulletin no 20), ICAR, 2009.

Irrigation Gladiolus is a water loving plant and needs sufficient moisture in the soil till the harvesting of spikes. Flower bud initiation and spike elongation are the most critical stages in gladiolus. Moisture stress during these stages results in a considerable damage to growth and yield. Water requirement and frequency of irrigation depend on the soil type, weather conditions and stage of the crop. Lateritic soils need more number of irrigations compared to sandy loam soils. Irrigation is not required in rainy season unless there is a dry spell. In lateritic soils, irrigation should be given once in a week during winter and twice in a week during summer whereas in sandy loam soils once in a week during summer and once in a week or 10days during winter. Normally, irrigation can be cut down after the harvest of spikes and withheld completely once leaves start yellowing. If the soil is hard, a light irrigation may be given to facilitate the lifting of corms from the soil. Irrigate the crop once in 10 days when it is grown under partial shade of coconut gardens during summer season. It can tolerate high summer temperature and come up well if sufficient moisture is maintained in the soil during the crop period. So, the success of the crop in summer is mainly dependent on the irrigation.

Earthing up Gladiolus is a shallow rooted crop and needs earthing up to prevent lodging of plants due to heavy wind, rain and weight of spikes. After emergence, spikes become gradually heavier and tend to bend down due to gravitational force. Hence, earthing up is an important practice in gladiolus cultivation and normally done once or twice during the crop period. Plants are earthed up to a height of 10-15 cm after a month of planting. It provides good anchorage or support to plants to sustain its own weight and avoid lodging. In addition, it checks weed growth and conserves moisture. Field operations like weeding, fertilizer application and earthing up have to be done at a time. Staking of plants with bamboo/ wooden sticks for avoiding lodging of plants is a recommended practice in gladiolus and practiced in some states.

However, earthing up is a better and cost effective practice than staking which is a cumbersome practice and increases the cost of cultivation. Deep planting ensures vertical and straight growth of shoots and prevents their lodging. Deep planting is a good alternative in high density planting where earthing up is not possible. Corms of all the categories can be planted 2.5cm deep than the recommended depth of planting to avoid the lodging of plants.

Mulching: Mulching helps in conservation of moisture and suppression of weeds during the crop period. This practice cuts down the expenditure and provides comfortable environment to plants. It is a good option for water scarcity areas and when the crop is grown during summer months. Farmers can reduce the frequency of irrigation, weeding, save sizeable amount of money and get higher yield. It should be kept in mind that mulching can be done only after earthing up operation. Farmers are advised to use dry grass available in and around the fields or else freely available materials like coir dust. Effect of mulching depends on the type and depth of mulch. Mulching must be at least 7.5 cm thick so that it does not allow any weed growth.

Nutrient Management in Rose

Soil: Rose require fertile loamy soil with pH of 5.5 – 6.5. Soil should be deep having good moisture, holding, capacity with proper drainage. Roses are susceptible to water logging.

Fertilizer requirement: In green-house rose cultivation, major nutrients required are NPK, Ca and Mg whereas minor nutrients are Mn, Fe, Cu and Zn. In greenhouse fitted with drip irrigation, liquid fertilizers containing 200-250 ppm of nitrogen, 160-180 ppm Phosphorus and 150-160 ppm potassium should be applied. If rose is grown under open field condition, the rose plants should be fed with 6-8 kg of well rotten manure per bush and mixed with soil around the plant. In addition, 60 gm per plant of mixture of NPK in the ratio 120-60-40 should be applied. This mixture at the rate of 10 gm per plant may be applied after every 6 weeks. A good balance of NPK and ca is important to reduce incidence of disease.

Source: Rose cultivation technology FAN, by Dr. Umed Pun

Fertilization of roses is a must to encourage production of large, vigorous basal canes. If inorganic fertilizers are used improperly it can burn plants. When using inorganic fertilizers a program of adding organic matter to the soil is needed to maintain good soil structure. A standard fertilization program calls for feeding three times per year using a 5-10-5 or similar analysis fertilizer. The rose plant requires relatively high amounts of phosphorus, which promotes root development and growth and flower formation. Roses are susceptible to iron chlorosis, which results in a light-yellow color on the leaves while the vines remain a darker green. Iron chlorosis is a result of a lack of available iron to the plant. Iron chelate sprayed on the foliage will restore the green color to the foliage in a few days, but foliar sprays are not long lasting. Acidify the soil around rose bushes by adding powdered sulfur at the rate of 1 to 2 teaspoons incorporated into the soil.

Source: growing roses, Kansas state university KSU

NUTRIENT MANAGEMENT IN FLOWERS

When to Fertilize: Fertilizers are applied properly when preparing the soil for planting. This greatly reduces the problem of getting nutrients to the plant roots and maintaining an adequate supply of nutrients. After this, apply fertilizer just after the plants have completed one burst of bloom. This provides the needed nutrients for new growth and next bloom. Then make an application every six to eight weeks. You may apply every two, three or four weeks but apply less fertilizer each time. You may alternate with dry, liquid and foliar feeding if you follow this method. A consistent program of fertilization is best. Follow recommendations on the package carefully as fertilizers in any form can cause damage to plants if used incorrectly. If using foliar sprays, do not spray if temperature is 32°C or above as this may cause leaf burn even though you follow all directions carefully. The first application should be made prior to bud break, at the same time as spring pruning. The second application should be during the first flowering period. The third application is a late-season fertilization after the first flush of blooms has faded and flowering has declined—no later than mid-August. Later fertilization will encourage succulent growth which will not be hardened-off by first frost.

Source: growing roses, Kansas state university KSU

How To Fertilize: Fertilizers should be applied uniformly to the soil. For dry fertilizers, be sure that the soil is moist to reduce the danger of burning the roots. Water the plants the day before you apply the fertilizer. When applying the fertilizer, place it no closer than 3 inches from the base of the plant and out to the leaf drip line; then scratch the fertilizer lightly into the soil. Better still make small holes in the soil some 6 inches deep, some 12 and some 18. These holes should be placed randomly in the area 3 inches from base of plant out to the leaf drip line. Place a proportionate amount of the fertilizer in each hole and cover. Thoroughly water after either method of application. To the regular fertilizer program. It is an excellent method of applying the micronutrients. The spray should have a sticker-spreader (a common household detergent works fine) to insure even application and adsorption of plant nutrients. Spray both surfaces of the leaf thoroughly until solution just begins to drip off. Regular dry fertilizers are not suitable for foliar sprays because they are only given as supplementary in diluted form.

Source: College of Tropical Agriculture and Human Resources University of Hawaii GENERAL HOME GARDEN SERI'ES No. 27

Irrigation: Rose plants in greenhouse should be irrigated through drip system and watering should be done immediately after planting. The pH and EC of water should be 7 and 0.2-0.7 dS/m. This system can be useful for both fertigation and irrigation. Mulching reduces water requirement. Big plants require approx. 1 litter of water per day. Plants are irrigated more frequently during summer. Feeding regime through drip should be done every day while water is also directly sprayed at root zone twice a week to improve relative humidity. Watering at late evening is not recommended as it increases humidity and many fungal diseases like powdery mildew attack plants.

Fertigation schedule for rose under protected structure

Fertigation schedule	Dose (ppm)		
	N	P	K
Vegetative stage (September to october)	80	50	60
Flowering and harvesting flush (November-March)	100	60	80
Flowering and harvesting normal (April-August)	80	50	80

Source: Janakiram et al., 2013

Nutrient management in chrysanthemum

Soil: Well drained sandy loam soil with good texture and aeration. Generally, the ratio 1:1:1 of soil: organic matter: sand is preferred. Production is seen higher in growing medium made of 1: 1: 2 of soil, compost and cocopeat with pH of 5.5 to 6.5. The beds are formed with 1 m width, 0.3m height and at convenient length. The soil pH must be 6.5 with 1 to 1.5 EC.

Manures and fertilizers in chrysanthemum cultivation:

Chrysanthemum crop responds very well to manuring and requires about 10-12 tonnes of well rotten farmyard manure (FYM) per acre. This farmyard manure can be supplemented at the time of land or soil preparation. As a basal dose, apply 50 kg of 'N' (Nitrogen), 160 kg P2O5 and 80 kg K2O. For increasing the flower yield, spray GA3 at 50 ppm at 30, 45, and 60 days after planting. Micronutrients like foliar spray of $ZnSO_4$ 0.25% + $MgSO_4$ 0.5% can be applied. As part of bio fertilizers, soil application of 2 kg each of Azospirillum and phosphobacteria per hectare at the time of planting should be applied. It should be mixed with 100 kg of farmyard manure (FYM) and applied.

Source: http://www.agrifarming.in/chrysanthemum-cultivation/

Fertigation system in chrysanthemum

generally, NPK @ 20:20:10 g/m2 is applied through Fertigation at weekly intervals. Basal application of DAP - 50 g/m2 during land preparation.

Weekly schedule - from 3rd week after planting.

Fertilizer	Quantity (g/m2)	
	Monday	Wednesday
19-19-19	3.0	1.0
KNO_3	3.0	1.0
CAN	2.0	1.0
Ammonium nitrate	2.0	1.0
$MgSO_4$	2.0	1.0

Source: http://agritech.tnau.ac.in/horticulture/horti_flower%20crops_cut%20chrysanthemum.html

Growth regulators:

Spray GA3 (50 ppm) at 30, 45 and 60 days after planting to increase flower stem length.

source:http://agritech.tnau.ac.in/horticulture/horti_flower%20crops_cut%20chrysanthemum.html

Irrigation

Drip irrigation with 8-9 litres of water/m2/day. Irrigation is done twice a week in the first month and subsequently at weekly intervals. Irrigation scheduling actually depends on environmental condition. Frequent irrigation may be needed during dry condition. Water logged condition in root zone of plants makes susceptible to root rot and many fungal diseases. If chrysanthemums are grown in greenhouse, never apply irrigation at late hours of the day.

Nutrient management in Marigold

Soil: well drained loamy soil with abundant organic matter is found suitable. However, if the soil pH should be 5.5-6.5 it is adopted in wide range of soils. Saline and acidic soils are not suitable for marigold.

Fertilizer requirement: During land preparation well rotten FYM @ 20-25/ha should be incorporated 2-3 weeks before planting. Seedlings are transplanted after 20 days (3-5 true leaf stage). Apply 90:90:75 kg NPK/ha. Use full dose of P, K and N as basal. Remaining half of nitrogen is applied at 30 and 60 days after transplanting as top dressing.

Source: Package of practices of commercial flower crops, Tamil Nadu Agriculture University

Foliar spray of zinc sulphate 0.5 % + urea 2% improves growth and flowering of marigold. Zinc and Phosphatic fertilizer should not be drilled together because they have antagonistic effect with each other and decrease the availability of each other.

Source: agrosan.com/marigold-cultivation

Irrigation: Irrigation should be given immediately after planting and life-saving irrigation upto third day. Subsequent irrigations are given at 5-7 days interval (during summer) and 10-15 days interval during winter. In light sandy soil frequent irrigation in small amount may be needed. Water stagnation should be avoided. Constant moisture should be maintained at bud formation stage.

Precision production technology for cultivation of African marigold for the L3 hybrid was standardized at Tamil Nadu agricultural university through the ICAR.

Hybrid L3 hybrid (for xanthophyll extraction)

Seeds and sowing: sown throughout the year. Seed rate is 200g/ha. Seeds are sown in portrays and 20 day old seedlings are transplanted on raised beds at 90 x 22.5 cm spacing to accommodate 44,400 plants / ha. Treat the seedlings with pseudomonas fluorescens @0.5% before planting

Biofertilizers: soil application of 2 kg each of Azospirillium and phosphobacteria per hectare at the time of planting. Biofertilizers are to be mixed with 100 kg of FYM and applied

Irrigation: Drip irrigation (once in 2 days)

Fertigation: Recommended dose of NPK is 90:90:75 kg/ha. 75% of this dose is applied through drip irrigation. Water soluble fertilizers such as polyfeed (19:19:19), Potassium Nitrate (13:0:45) and urea can be used.

Micro-nutrients: foliar spray of $FeSO_4$ 0.5% +$ZnSO_4$ ON 30th & 45th day after transplanting.

Bio-stimulant application: foliar application of humic acid @ 0.2% and sea weed extract 0.25 % at 30 and 45 days after transplanting

Source: gritech.tnau.ac.in /pdf/2013/precision-Marigold pdf.

References

AF (Agri. Farming). 2015. Chrysanthemum cultivation guide

Brady NC and RC Weil. 2012. The nature and properties of soils. 14th edition.

FAN. 2015. Carnation cultivation guide published by floriculture association Nepal, Kathmandu Nepal

FAN.2017. Chrysanthemum flower cultivation technology

FAN.2017. Marigold flower cultivation technology by floriculture association Nepal

FAN.2017. Rose flower cultivation technology by floriculture association Nepal

Flower crops cultivation and management. 2010. By Dewasish Chaudhary and Amal Mehta. Oxford book company. Jaipur, India.

Janakiram T, Panwar S, Kumar PP and Narkar ND. 2013. Production technology of flower crops under protected cultivation. In: National Workshop on Production Technology of Horticultural Crops under Protected Condition, held at University of Agricultural Science, GKVK, Bangalore, November 12-13, p. 9-26

KF. 2008. Gerbera manual. Kumar florist (KF) bioplants pvt, 178, Kirtane Baug, Mundhwa Road, Magarpatta, Hadapasar, Pune.

KF.2013. Carnation manual. Kummar Florist (KF) Bioplants Pvt. Ltd.178, Kirtane Baug, Mundhawa Road, Magarpathha, Hadapasar Pune India.

The flower expert. 2013. Guide on flowers and gardening.

TNAU. 2013. Horticulture:: Flower crops :: cut chrysanthemum. TNAU Agritech Portal. http://agritech.tnau.ac.in/horticulture/horti_flower%20crops_cut%20chrysanthemum.html

United flora Pvt. Ltd. 2013. Teku, Kathmandu. Improved gladiolus cultivation guide, Tripureshwor, Kathmandu

Part II: A SURVEY REPORT ON- FERTILIZER USE SITUATION AMONG MAJOR FLOWER GROWERS IN NEPAL

INTRODUCTION

Floriculture is a branch of horticulture. It includes cut flowers, cut greens, bedding plant, houseplants, flowering garden and potted plants etc. Floriculture business in increasing recently in Nepal due to raising living standard of people and urbanization. There are different factors affecting quantity and quality of cut flowers production among which nutrient management is the most important.

Among all nutrients, nitrogen, phosphorus and potassium are the major nutrient required for various plant function. Also, secondary nutrients like Ca, Mg and S are essential and affect plant growth. Similarly, different micronutrients are essential at different stage of floriculture crops among which B, Cl, Mo, Fe, Zn etc are important ones.

Different cut flowers like Rose, Gladiolus, Gerbera, carnation, Chrysanthemum etc. are most cultivated in case of Nepal and required different nutrients in different growth stages and are effected by different concentration of nutrient.Management of nutrient during growth stages is utmost important to maintain good quality flower and increase vase life. Moreover, economic and balance use of fertilizer is of great concern for flower growers for sustainable production.

Statement of the problem

Presently due to the co-ordination of FAN (Floriculture Association of Nepal) many of the entrepreneurs are involved in the floriculture production business. Farmers grow major cut flowers like rose, marigold, chrysanthemum, gladiolus, carnation, gerbera, etc. However, due to lack of research in nutrient management in flowers, farmers are facing trouble. Moreover, haphazard use of fertilizer, lack of recommended dose, shortage of information on type of fertilizer to be used, method and time of use of fertilizer has created confusion among flower growers.

Rationale of study

This survey was done with a view to know the current status of fertilizer use situation among major flower growers of Ktm and Chitwan. This may be useful for the policy makers, researchers, farmers, concerned organizations and authorities. This reveals actual situation of fertilizer use in floriculture in Nepal. This can be a guiding report to concerned authorities like Government and FAN to formulate their programs accordingly.

Objectives

The research focuses on the different objectives.

Broad objective

- To know about the fertilizer use practices followed by various flower growers.

Specific objectives

- To know the different fertilizers and their amount applied in different flowers.
- To know the pH of soil, water and EC of irrigation water used in farms.
- To know the fertilizer application methods.
- To know status of micro nutrient and hormones used.

METHODOLOGY

According to the research matter Kathmandu Valley and Chitwan district were selected as interested areas.Different farms were listed according to the flower production. The survey was among the selected farms from conducted from 1st Baishak to 15th ofBaishak 2075. Before the survey questionnaire was prepared and finalized after pretesting. According to the data required and questionnaire data were collected by interview with the growers and entry was done in MS excel and analysed bySPSS 16 version. It was analyzed and interpretation was done. In this way report was prepared.
Selection of Survey sample

List of flower farms that were visited during the survey are as follows:

Name of respondent	Farm name	Address	Commodity	Area of production
Dipesh Shrestha	Ichangu Narayan Nursery	Ichangunarayan VDC- 1, Kathmandu Nepal	Rose	9 ropani
Pandav Shrestha	Shreejana Cut flower Nursery	Ichangu Narayan-1, Kathmandu, Nepal	Rose	9 ropani
Prakash Pant	Abloom Flora Farm	Gunjanagar, Chitwan	Gladiolus	133 ropani
Kamal Subba	Kamal cut flower	Godawari-2, Kitini Lalitpur	Rose	15 ropani
Rudra Bahadur Khadka	RNA Flora Farm	Janagal Ugratara-8, Kavre	Carnation	3.5 ropani
Hem Bahadur Sunar	Barsha Nursery	Godawari-4, Badikhel	Carnation	10 ropani
Sulochana Giri	Ramkot Flora & Agro Farm	Ramkot-2, Kathmandu	Carnation	9 ropani
Dasharam Sunuwar	Naba Sewa Nursery	Godawari-1, Taukhel, Lalitpur	Carnation	13 ropani
Birendra Bahadur Shrestha	Horizon Nursery	Shreekhandapur, Dhulikhel-9, Kavre	Carnation	4 ropani
Kamal Subba	Kamal cut flower	Godawari-2, Kitini Lalitpur	Marigold	15 ropani
Prem Bahadur Dong	Cycus Nursery	Tokha, Kathmandu	Marigold	3 ropani
Deepak Pakhrin	Pakhrin Nursery	Maghauli Chitwan	Marigold	26 ropani

Deepak Pakhrin	Pakhrin Nursery	Maghauli Chitwan Nepal	Gladiolus	26 ropani
Birendra Bahadur Shrestha	Horizon Nursery	Shreekhandapur, Dhulikhel-9, Kavre	Chrysanthemum	4 ropani
Rudra Bahadur Khadka	RNA Flora Farm	Janagal Ugratara-8, Kavre	Chrysanthemum	3.5 ropani
Pandav Shrestha	Shreejana Cut flower Nursery	Ichangu Narayan-1, Kathmandu, Nepal	Gerbera	9 ropani
Sushil Khadka	JS Nursery	Dadhikot-4, Gamcha	Gerbera	7 ropani

RESULTS AND DISCUSSION

Fertilizer use situation in Carnataion

Most of the flower growers were found to be using both kinds of fertilizers i.e. organic as well as chemical. In case of organic fertilizer FYM was mostly preferred by them. Other organic fertilizers like poultry manure was found to be used in very low amount. Most of the respondent (nearly 100%) used DAP, MOP along with NPK solution. None of them used urea. Only one respondent used biofertilizer.

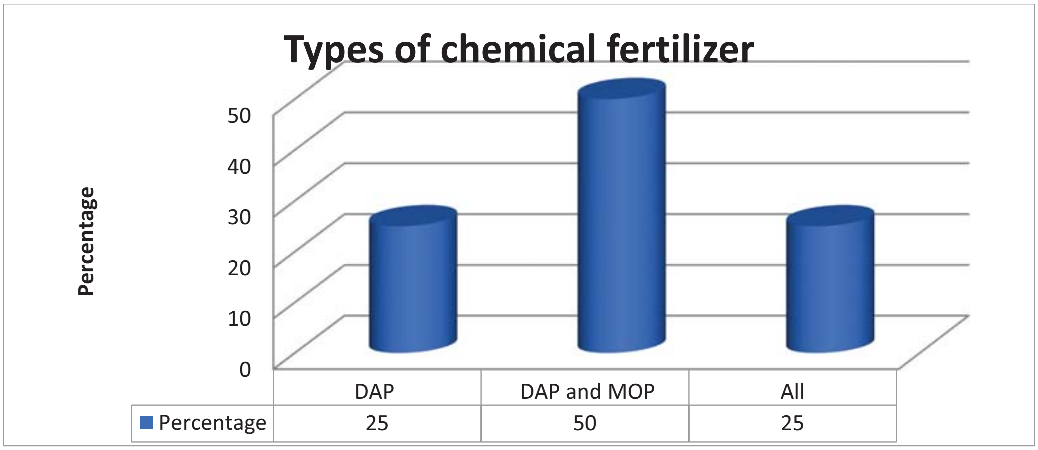


Fig 1. Types of Chemical fertilizer used by Carnation growers

They apply around 300 Kg of organic fertilizer (FYM) during the field preparation whereas chemical fertilizers are used twice a year i.e. Ashar/Shrawan and Mangsir/Poush. They use 5 Kg of urea, 10 Kg of DAP, 3 Kg of MOP per ropani of land. Similarly, some growers use 3.5 of biome enzyme for proper growth and development of flowers.

Method of fertilizer application

All of the grower apply organic fertilizer directly into the soil where as method of chemical fertilizer use was found to be different. 50% of the respondents apply chemical fertilizer through soil application and remaining 50% of the respondents apply chemical fertilizer apply chemical fertilizer through fertigation. Growers also use micronutrient but the exact volume of micronutrient is not known. Similarly respondent did not use any hormones.

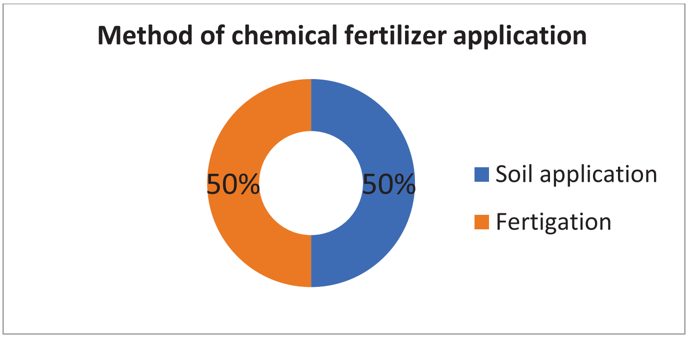


Fig 2.: Method of chemical fertilizer application in carnation

25% respondents produce organic fertilizer by themselves and 75% buy organic fertilizer from the nearby community. In case of chemical fertilizer and micronutrient, all the growers bought from nearby agrovet. They did not have fix marketing channel for those fertilizer. All the carnation growers used chemical fertilizer from the initial time of business.

Soil test

Although it has been a long time that there is a provision of soil test in the country, but still this has not been effectively implemented in the agriculture so as in floriculture sector. Only about 75% of carnation grower had performed soil test. The main purpose of soil test was to find the pH value of soil. During the soil test NPK value, micronutrient levels were not tested. Among the tested soil, 50 percent of respondent said that their pH value remained same whereas 25% said that pH value decreased from the initial phase of cultivation. Average pH value of carnation field was 5.8 and pH value that of water was 6.9. And average EC value of water used in irrigation was found 0.41.

Irrigation

Different respondent were found using different source of irrigation such as stream, boring etc.

Table 1: Source of irrigation water of different carnation growers

S.N	Source of irrigation	Percentage (%)
1	Well	25
2	deep boring	25
3	Stream	50

Now talking about the time of irrigation, all most all growers give irrigation at morning and evening. It is because during the day time there is higher rate of evaporation due to which provided irrigation may not be much effective. In case of method of irrigation 50% of respondent used drip irrigation whereas remaining one gave irrigation through pipe manually.

In fertigation process mostly 1kg of urea, 0.5 Kg of DAP, 0.5 Kg of MOP per 100 liter of water was mixed and given at morning hours.

Production

By the above mentioned practices 33 sticks of flowers were produced from single plant during its life cycle by those respondents.

Fertilizer use situation in Marigold

Data was taken from the nursery of Kathmandu valley and Chitwan District. Sample was taken from 44 ropani of land.

Among the sample taken, 25% of them used organic fertilizer only. 50% used both organic and chemical fertilizer. And remaining 25% of respondent used Biofertizer along with organic and chemical fertilizer. Various types of organic fertilizers were used. Most common fertilizers were FYM(25%), poultry (25%) ,compost (25%) and 25% used FYM, compost , vermicompost and poultry manure. 50% of the chemical fertilizer user used all type of fertilizers (urea, DAP, MOP) and others used only DAP.

During land preparation they apply around 1.54 quintal of organic fertilizer and 3.08 kg each of urea , DAP and MOP per ropani of land. And for top dressing they apply 1.54 kg each of urea, DAP and MOP. 1.54 kg of micronutrient (zinc and boron) were applied by them. In addition hormone was added for flower induction purpose at 2 ml per litre of water.

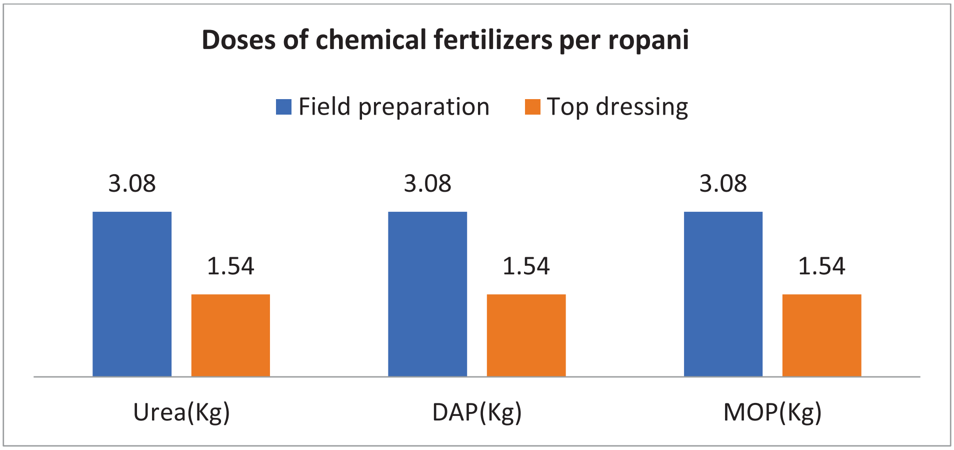


Fig 3. Amount of chemical fertilizer used at different stages.

Method of fertilizer application

All of the grower apply organic fertilizer directly into the soil where as method of chemical fertilizer use was found to be different. Among the chemical users 50% of the respondents apply chemical fertilizer through soil and foliar application and remaining 50% of the respondents apply chemical fertilizer through fertigation. 33% growers use hormones like Nitrobenzene at the rate of 2 ml per litre per ropani.

33% respondents produced organic fertilizer by themselves and 66% used to buy organic fertilizer from the nearby community. In case of chemical fertilizer and micronutrient, all the growers bought from nearby agrovet. They did not have fix marketing channel for those fertilizer. 75% of marigold growers used chemical fertilizer from the initial time of business. 25 % of the growers don't have used any chemical fertilizer till this date.

Soil test

Only about 33% of the marigold grower had performed soil test. The main purpose of soil test was to find the pH value of soil. During the soil test NPK value, micronutrient levels were not tested. Among the tested soil, 100 percent of respondent said that their pH value remained same. Average pH value of marigold field was 6.1 and pH value that of water was 6.7. And average EC value of water used in irrigation was found 0.28.

Irrigation

Different respondent were found using different source of irrigation such as stream, boring etc.

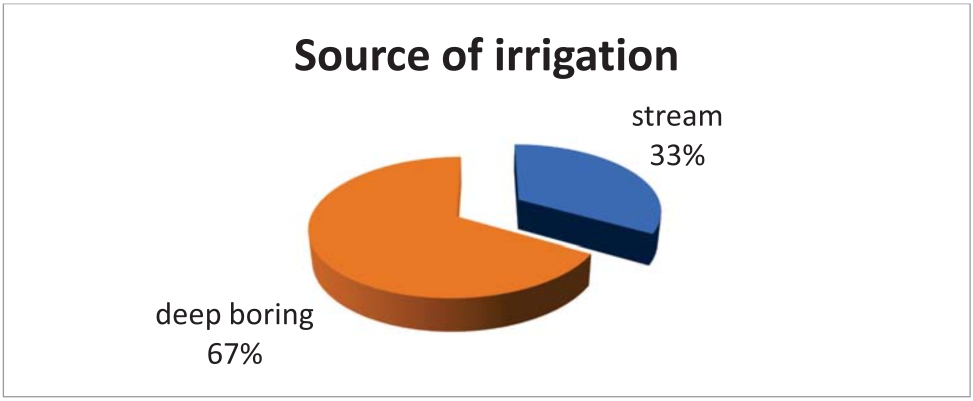


Fig 4: Source of irrigation water in different marigold nurseries

Now talking about the time of irrigation, all most all growers give irrigation at morning and evening (67 %) and 33 % give only in the morning hours. In case of method of irrigation 33% of respondent used drip irrigation whereas remaining 67% gave irrigation through flooding application.

Production

From the above mentioned practices 3-4 garlands per plant were produced during its life cycle.

Fertilizer use situation in Rose

Data was taken from the nursery of Kathmandu valley. Sample was taken from 30 ropani of land. 100% respondent (Rose growers) used both organic and chemical fertilizer. None of them used biofertilizer. Various types of organic fertilizers were used. 67% growers used FYM and 33% of respondent used compost as organic fertilizer. 67% of the respondents used DAP and MOP both whereas 33 % used DAP only. According to the respondent 2 gram of DAP and MOP mixture solution per day is given to each plant.

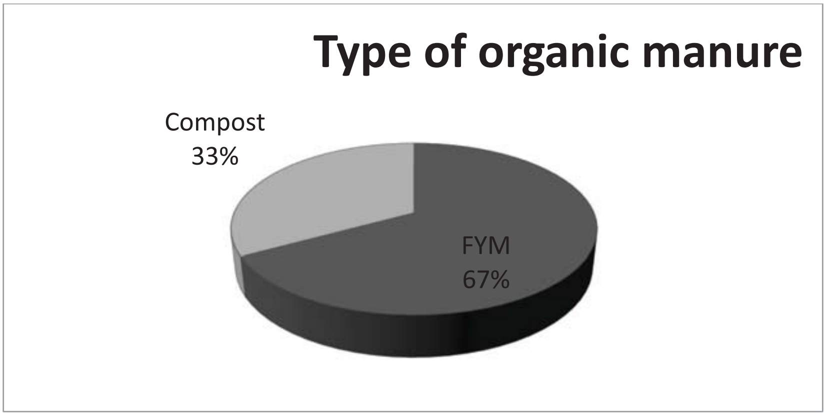


Fig. 5: Type of organic manure used by rose growers

Method of fertilizer application

All of the grower apply organic fertilizer directly into the soil where as method of chemical fertilizer use was drip irrigation and soil application also. During land preparation they apply around 1 quintal of organic fertilizer and during the peak season hormones like GA, IBA, IAA (10%) were used for higher production.

33% respondents produced organic fertilizer by themselves and 66% used to buy organic fertilizer from the nearby community. In case of chemical fertilizer and micronutrient, all the growers bought from nearby agrovet. All of rose growers used chemical fertilizer from the initial time of business.

Soil test

In case of rose, all of them were concerned about the soil test. The main purpose of soil test was to find the pH value of soil. But still during the soil test NPK value, micronutrient levels were not tested. Interval of soil test ranged from 3 months to 1 year. Among the tested soil, 67 percent of respondent said that their pH value remained same whereas 33% soil pH value was found increased. pH value of soil and water ranges from 6.5 to 7.4 and 6.8 to 9.6 respectively. Average pH value of rose field was 7.1 and pH value that of water was 7.8. And average EC value of water used in irrigation was found 0.27

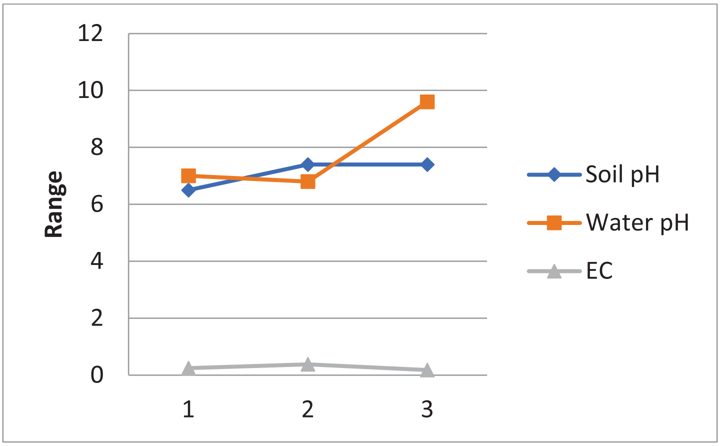


Fig. 6: Range of soil pH, water pH and EC value

Irrigation

In the case of source of irrigation, much uniformity was observed. Stream was near the farm due to which all the respondent used stream as a source of irrigation. Similarly, talking about the time of irrigation, all most all growers give irrigation at morning and evening (67 %) and 33 % give only in the morning hours. All of the flower growers were using drip irrigation method. The reason behind this is that rose is perennial flower and drip irrigation pipe is once set up it can be use for many years. As rose is a bushy type of flower so other method of irrigation are not much feasible. And taking about the drip irrigation method it is much effective one and it helps in fertigation.

Production

Rose is perennial plant. Training and pruning in rose plays a vital role in the flower production. From the survey average production of rose was found 17 flowers per plant per year.

Fertilizer use situation in Gladiolus

Gladiolus is not commonly grown in Kathmandu valley. Therefore, data was taken from the farms that are located in Chitwan District. Sample was taken from 159 ropani of land at which presently gladiolus are successfully grown.

All of the respondents were using both fertilizers i.e. organic as well as chemical fertilizer. In case of organic manure all growers were familiar with different types of manure. They used FYM, compost, Poultry manure for the gladiolus production. Similarly 100% of the gladiolus growers used urea, DAP and MOP as a chemical fertilizer. They were using micronutrient in little amount too.

In an average during field preparation growers used 225 Kg of organic manure and 1 kg of urea, 4 kg of DAP and 2 kg of MOP per Kattha. And at the stage of top dressing they only chemical fertilizer i.e. urea (1.25 Kg), DAP (0.5 Kg) and MOP (0.5 Kg) per kattha. Micronutrient was found to be used in 1 kg per Kattha. In addition other 500 ml/kattha micronutrient was sprayed.

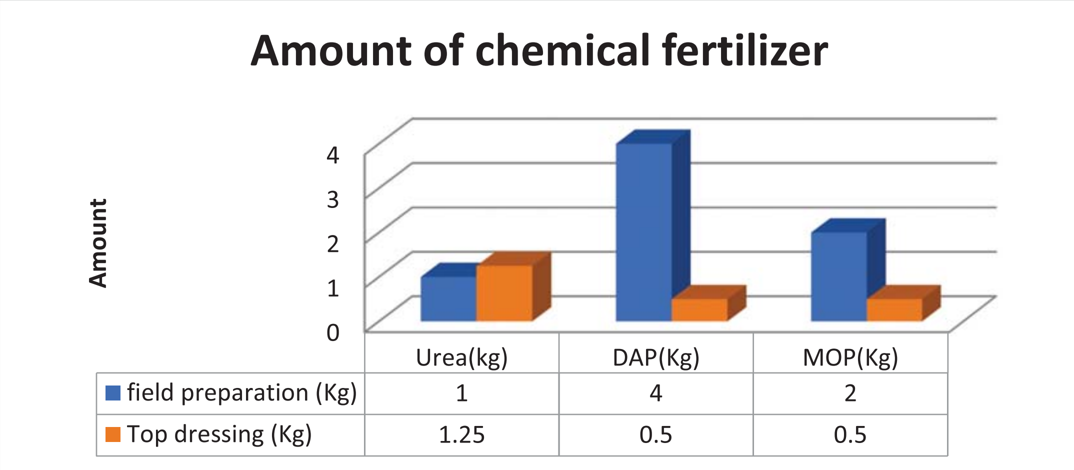


Fig 7. Amount of chemical fertilizer used at different stages.

Method of fertilizer application

All of the grower apply organic fertilizer directly into the soil where as method of chemical fertilizer use was found to be different. Among the chemical users 50% of the respondents apply chemical fertilizer through soil and foliar application as well as fertigation and remaining 50% of the respondents apply chemical fertilizer through soil application and foliar application. 50% growers use hormones like Miroculan at the rate of 1 ml per litre before flowering. This promotes the growth of flower and plant.

100% respondents that are involved in gladiolus production produced organic fertilizer by themselves and they bought chemical fertilizer, micronutrient and hormones from nearby agrovet.

Soil test

Only about 50% of the gladiolus grower had performed soil test. The main purpose of soil test was to find the pH value of soil. During the soil test NPK value, micronutrient levels were not tested. Among the tested soil, 100 percent of respondent said that their pH value remained same.

Irrigation

All of the respondents had a deep boring for the source of irrigation. There is no other source of irrigation near the farm. So, most of them preferred this source (deep boring).

Now talking about the time of irrigation, 50% growers give irrigation at morning and evening and remaining 50 % give only in the morning hours. In case of method of irrigation 50% of respondent used drip irrigation and flooding whereas remaining 50% gave irrigation through flooding application only.

Production

From the above mentioned practices 6250 sticks of flowers per kattha were produced. Similarly, about 7000 bulbs also were produced from 1 kattha of land.

Fertilizer use situation in Gerbera

Gerber production is one of the emerging sector in the field of flower production. Data was taken from the nursery of Kathmandu valley. Sample was taken from 14 ropani of land.

Among the sample taken, 100% of the respondent useed both organic and chemical fertilizer. They were seen familiar with the use of biofertilizer. Most common organic fertilizers were FYM and poultry manure. The new innovation was also observed in gerbera production i.e. use of ash as a manure. Ash can act as a manure as well as fungicide. It is helpful in controlling of different fungal diseases. 67% of the chemical fertilizer user used all type of fertilizers (DAP, MOP) and others used only DAP. Other than these some of the respondent provided the data (chemical Fertilizer + micronutrient) as given below:

Table2: Use of different chemicals in gerbera farm

S.N	Name of particulars	Dose (per ropani)
1	Royal star	100 gram
2	Zyme	1 Kg
3	Carbofuran	1 Kg
4	Borax	1 Kg
5	Neem cake	10 Kg
6	Zinc sulphate	1 Kg

During land preparation they apply around 1350 Kg of organic fertilizer. According to the requirement hormone is applied at the rate of 1ml/liter of water. 8 liter of this solution is required for 1 ropani of land.

Method of fertilizer application

All of the grower apply organic fertilizer directly into the soil where as method of chemical fertilizer use was found to be different. Among the chemical users all of the respondents apply chemical fertilizer through fertigation. Hormone is applied by foliar and fertigation method.

The respondents buy organic fertilizer from the nearby community. In case of chemical fertilizer and micronutrient, all the growers bought from nearby agrovet. They did not have fix marketing channel for those fertilizer. The growers of gerbera used chemical fertilizer from the initial time of business.

Soil test

Gerbera growers seem to be more familiar with soil test. They performed soil test to test the pH of soil. During the soil test NPK value, micronutrient levels were not tested. pH of the soil is found to be decreased form initial level. Average pH value of gerbera field was 6.7 and pH value that of water was 8.1. And average EC value of water used in irrigation was found 0.47.

Irrigation

All of the respondents had a deep boring for the source of irrigation. There is no other source of irrigation near the farm. So, most of them preferred this source (deep boring).

Now talking about the time of irrigation, all growers gave irrigation at morning and evening. According to the respondent drip irrigation was more effective than other method therefore they used drip irrigation in gerbera.

Production

From the above mentioned practices 150 flowers per plant were produced during its life cycle.

Fertilizer use situation in Chrysanthemum

Chrysanthemum's data was taken from farms which was located in Kathmandu. Samples were taken from 6 ropani of land.

Most of the flower growers were found to be using both kinds of fertilizers i.e. organic as well as chemical. In case of organic fertilizer FYM was mostly preferred by them. Other organic fertilizer like poultry manure was found to be used in very low amount. Most of the respondent (nearly 100%) used all type of chemical fertilizers i.e. Urea, DAP and MOP. But DAP was used in higher amount. Respondent were not familiar with biofertilizer.

They apply around 900 Kg of organic fertilizer (FYM) during the field preparation whereas chemical fertilizers like urea, DAP + MOP are used in the amount of 1kg and 10 kg respectively per ropani of land. NPK solution is also given according the requirement.

Method of fertilizer application

All of the grower apply organic fertilizer and chemical fertilizer where as micronutrients were applied by foliar spray. In the initial phase fertigation was done through drip irrigation channel but the nozzles of the pipe were blocked and then fertilizers were applied directly to the soil.

Chrysanthemum growers produce organic fertilizer by themselves. In case of chemical fertilizer and micronutrient, all the growers bought from nearby agrovet. Chrysanthemum growers used chemical fertilizer from the initial time of business.

Soil test

Although in the agriculture soil test is one of the most important activities that have to be done, chrysanthemum growers were not concern about soil test. None of them tested the soil. Average pH value of chrysanthemum field was 6.9 and pH value that of water was 7.1. And average EC value of water used in irrigation was found 0.55.

Irrigation

The source of irrigation was well. Now talking about the time of irrigation, all most all growers give irrigation at morning and evening. It is because during the day time there is higher rate of evaporation due to which provided irrigation may not be much effective. Growers used flooding type of irrigation.

Production

By the above mentioned practices in an average 4 sticks of flowers were produced from single plant.

CONCLUSION

Floriculture is one of the emerging businesses in the field of agriculture in Nepal. People's investment and involvement toward this business is increasing day by day. But still the fertilizer management practices are not found in much scientific way. It is because the flower growers do not have proper knowledge on doses and calculation of various chemical and organic fertilizers too. From the survey it is found that FYM is the most preferred and used organic fertilizer in flower production farms. In the similar way DAP is mostly used chemical fertilizer followed by urea and MOP. About 50 percent of total respondent produced the organic manure in their farms and all the growers buy chemical fertilizer from nearby agrovets. They do not have proper marketing or buying channel for those fertilizers.

The pH value soil and irrigation water is slightly basic in most of the cases. Similarly EC value of irrigation water ranges from 0.17 to 0.55. Till the date according to the respondents the production in flower sector is found somehow satisfactory. But still it needs more kind of more kinds of modern techniques and practices especially in fertilizer management. We can say that if proper fertilizer management practices are not used, there is a risk of flower business in Nepal.

APPENDIX

Questionnaire used for the Survey

Name of the Respondent: ....
Name of the Farm/Nursery..
Address: ....
Contact Number: ....
Commodity of Production: ....
Area of Production: ....
Year of the Business start: ....

General Information on Fertilizer Use

1. Presently what type of fertilizer are you using?

a) Chemical b) Organic c) Both d) Biofertilizer All

2. Which of the chemical fertilizer you use the most?

a) Urea b) DAP c) MOP
b) Other (...)

3. Which of the organic fertilizer you use the most?

a) FYM b) Compost c) Vermi-compost
c) Poultry e) Goat All

4. Which of the Bio-fertilizer do you use?

a) Rhizobium b) Azotobacter c) PSB
b) Others (...)

5. How much fertilizer do you use at different stages?

Stages	Amount					
	FYM	Urea	DAP	MOP	Others	

6. What are the methods of your fertilizer use?

Fertilizer	Soil application	Foliar	Fertigation	Others
Organic				
Chemical				
Micronutrient				
Hormones				

7. From where do you buy fertilizers?

Fertilizer	Self Production	Agrovets	Co-operative	Nepalese Company	Import from India	Import from third country
Organic						
Chemical						
Micronutrient						
Hormones						

8. Do you perform Soil test?

a) Yes ( ) b) No ( )

Interval of Soil Test? .... years

9. Purpose of soil test

To Check a) pH( ) b) N( ) c)P ( ) d)K( ) e)Micronutrient( )

10. Duration of Chemical fertilizer use? .... Years

11. Change in pH

a) Increase B) decrease c) no change

12. Present NPK value in the soil? ....

13. Present pH value in the soil? ....

14. Present pH value in the Water? ....

15. Present EC value in the Water? ....

16. Source of irrigation water and time of irrigation

a) Sources: ....

b) Time: ( ) morning ( ) day ( ) evening

c) Method of irrigation ( ) Drip irrigation ( ) Flooding ( ) Sprinkler ( ) Fogging

17. How do you perform fertigation?

Fertilizers used	Dose/Liter	Time of application	Problems if any

18. Do you use Hormones?

a) Yes b) No

Hormones	Dose	Time of application	Purpose of use

19. Present Production situation Per plant............ Per Sq. M ....

Thank You