CHAPTER: 1

INTRODUCTION

Flowers are a proud assertion that a ray of beauty out values all the utilities of the world. A flower's appeal is in its contradictions - so delicate in form yet strong in fragrance, so small in size yet big in beauty, so short in life yet long on effect. Flowers always make people better, happier and more helpful; they are sunshine, food and medicine for the soul. They are attractive, useful and sought after both by humans and insects - they adorn our environment.

The scope of utility and importance of flowers have been realized throughout the world and in this modern age, floriculture has developed into a profitable industry in the recent years both for domestic and export market. Floriculture has tremendous potential for export beside domestic consumption. There is an increasing demand all over the world for the decoration of living and working places with eco-friendly things like fresh foliages, flowers, dried plant parts and dry flowers.

The estimated area under flower growing in the country is about 3.07 lakh hectares with 18.05 lakh MT productions of loose flowers and 7.04 MT productions of cut flowers. The area under cultivation is maximum (52.37 thousand hectares) in Karnataka, while highest loose flower production (4.26 lakh tonnes) in Tamilnadu and cut flower production is maximum in West Bengal (2.03 lakh tonnes). The total area under flower crops in Gujarat is 20.64 thousand hectares with 1.95 lakh tonnes productions of loose flowers in 2017-18 (Anon., 2018).

Tuberose (Polianthes tuberosa L.) is one of the most important tropical ornamental bulbous flowering plants cultivated for production of long lasting flower spikes. It is popularly known as Rajanigandha or Nishigandha. It belongs to the family Amaryllidaceae and is native of Mexico. Tuberose is an important commercial cut as well as loose flower crop due to pleasant fragrance, higher returns and wide adaptability to varied climate and soil. Its cultivation can also be extended economically in almost unproductive soils affected by salinity and alkalinity. Loam
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and sandy loam soils having pH range from 6.5 to 7.5 with good aeration and drainage are considered suitable for its cultivation. The soil should be rich in organic matter and retain sufficient moisture for proper growth.

Tuberose is best suited for cultivation in tropical to subtropical and temperate climates. Tuberose prefers to grow in an open sunny location, away from the shade of trees. It requires warm and humid climate although flowering is profuse under mild climate. The crop is reported to flower profusely throughout the year, if the climate is mild and free from extremes of high and low temperature. If the temperature is above 40 °C, the length of the spike and quality of the flowers are severely affected. Very low temperature and incidence of frost will damage the plants and flowers. Tuberose although not strictly photosensitive, long-day exposure promotes vegetative growth as well as early emergence of the first flower spike and also increases flower spike length. Early spike emergence and flowering was also noted in ratoon crops compared to the first year crop (Malam et al., 2010).

In India, commercial cultivation of tuberose is popular in West Bengal, Tamil Nadu, Maharashtra, Andhra Pradesh, Karnataka, Rajasthan; Navsari and Valsad of Gujarat. The flower is very popular for its strong fragrance and its essential oil is important component of high grade perfumes. ‘Single’ varieties are more fragrant than ‘Double’ type and contain 0.08 to 0.14 % concrete which is used in high grade perfumes (Singh and Uma, 1995).

The flowers of tuberose are also used for making artistic garlands, floral ornaments, bouquets, buttonholes, gajras and extraction of essential oil. The flowers emit a delightful fragrance. Tuberose represents sensuality and is used in aromatherapy for its ability to open the heart and calm the nerves, restoring joy, peace and harmony.

Tuberose is half-hardy, herbaceous perennial, bulbous plant. It is classed as a monocotyledon, leaves often lighter green in colour. It is an erect herb, with stout and short bulbs. Bulbs are made of scales and leaf bases and stem remains concealed within scales. Fibrous roots are mainly adventitious and shallow. Leaves are basal, linear, grass like foliage, bright green, reddish near the base. Tuberose inflorescences (spikes) bear 25 ± 10 pairs of florets which open acropetally (i.e., from base to top of the spike). Tuberose is a cross pollinated crop. Polianthes genus contains three types
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of flowers. One of them is single flower type having basic chromosome number \( n = x = 30 \) and \( 2n = 60 \), which is female fertile used in perfumery industry and breeding programme as female parent. The other two are semi-double and double flower types and generally used as cut flower. Tuberose flowers have a funnel shaped perianth and star shaped floret, and are fragrant, tubular and waxy white, the tube bent only near the base, filaments attached on upper part of corolla, in long terminal racemes. Stamens are six in number, ovary 3 locular, ovules numerous and fruit is a capsule.

Tuberoses are propagated by bulbs, bulblets and seeds. The bulbs remain dormant during the winter months in places where the temperature is low. The dormancy of the bulbs can be successfully broken by dipping the bulbs in 4 % Thiourea solution for one hour if early planting is desired.

Increased flower production, quality of flowers and perfection in the form of plants are greatly influenced by climatic, geographical and nutritional factors. Out of them, nutritional factor is playing a major role. At present, nutrients are supplied through chemical fertilizers. The indiscriminate and continuous use of chemical fertilizers has leaded to an imbalance of nutrients in soil which has an adversely effected the soil health, affecting the yield and quality of the product. Therefore, use of organic fertilizers is the need of the today. The use of biostimulants and biofertilizers improves Physico-chemical and biological properties of soil, besides improving the efficiency of applied nutrients.

Biostimulants are products of natural and organic origin that stimulates plants to achieve their highest growth and yield potential. Biostimulants are akin to biofertilizers as they also promote crop growth and yield. The use of biostimulants along with fertilizers could reduce chemical fertilizer use to a large extent and as much as 50 % as they supplement the soil with essential nutrients.

Banana pseudostem sap acts as biostimulants. Banana pseudostem sap is one such natural product which made from banana pseudostem. It is well known that banana is the heavy feeder crop of nutrients. After harvest of banana, remaining plant parts treated as waste. This contain high amount of essential plant nutrients, which is being lost. By utilizing such waste plant material, many useful by-products like fiber, paper, fabrics, organic manure etc. can be prepared. While separating fibers from the banana pseudostem, the liquid available is known as sap which contains good
amount of essential macro and micronutrients like K, Fe as well as growth promoting substances like cytokinin, GA$_3$.

Seaweed extract is a marine bioactive substances extracted from marine algae are used in agricultural and horticultural crops, and many beneficial effects, in the terms of enhancement of yield and quality. Seaweed extracts contains major and minor nutrients, amino acids, vitamins, cytokinins, auxin and abscisic acid like growth promoting substances and have been reported to stimulate the growth and yield of plants, develop tolerance to environment stress, increase nutrient uptake from soil and enhance antioxidant properties.

Panchagavya, an organic product has the potential to play the role of promote growth and providing immunity in plant system. Panchagavya consists of main five products viz. cow dung, ghee, urine, milk and curd. However, for a good effect of panchgavya on crop so, add another product like jaggery, ripened banana and tender coconut water, when suitably mixed and used, these have miraculous effects. Physico-chemical properties of Panchagavya revealed that they possess almost all the major nutrients, micro nutrients and growth hormones (IAA & GA) required for crop growth. Predominance of fermentative microorganisms like yeast and lactobacillus might be due to the combined effect of low pH, milk products and addition of jaggery/sugarcane juice as substrate for their growth.

Humic acids (HA) are the main fractions of humic substances (HS) and the most active components of soil and compost organic matter. In particular, HS stimulate plant growth by accelerating respiration, by their effects on photosynthesis, by increasing water and nutrient uptake, by affecting enzyme activities. Humic acids promote plant health and growth. The importance of humic acids lies in their ability to promote hormonal activity in plants. Humic acids also promote antioxidant production in plants which, in turn, reduces “free radicals”. Free radical molecules result from stress such as drought, heat, ultraviolet light and herbicide use. Free radicals are damaging because they are strong oxidizing agents which damage lipids, proteins and DNA within plants cells. Antioxidants are metabolites and enzymes which seek out free radical molecules and protect plants from damage. They include lipid soluble substances like vitamin "E" and beta-carotene and water soluble materials such as vitamin C and various enzymes.
Bio-fertilizers are natural fertilizers which are the preparations containing living cells of microorganism which when inoculated into soil provide essential nutrients to plants. Biofertilizers are biologically active products containing certain strains of bacteria, algae or fungi, as a single or composite culture. They produce hormones and anti metabolites which promote root growth. They decompose organic matter and help in mineralization in soil. When applied to seed or soil, biofertilizers increase the availability of nutrients and improve the yield by 10 to 25 % without adversely affecting the soil and environment. Biofertilizers replace 25-30 % chemical fertilizers, increase the yields by 10-40%, decompose plant residues, and stabilize C:N ratio of soil. It’s also improve texture, structure and water holding capacity of soil. It involves inoculation of beneficial microorganisms that help nutrient acquisition by plants through fixation of nitrogen, solubilization and mobilization of other nutrients.

_Azotobacter_ is an aerobic free living, heterotrophic N- fixing bacterium (fixes about 10-25 kg N/ ha/ season) which is commonly found to be involved in close association with crop and fix atmospheric nitrogen in soil and make it available to the plant. It can also synthesize growth promoting substances such as auxin and gibberellins and also to some extent the vitamins.

Phosphate solubilizing bacteria are beneficial bacteria capable of solublizes the insoluble forms of phosphates like tricalcium, iron and aluminium phosphates into available forms. They convert insoluble phosphates into soluble forms through the production of organic acids. Efficiency of applied phosphorus is very low due to its fixation either in the form of aluminum or iron phosphates in acetic soil or in calcium phosphate in neutral or alkaline soils. Several soil bacteria and fungi notably species of _Bacillus, Pseudomonas, Asperigillus, Penicillium_ secrete organic acids such as formic, acetic, propionic, lactic, glycolic, fumaric and succinic acids which contribute about 10-15 kg P₂O₅ / ha /season.

Potassium solubilizing bacteria play vital role in making available insoluble forms of potassium by mineralization. In Indian soil the soluble K form are present in approximately 2 % and insoluble are present in range of 98 % in form of minerals like biotite, feldspar, mica, muscovite, vermiculite (Goldstein,1994). Potassium solubilizing bacteria solublizes potassium from insoluble forms like mica, feldspar
and others by producing organic acids, siderophores and also capsular polysaccharides. Potassium uptake of plants can be increased by using potassium solublizes as bio-inoculants further increasing the crop production.

The quality and yield of tuberose flowers is influenced by application of biostimulants and biofertilizer are essential for crop growth and development. These biostimulants and biofertilizers are cost effective renewable energy source and play a crucial role in reducing the inorganic chemical or fertilizer application and at the same time increasing the flowering growth, quality and yield of flowers. Hence, considering the above facts, the present study was undertaken to find out “Effect of biostimulants and biofertilizers on growth, flower yield, and quality of tuberose (Polianthes tuberosa L.) cv. Prajwal” was carried out with the following objectives:

**OBJECTIVES**

1) To study the effect of biostimulants on growth, flower yield, and quality of tuberose cv. Prajwal.

2) To study the effect of biofertilizers on growth, flower yield and quality of tuberose cv. Prajwal.

3) To find out the interaction effect of various biostimulants and biofertilizers on growth, flower yield and quality of tuberose cv. Prajwal.

4) To study the economics of biostimulants and biofertilizers for cultivation of tuberose cv. Prajwal.