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Effect of *jeevamruta* on quality of tuberose (*Polianthes tuberosa* L.) cv. Arka Prajwal and on soil parameters

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Abstract
This investigation was conducted with the aim to find out the effect of *jeevamruta* on quality of tuberose (*Polianthes tuberosa* L.) cv. Arka Prajwal and on soil parameters. The experiment was laid out in a Randomized Block Design (RBD) with three replications and seven treatments were evaluated in the present study *viz*., T_1: 100% RDF; T_2: 80% RDF; T_3: 80% RDF + application of *jeevamruta* at 30 days interval; T_4: 80% RDF + application of *jeevamruta* at 45 days interval; T_5: 60% RDF; T_6: 60% RDF + application of *jeevamruta* at 30 days interval; T_7: 60% RDF + application of *jeevamruta* at 45 days interval. The results revealed that among different treatments, maximum quality attributes *viz.*, length of spike (89.30 cm), length of rachis (43.57 cm), weight of ten floret (21.37 g), number of florets per spike (51.33), shelf life (3.40 days) were recorded with T_3 (80% RDF + application of *jeevamruta* at 30 days interval). The results revealed that among different treatments, soil attributes *viz.*, significantly maximum available nitrogen (234.90 kg/ha), available phosphorus (42.47 kg/ha) and available potassium (256.47 kg/ha) were recorded with T_3 (80% RDF + application of *jeevamruta* at 30 days interval). Maximum bacterial colonies (182.33 x 10^6 cfu/g of soil) were recorded in treatment T_6 (60% RDF + application of *jeevamruta* at 30 days interval) while, maximum organic carbon (0.35%) was recorded with T_1 (100% RDF).

Keywords: Tuberose, RDF, *jeevamruta*, quality, soil parameters

Introduction
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 owing to pleasant fragrance, longer vase life of spikes, higher returns and wide adaptability to varied climate and soil. The flower is very popular for its strong fragrance and its essential oil is important component of high grade perfumes. Flowers of the Single type (single row of perianth) are commonly used for extraction of essential oil, loose flowers, making garland etc., while that of Double varieties (more than two rows of perianth) are used as cut flowers, garden display and for interior decoration.

Like many of the crops, tuberose also responds well to the application of manures and fertilizers, which are observed to be varying depending on the climatic conditions and soil types. However, modern and intensive agriculture involves the heavy dependence on fertilizer and chemicals, which cause pollution besides neglecting the ancient practices. In many areas, in general the health and productivity of the soils have declined to the extent that they cannot sustain profitable farming any more. Even the high yielding varieties of crops can perform to their potential, only when they are grown in productive soil.

Jeevamruta is one such natural amendment which can either replace or complement and reduce the use of chemical fertilizers and reclaim the sustainability of the soil and environment. It is prepared from cow dung, cow urine, pulse flour, jaggery and one handful of forest soil. Foliar application of *jeevamruta* also bring in some changes in the phylosphere microclimate. *Jeevamruta* enriches the soil with nutrients and increases the soil fertility. Soil application of *jeevamruta* create favourable conditions for the availability of nutrients by increasing pH in

acidic soils and decreasing the pH in alkaline soils and maximizing nutrient availability at pH 6.5 to 7.8 (Kulkarni, 2019) [18]. *Jeevamruta* is considered as a miracle of natural farming as it is easy to prepare, composed of macro and micro nutrients, presence of beneficial microorganisms like some bacteria, actinomycetes and some fungi (Reddy and Menon, 2012) [18]. *Jeevamruta* is acidic in nature and good source of macro and micro-nutrient *viz*., N (1.97%), P (0.172%), K (0.29%), Mn (47 ppm) and Cu (50 ppm) (Kumar *et al*., 2011) [9]. This natural preparation stimulates the activity of N fixers, P solubilizers and other beneficial microorganisms which are useful to plants.

Materials and Methods

A field experiment on tuberose was conducted during April 2022 to January 2023 at College Farm, College of Horticulture, S. D. Agricultural University, Jagudan, Gujarat, (India). The soil of the experimental plot was loamy sand in texture with moderately alkaline in reaction, low in organic carbon and available nitrogen, high in available phosphorus and medium in available potassium. The pH of the soil is neutral and normal in salt content. The experiment was laid out in a Randomized Block Design (RBD) with three replications and seven treatments were evaluated in the present study *viz*., T_1: 100% RDF; T_2: 80% RDF; T_3: 80% RDF + application of *jeevamruta* at 30 days interval; T_4: 80% RDF + application of *jeevamruta* at 45 days interval; T_5: 60% RDF; T_6: 60% RDF + application of *jeevamruta* at 30 days interval; T_7: 60% RDF + application of *jeevamruta* at 45 days interval.

The experimental field was thoroughly prepared by two ploughing followed by harrowing before planting of tuberose bulb. The required quantity of FYM (20 t/ha), 25% of Nitrogen, full dose of Phosphorus and Potassium (200:200:2000 kg/ha) were incorporated in experimental plot during the land preparation and rest of 75% of nitrogen was applied in three splits at 60, 120 and 180 days after planting. The raised bed plot size 2.25 m × 1.2 m was prepared and levelled properly. Then, healthy, disease free bulb of uniform size (2-3 cm) was planted at 45 cm × 20 cm distance. Five plants were randomly selected from each experimental plot for recording observations on quality parameters.

Results and Discussion

Quality parameters

The observations of different quality parameters such as length of spike, length of rachis, weight of florets, number of florets per spike and shelf life influenced by various treatments (Table 1). Among different treatments, significantly maximum length of spike (89.30 cm) observed with T_3 (80% RDF + application of *jeevamruta* at 30 days interval) which was found at par with T_4, T_1 and T_2 treatments. Significantly maximum length of rachis (43.57 cm) observed with T_3 (80% RDF + application of *jeevamruta* at 30 days interval) which was found at par with T_4, T_1 and T_2 treatments. This might be due to induced nutrient uptake, phytosynthesis and source sink relationship besides excellent physiological and bio chemical activities (Waheeduzzama *et al*., 2007) [20]. The result was obtained by Bhalla *et al*., (2006) [2] in gladiolus.

The maximum weight of ten florets (21.37 g) was recorded in treatment T_3 (80% RDF + application of *jeevamruta* at 30 days interval) which was found at par with T_4 treatment. This might be due to the availability of better food reserve, nutrients and growth promoting substances like gibberlic acid and indole acetic acid (Gore and Sreenivasa, 2011) [6]. Similar results were observed by Sushma *et al.* (2012) [18] in heliconia, Chaupoo and Kumar (2020) [9] in marigold.

Significantly maximum number of florets per spike (51.33) observed with T_3 (80% RDF + application of *jeevamruta* at 30 days interval) which was found at par with T_4 and T_1 treatments. The combination of organic manures and controlled release fertilizers might have helped in better availability and uptake of nutrients by the plants (Deepthi *et al.*, 2022) [5]. Results are in accordance with the findings of Zhu *et al.* (2009) [21] in Chrysanthemum, Kalmotia (2015) [8], Blomme and Dambre (2012) [3] in gerbera.

The data from Table 1 clearly elaborated that significantly maximum shelf life (3.40 days) reported with T_3 (80% RDF + application of *jeevamruta* at 30 days interval) which was found at par with T_4 treatment. The higher shelf life of florets due to application of *jeevamruta* which influenced flower longevity due to the increased nutrient uptake by plant and greater development of water conducting tissues (Singh *et al.*, 2015) [17]. *Jeevamruta* are organic substances that can promote growth and boost immunity. It has a vital role in extending the shelf life and reduce the loss of moisture content from florets (Hegde *et al.*, 2018) [7]. The results are in conformity with the finding of Sendhilnathan *et al*. (2017) [14] in marigold.

Soil parameters

The observations on the different soil parameters such as organic carbon, available nitrogen, available phosphorus, available potassium and microbial count influenced by various treatments (Table 2). Among different treatments, significantly maximum organic carbon (0.35%) was found with T_1 (100% RDF) which was at par with T_3 and T_4 treatments. This might be due to the addition of organic matter through FYM and higher crop growth and biomass addition due to leaf shedding and root biomass addition under NPK + FYM might have contributed to higher soil organic carbon content (Acharya *et al.*, 1988) [1].

Table 1: Effect of *jeevamruta* on quality parameters of tuberose

Treatments	Length of spike (cm)	Length of rachis (cm)	Weight of ten florets (g)	Number of florets per spike	Shelf life (days)
T_1	84.63	40.73	18.27	48.77	2.93
T_2	82.33	39.37	17.33	47.20	2.73
T_3	89.30	43.57	21.37	51.33	3.40
T_4	87.70	42.57	20.43	49.30	3.33
T_5	73.73	33.70	12.83	42.80	2.53
T_6	79.17	36.17	16.93	47.50	2.87
T_7	75.83	34.37	14.43	44.10	2.67
S.Em±	2.95	1.76	0.92	1.24	0.08
CD at 5%	9.10	5.41	2.83	3.82	0.25
C.V.%	6.25	7.87	9.17	4.55	4.80

The maximum available nitrogen (234.90 kg/ha) was found with T_3 (80% RDF + application of *jeevamruta* at 30 days interval) which was at par with T_4, T_1 and T_6 treatments. Drenching of *jeevamrut* increased the availability of nutrients due to enhanced population of soil micro flora resulting in increased bacteria, fungi and actinomycetes population and higher enzyme activity in the soil and also due to increasing earthworm activity in soil which helps in faster decomposition of organic matter that ultimately add the nutrient to the soil (Ravi *et al*., 2022) [11]. Findings of Gore and Srinivasa (2011) [6] in tomato also reported the similar results.

Significantly maximum available phosphorus content (42.47 kg/ha) was recorded in treatment T_3 (80% RDF + application of *jeevamruta* at 30 days interval) and was found to be statistically at par with T_4 and T_1 treatments. The higher soil phosphorus status with increasing levels of NPK coupled with *jeevamruta* might be due to lower utilization of phosphorus by the crop from applied sources, which resulted in building up of higher soil phosphorus status (Sharma *et al.*, 2009) [15]. Further, the complex organic anions and hydroxyl acids such as tartaric, citric, malonic and malic acids liberated during the decomposition of organic matter might have chelated Al^{+}, Fe^{+3} and Ca^{+2} and decreased the phosphate precipitating power of these cations thereby increased the phosphorus availability (Reddy *et al.*, 1990) [12]. The finding corroborates with the results reported by Gore and Sreenivasa (2011) [6] in tomato.

The maximum available potassium content (256.47 kg/ha) was registered in treatment T_3 (80% RDF + application of *jeevamruta* at 30 days interval) which was at par with T_4 and T_1 treatments. Different doses of NPK in combination with application of *jeevamruta* significantly influenced the potassium build up in soil. It might be attributed to direct addition to the available K pool of the soil, besides reduced K-fixation and release of K due to the interaction of organic matter present in biostimulants with clay (Sharma, 2020) [16]. The results are in line with the findings of Kumar *et al.* (2011) [9] and Sathyanarayana *et al.* (2017) [13] in gladiolus.

The data from Table 2 clearly elaborated that significantly maximum bacterial colonies (182.33 x 10^6 cfu/g of soil) were recorded in treatment T_6 (60% RDF + application of *jeevamruta* at 30 days interval) which was at par with T_7 treatment. Colonies of naturally occurring effective microorganisms were improved with *jeevamruta* application. It is evident from the data that maximum number of bacterial colonies was isolated from T_6 (60% RDF + application of *jeevamruta* at 30 days interval). This is ascribed to presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi detected in *jeevamruta* (Swaminathan, 2005) [19]. Natarajan (2007) [10] reported that the *jeevamruta* contains macronutrients like NPK, essential micronutrients, many vitamins, essential amino acids, which may provide nutrition to the rhizosphere microorganisms and thus help to increase their population.

Table 2: Effect of *jeevamruta* on soil parameters of tuberose

Treatments	Organic carbon (%)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potassium (kg/ha)	Bacterial count (x 10^6 cfu/g)
T_1	0.35	228.57	41.13	254.80	91.00
T_2	0.31	222.66	38.27	241.30	101.33
T_3	0.34	234.90	42.47	256.47	167.67
T_4	0.33	228.87	41.27	255.93	160.33
T_5	0.28	214.17	36.37	231.83	124.00
T_6	0.30	225.40	39.33	242.30	182.33
T_7	0.29	217.77	37.67	236.77	177.67
S.Em±	0.01	3.97	0.67	1.45	2.05
CD at 5%	0.03	12.22	2.06	4.47	6.31
C.V.%	4.92	3.06	2.94	1.02	2.47

Conclusion

In light of the results obtained in the present study, it can be concluded that planting of tuberose variety Arka Prajwal under 80% recommended dose (160:160:160 NPK kg/ha and 16 t/ha FYM) of fertilizers with *jeevamruta* application at 30 days interval was found most beneficial in terms of flower quality and for improving soil parameters.

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