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Original Research Article

Effect of Integrated Nutrient Application on Yield and Bulb Production Characters in Tulip (*Tulipa gesneriana* L.) cv. "Red Beauty"

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A B S T R A C T

The present investigation entitled "Bio-intensive nutrient management in Tulip (*Tulipa gesneriana* L.) cv. Red Beauty", was conducted at the Regional Research Station, Wadura, Sopore, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir during 2015 and 2016. Biofertilizers were applied to the bulbs at planting time using the dip method followed by shade drying before planting. The experiment was laid out in Randomized Complete Block Design with 12 treatments replicated three times. The treatments comprised of 100% NPK of recommended fertilizer dose (RFD), 75% NPK(RFD), 50% NPK(RFD), 25% NPK(RFD), Biofertilizers (PSB+KSB+VAM) + 100% NPK, Biofertilizers (PSB+KSB+VAM) + 75% NPK, Biofertilizers (PSB+KSB+VAM) + 50% NPK, Biofertilizers (PSB+KSB+VAM) + 25% NPK, Vermicompost + 100% NPK, Vermicompost + 75% NPK, Vermicompost + 50% NPK and Vermicompost + 25% NPK. The results revealed that tulip responded well to the biofertilizers and significant improvement was observed in bulb characteristics. Treatment combination containing biofertilizers (PSB+KSB+VAM) + 100% NPK resulted in highest number of bulbs plant^{-1} (1.91) and m^{-2} (56.85), maximum number of bulblets plant^{-1} (3.48), maximum weight of bulbs (779.33 g m^{-2}), maximum weight of bulblets plant^{-1} (4.59 g) and maximum size of bulb (12.85 cm). Results of the present investigation has led to the conclusion that treatment T_5 (Biofertilizers (PSB+KSB+VAM) + 100% NPK) proved to be superior in terms of yield and bulb production characters.

Keywords

Tulip, PSB, KSB, VAM, Vermicompost

Introduction

Tulip (*Tulipa gesneriana* L.), is a bulbous flowering plant which belongs to family Liliaceae and is believed to be native of Mediterranean and China but the natural origin of garden tulip seems to be lost, though many workers believe that tulip is derived from Gesneriana (Hall, 1940). It occupies 4th position among the top ten cut flowers in global floriculture trade (John and Neelofer, 2006). Tulips are spring-blooming perennials that grow from bulbs. Depending on the species, tulip plants can grow upto 4 inches (10 cm) to 28 inches (71 cm) high. Tulips are generally grown in beds, borders

and pots in gardens and lawns for aesthetic purpose and as well as cut flowers for commercial purpose. Tulips are flowers of rich brilliant colours and of good substance. In India, tulips are grown chiefly in the state of Jammu and Kashmir. However, there is great scope of growing tulips for various purposes in temperate zones like Himachal Pradesh, Uttaranchal and other similar hilly regions of the country. Bulbous crops generally require more energy for their growth and yield as compared to non-bulbous crops. Indiscriminate use of synthetic fertilizers impart reduced nutritive value and sensory parameters, whereas integration of organic amendments and bio-fertilizers reduce the NPK (nitrogen, phosphorus and potassium) doses and improve the soil health and plant nutrient availability resulting in higher crop yields besides being environmentally safe (Kumari *et al.,* 2017; Pandey *et al.,* 2017).

Biofertilizers are cheap source of nutrients, supply of micronutrients, enhances organic matter, counteract negative impact of chemical fertilizers and helps in secretion of growth hormones (Gaur, 2010; Kumari *et. al.,* 2017). It is reported that flower yield can be increased up to 40% with the use of biofertilizers as a supplement (Singh, 2005; Srivastava and Govil, 2007). A review (Choudhary, 2010) indicated that biofertilizers (Phosphorous Solubilising Bacteria and Arbuscular Mycorhyzae Fungi) not only help in improving the nutrient uptake by the plants, releasing of growth hormones and antibiotics but also improve the quality of produce along with reduced cost of production.

Potassium solubilizing bacteria (KSB) such as *Bacillus mucilagenosus* and *Bacillus edaphicus* are able to solubilize potassium rock through production and secretion of organic acids (Han and Lee, 2005).

Many microorganisms associated with roots have the ability to increase plant growth and productivity. Among them, Phosphate Solubilizing Microorganisms (PSMs) are ubiquitous in soils and could play an important role in supplying phosphorous to plants in a more environment friendly and sustainable manner (Kumari *et al.,* 2017).

The Phosphorus Solubilizing Bacteria (PSB) in the rhizosphere are known to increase the solubility of insoluble phosphorus through production of aliphatic and aromatic acids, phytase and phospholipase (Kumar and Ahlawat, 2006). These microorganisms render insoluble phosphate into soluble form through the process of acidification, chelation and exchange reactions. This process not only compensates for higher cost of manufacturing fertilizers in industry but also mobilizes the fertilizers added to soil (Rodriguez and Fraga, 1999).

Vermicompost which is a product of fragmentation of organic waste of earthworm has been established to be a potential source of nutrient for the growth of plants (Atiyeh *et al.,* 2000; Singh *et al.,* 2017). Use of such nutrients provide resources essential for building up of the molecules in plants to induce better growth, greater capacity to fight against disease and to encounter obnoxious chemical substances available in the vicinity of the plants (Edwards and Burrows, 1988). Although the influence of integrated nutrient management (INM) on the performance of cereals, vegetables and tree crops has widely been studied, yet the studies showing its effect on the performance of bulbous ornamentals especially Tulip, that too in India are meager. Keeping in view the importance of all these points, the present investigation was undertaken with the objective of studying the effect of biofertilizers on bulb production in Tulip cv. Red Beauty.

Materials and Methods

The investigation was conducted at the Regional Research Station, Wadura, Sopore, Sher-e-Kashmir University of Agriculture Sciences and Technology of Kashmir which is situated 80 km away from Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar that lies at 34º5' N latitude and 74º9' E longitude at an altitude of 1701 meters above sea level.

Healthy and uniform bulbs of 8 to 10 cm circumference were used as planting material. The bulbs were cleaned and inoculated by dipping in carried based biofertilizers [PSB + KSB (1:1)] for 30 minutes. VAM (250 g per m^2) and vermicompost (5 kg per m^2) was applied in the field by mixing with the soil. Treated bulbs were shade dried before planting in the field.

Uniform cultural practices were carried out throughout the experimental plot. The data on following parameters were recorded from ten randomly selected plants leaving border plants in each replication.

Number of bulbs plant^{-1}

Total number of bulbs harvested per plant per treatment were counted and recorded from five representative plants.

Number of bulbs m^{-2}

The number of bulbs obtained per meter square was counted at harvest.

Number of bulblets plant^{-1}

Number of daughter bulbs were counted in each representative plant and average were calculated.

Bulb weight m^{-2} (g)

Weight of bulbs was recorded from each representative plant by a digital electronic balance.

Weight of bulblets plant^{-1} (g)

The weight of bulblets per plant was recorded by weighing all the non-flowering bulbs produced per plant

Bulb size (cm)

The size of bulbs was recorded by measuring the circumference of bulbs in north to south and east to west direction by using vernier caliper.

Results and Discussion

The data presented in Table 1 revealed that maximum number of bulbs plant^{-1}(1.91) and m^{-2} (56.85) were recorded in treatment T_5 (Biofertilizers (PSB+KSB+VAM) + 100% NPK), which was at par with the treatment T_9 (Vermicompost + 100% NPK) (1.88 number of bulbs plant^{-1}) and (55.91 m^{-2}) while as the treatment T_4 [25% NPK (RFD)] resulted in lowest number of bulbs plant^{-1} (1.41) and m^{-2} (41.88).

The maximum number of bulblets plant^{-1} (3.48) were recorded in treatment T_5 (Biofertilizers (PSB+KSB+VAM) + 100% NPK of recommended dose), which was at par with the treatments T_9 (Vermicompost + 100% NPK) (3.15) and T_6 (Biofertilizers (PSB+KSB+VAM) + 75% NPK) (2.99). The treatment T_4 [25% NPK (RFD)] resulted in minimum number of bulblets plant^{-1} (1.40). Increase in bulb yield due to application of biofertilizers might be due to enhanced N availability to the plants which might increase average number of bulbs and number of bulblets.

Table.1 Effect of integrated nutrient application on yield and bulb production in tulip (*Tulipa gesneriana* L.) cv. Red Beauty

Treatments	Number of bulbs plant^{-1}	Number of bulbs m^{-2}	Number of bulblets plant^{-1}	Bulb weight m^{-2} (g)	Weight of bulblets plant^{-1} (g)	Bulb size (cm)
T_1	1.72	51.34	2.77	766.80	6.63	11.82
T_2	1.66	49.26	2.54	764.38	6.45	11.61
T_3	1.53	45.35	2.12	760.25	5.24	10.72
T_4	1.41	41.88	1.40	751.27	4.59	9.10
T_5	1.91	56.85	3.48	779.33	7.57	12.85
T_6	1.82	53.82	2.99	771.88	7.35	12.26
T_7	1.61	47.93	2.27	762.54	6.27	11.42
T_8	1.47	43.93	2.04	756.37	5.26	10.43
T_9	1.88	55.91	3.15	777.87	7.14	12.25
T_{10}	1.78	52.88	2.94	769.79	6.87	11.82
T_{11}	1.59	47.18	2.18	761.38	6.04	11.18
T_{12}	1.45	43.16	1.96	755.69	5.03	9.93
$C.D_{(p\leq0.05)}$	0.04	3.55	0.50	2.36	0.52	1.10

Improved physical condition of soil may also have contributed to increased number of bulbs and bulblets. *Pseudomonas* has plant growth promoting activity along with it helps in solubilisation of 'P' and other micro nutrients. This might have helped in production of more bulbs and bulblets. These results were in line as reported in gladiolus by Dubey *et al.,* 2005. The maximum weight of bulbs m^{-2} (779.33 g) and weight of bulblets $plant^{-1}$ (7.57 g) observed in treatment T_5. Whereas minimum weight of bulbs m^{-2} (751.27g) and weight of bulblets $plant^{-1}$ (4.59 g) observed in treatment T_4.

The maximum size of bulb (12.85 cm) was recorded in treatment T_5 whereas the minimum size (9.10 cm) of bulb $plant^{-1}$ were observed in the treatment T_4. Increase in phosphorus availability due to the application of phosphorus solubilizing biofertilizers resulted in a significant increment in bulb circumference (cm), weight of bulblets $plant^{-1}$ and weight of bulbs m^{-2} during both the years. This may be due to more dry matter production by the plants which exhibited superior vegetative growth in treatment combination containing of bio-fertilizers (PSB+KSB+VAM) + 100% NPK and thus higher rates of transport and accumulation of metabolites in storage structures. The results are in close agreement with those obtained by Sehrawat *et al.,* (2003) in gladiolus.

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