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Integrated Nutrient Management for Improving Plant Growth, Flowering and Bulb Production in *Hyacinth* cv. Yellow Stone

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ABSTRACT

The present investigation entitled "Integrated Nutrient Management for improving plant growth, flowering and bulb production in Hyacinth (*Hyacinthus orientalis*) cv. Yellow Stone" was carried out at the Floriculture experimental field SKUAST-K during the year 2018-19. 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 15 treatments replicated three times. The results of the study revealed that the treatment T_{15} significantly improved vegetative, floral, and bulb characteristics. Treatment combination containing 80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB +Azotobacter) resulted in a minimum number of days taken to bulb sprouting (75.83days), first leaf appearance (81.50days), second leaf appearance (83.50days), third leaf appearance (85.33days), bud appearance (88.33 days) , color break (99.58days), complete flower formation(109.83days), maximum plant height (18.40cm), leaf length (13.87cm), leaf width (2.45cm), length of a spike (18.06cm), Spike thickness (7.90mm), number of leaves per plant (23.83), number of florets per spike (20.33), the diameter of inflorescence (7.06cm), length of inflorescence (7.10cm), duration of flowering (18.33days), bulb weight (40.22g), bulb size(11.52cm), number of offsets per bulb (3.83), weight of offsets per bulb (20.17g).

Keywords: Azotobacter, *Hyacinthus orientalis,* KSB, PSB, Sheep manure, Vermicompost

INTRODUCTION

Ornamental temperate bulbous crops have an important place in the floriculture trade. Among these *Hyacinthus orientalis* is one of the important bulbous crops which has been commercially used as it is having Landscape use under temperate and subtropical climatic conditions. Hyacinthus belongs to the family Asparagaceae. These are commonly called as "Hyacinth". Hyacinthus is native to the Eastern Mediterranean region including Turkey, Iraq, Turkmenistan, Iran, Lebanon, Syria, and the Palestine region.

Hyacinthus grows from bulbs, each producing four to six linear leaves. The flowering stem is raceme which grows to 20-35 cm tall. *Hyacinthus orientalis* has a single dense spike of fragrant flowers in shades of red, blue, white, orange, pink, violet or yellow. Nutrient enrichment plays an important role in quality bulb production. Organic matter plays an important role in the proliferation of bulblets and offsets as it provides loose and friable conditions. Besides this organic manure enriches the soil with organic carbon content, and macro and micronutrients for better growth and development. Integrated nutrients in optimum quantity assure proper growth and development of a plant and have been reported to enhance the bulb yield in *Hyacinthus orientalis* and other bulbous crops. Given these functions reflected above the goal of soil fertility enrichment can be achieved which in turn can help in an enhanced proliferation ratio. Thus the integrated use of organic manures, inorganic fertilizers and biofertilizers can help in better propagation ratio in hyacinth but at what ratio is always questioned. Therefore the present investigation aims to delaminate the optimum combination of organic manures, inorganic fertilizers, and bio fertilizers which can help in enhancing bulb propagation ratio as well as stabilize soil health conditions.

MATERIAL AND METHOD

The present investigation entitled "Integrated Nutrient Management for improving plant growth, flowering and bulb production in Hyacinth (Hyacinthus orientalis) cv. Yellow Stone" was carried out at the Floriculture experimental field SKUAST-K from Nov.2018 to June 2019. 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 15 treatments replicated three times.For recording various observations four plants in each plot were selected randomly and tagged for recording observations on growth, flowering, and bulb attributes at successive stages. The mean of the three plots of three replications was considered as an average for a particular treatment.

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S.No	Details of treatment	Symbol used
1	Recommended fertilizer dose (N: P :K @ 75 : 50 : 50 kg/ha)	T_1
2	60% RFD	T_2
3	80% RFD	T_3
4	60% RFD + FYM (40 tons ha^{-1})	T_4
5	60% RFD + Sheep manure (40 tons ha^{-1})	T_5
6	60% RFD + vermicompost(12 tons ha^{-1})	T_6
7	80% RFD + FYM(40 tons ha^{-1})	T_7
8	80% RFD + Sheep manure(40 tons ha^{-1})	T_8
9	80% RFD + Vermicompost (12 tons ha^{-1})	T_9
10	60% RFD +FYM (40 tons ha^{-1}) + Biofertilizers(PSB + KSB + Azotobacter)	T_{10}
11	60% RFD + sheep manure (40 tons ha^{-1}) +Biofertilizers (PSB + KSB + Azotobacter)	T_{11}
12	60% RFD + vermicompost(12 tons ha^{-1}) + Biofertilizers (PSB + KSB + Azotobacter)	T_{12}
13	80% RFD + FYM(40 tons ha^{-1}) + Biofertilizers(PSB + KSB + Azotobacter)	T_{13}
14	80% RFD + Sheep manure (40 tons ha^{-1}) +Biofertilizers (PSB + KSB + Azotobacter)	T_{14}
15	80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB + Azotobacter)	T_{15}

RESULTS AND DISCUSSION

Vegetative parameters

At all crop growth stages, significant variation in vegetative stages was observed among different treatments. It was observed that treatment T_{15} i.e.,80% RFD +Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB + Azotobacter) resulted ina minimum number of days taken to bulb sprout (75.83 days) whereas the maximum days taken to bulb sprout (88.33 days) were recorded in treatment T_2 containing 60% RFD. (Table 1).Earliness in bulb sprouting by treatment T_{15} might be due to the optimum availability of macronutrients, micronutrients and enzymes. Vermicompost is well known to contain macro elements besides Fe, Zn and provides an excellent atmosphere for the proliferation of microbes. Azotobacter inoculation increases the microbial population in the rhizosphere and enhances the availability of nutrients to plants. Phosphorus Solubilizing Bacteria (PSB) on the other hand secretes organic acids which form chelates and such chelation results in the effective solubilization of phosphate. Besides this PSB increase the efficiency of phosphorus uptake and improves the means of nitrogen uptake as phosphorus is known to increase the uptake of nitrogen. The integrated nutrient approach help bulbs to sprout early as it facilitates conditions for the early sprout of the bulb through its influence on alterations in bulb physiological conditions. These results are conform with the findings of [3], [12], [1].

The results about the number of days taken for leaf appearance were significantly influenced by various treatment combinations. The minimum number of days taken to first leaf appearance (81.50 days), second leaf appearance (83.50 days), third leaf appearance (85.33 days) with treatment T_{15} i.e., 80% RFD+Vermicompost (12 tons ha^{-1})+Biofertilizers (PSB+KSB+ Azotobacter) and maximum days taken to first leaf appearance (93.33days), second leaf appearance (95.25days), third leaf appearance (97.25 days) with 60% RFD i.e., treatment T_2 (Table 1). Earliness in first, second, and third leaf emergence could be the synchronized influence of vermicompost, Azotobacter, PSB, and inorganic fertilizers through the availability of optimum nutrients which aids meristematic activities, root development, efficient translocation of stimulating compounds and maintains a balance between metabolism and respiration and might have resulted with early leaf emergence and its development. Early vegetative growth with a treatment containing Vermicompost + Azotobacter + PSB was reported by [3], [13].

The observations recorded on plant height at maturity indicate the application of treatment T_{15} i.e., 80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB + Azotobacter) improved plant height significantly over all other treatments and recorded maximum plant height (18.40cm) where as minimum plant height (15.05cm) was noticed with treatment T_2 containing 60% RFD.(Table 1). Plant height may be attributed to the presence and synthesis of gibberellins in organic manures. Gibberellins cause both cell elongation and division which stimulated elongation and results in increased plant height. Moreover, the application of biofertilizers in addition to organic manures and inorganic fertilizers might have increased the absorption of the macro and micronutrients of plant. This might be because the combined application of biofertilizers enhance the rate of mineralization of plant nutrients in the soil and thus help in better nutrition of the crop which is reflected in increasing plant height. These results are in Conformity with the findings of [4], [6],[5].

Maximum leaf length (13.87cm), and leaf width (2.45cm) were recorded in treatment T_{15} i.e., 80% RFD +Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB + Azotobacter) whereas the minimum leaf length (9.10cm), leaf width (1.03cm) was recorded in treatment T_2 containing 60% RFD (Table 1).The dominance of treatment T_{15} might be due to easily available nutrients and uptake. Vermicompost has rich nutrient content and serves seat for the proliferation of microbes which are responsible for fixing or making macro nutrients available to plants. The increased population of microbes through multiplication helps in proper nitrogen fixation and availability of other nutrients as well. The role of Azotobacter in the secretion of growth promoting substances helps in phosphate solubilization as well as the causes biosynthesis of auxin. Thus all these combined factors might have improved leaf length and leaf width. These results are in Conformity with the findings of [10].

Highest number of leaves per plant (23.83) were recorded in treatment T_{15} i.e., 80%RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB+ Azotobacter) whereas the lowest number of leaves per plant (17.33) were recorded in treatment T_2 containing 60% RFD (Table 1). Increasing the number of leaves with the application of bio and chemical fertilizers may be due to increased nitrogen availability as it is a constituent of protein, a component of protoplast and increases the chlorophyll content in leaves. All these factors contribute to cell multiplication, cell enlargement, and differentiation which could have resulted in better photosynthesis and ultimately exhibited better vegetative growth. Besides this dominance in terms of the number of leaves might be due to optimum nutrient availability especially NPK and activities of Azotobacter and PSB which enhance the population of growth-promoting substances i.e., auxins, gibberellins and cytokinins. These results are in Conformity with the findings of [7],[14].

Table-1: Effect of integrated nutrient management on Vegetative parameters of Hyacinth (Hyacinthus orientalis) cv. Yellow Stone

Treatment Symbol	Days taken to bulb sprouting	Days taken to 1st leaf appearance	Days taken to second leaf appearance	Days taken to third leaf appearance	Plant height at maturity (cm)	Leaf length (cm)	Leaf width (cm)	Number of leaves per plant
T_1	86.08	91.08	93.16	95.16	15.56	9.81	1.20	17.83
T_2	88.33	93.33	95.25	97.25	15.05	9.10	1.03	17.33
T_3	87.41	92.41	94.41	96.41	15.29	9.48	1.12	17.58
T_4	85.25	90.41	92.41	94.33	15.73	10.18	1.31	18.33
T_5	84.08	89.08	91.16	93.25	16.05	10.43	1.41	18.58
T_6	83.66	88.66	90.66	92.58	16.29	10.86	1.51	19.16
T_7	83.16	88.16	90.25	92.16	16.74	11.11	1.64	19.58
T_8	82.66	87.66	89.66	91.66	16.93	11.42	1.74	20.33
T_9	82.16	87.16	89.25	91.16	17.04	11.86	1.87	20.58
T_{10}	81.33	86.33	88.50	90.75	17.28	12.06	1.93	21.33
T_{11}	80.25	85.25	87.08	89.08	17.54	12.44	2.05	21.66
T_{12}	79.25	84.25	86.16	88.25	17.74	12.85	2.12	22.33
T_{13}	78.16	83.16	85.16	87.25	17.95	13.10	2.25	22.58
T_{14}	77.25	82.25	84.33	86.33	18.13	13.63	2.37	23.41
T_{15}	75.83	81.50	83.50	85.33	18.40	13.87	2.45	23.83
C.D($p \leq 0.05$)	0.54	0.51	0.56	0.51	0.07	0.07	1.20	0.19

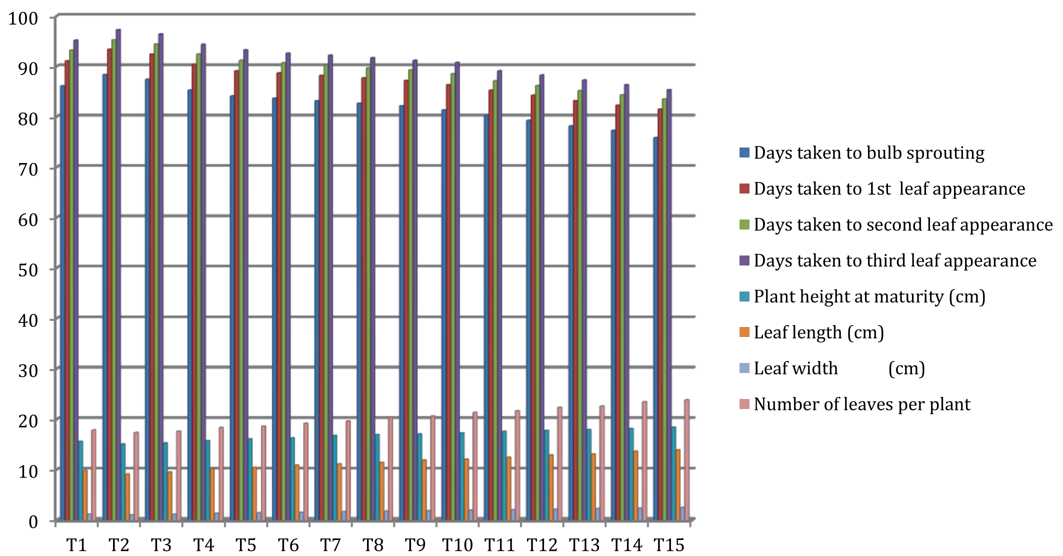

Fig. 1: Graphical representation of Effect ofintegrated nutrient management on Vegetative parameters of Hyacinth (Hyacinthus orientalis) cv. Yellow Stone

Floral parameters

At all crop growth stages, significant variation in reproductive stages was observed among different treatments. It was observed that a minimum number of days taken to bud appearance (88.33 days),colour break (99.58 days), days taken to complete flower formation(109.83 days) was recorded in treatment T_{15} i.e., 80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB + Azotobacter) whereas the maximum days taken to bud appearance (100.25 days), colour break (111.41 days) , days taken to complete flower formation (121.75 days)was recorded in treatment T_1 containing 100% RFD (Table 2).

From physiological point of view balanced amount of nitrogen, phosphorus and potassium is a pre-requisite for bud initiation and its development as these are important in the initiation of flower primordial formation. Besides this phytohormones produced by Azotobacter and PSB influence wall pressure and turgor pressure of cells which lead to quick cell enlargement and division at the meristematic portion and advances flowering. These results are in close Conformity with the findings of [3], [8].

The number of florets per spike, length of spike, and spike thickness were significantly influenced by various treatments. Significantly maximum number of florets per spike (20.33),highest length of spike (18.06cm), and maximum Spike thickness (7.90 mm) were recorded in treatment T_{15} i.e., 80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB+ KSB + Azotobacter) whereas the minimum number florets per spike (14.91), lowest length of spike (12.56cm), minimum spike thickness (5.03mm) were recorded in treatment T_2 containing 60% RFD (Table 2). The role of macronutrients, micronutrients and plant hormones in augmenting general growth and flowering is well known. The improvement in vegetative characteristics of plant, in turn, helps in increasing the biomass which in turn influences the length of spike. Apart from the above reasons in improvement in the number of florets and length of spike, there are other important functions of balanced nutrients application. Nitrogen is an important constituent in chlorophyll and helps in efficient photosynthesis. Phosphorus on the other hand, increase the root density which could be due to the involvement of phosphorus in metabolic activities of root cell elongation and division resulting in increased root growth, and diameter which in turn aids the efficacy of nutrient uptake with advanced growth. Thus the efficient growth and optimum nutrient application might have enhanced spike thickness. These results are in close conformity with the findings of [9].

The maximum diameter of inflorescence (7.06cm) was recorded in treatment T_{15} i.e., 80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB+ KSB + Azotobacter) whereas the minimum diameter of inflorescence (4.16cm) was recorded in treatment T_2 containing 60% RFD (Table 2). The dominance in diameter of inflorescence by application of treatment T_{15} might be due to the rich and readily available nutrient composition of vermicompost containing macronutrients, Fe, Zn and also aids in improvement in the proliferation of microbes and efficacy of enzyme activity. Azotobacter inoculation increases the microbial population in the minor rhizosphere and enhances nitrogen fixation. Phosphorus Solubilizing Bacteria (PSB) on the other hand secretes organic acids which form chelates and such chelation results in the effective solubilization of phosphate. Besides this PSB increase the efficiency of phosphorus uptake and improves the means of nitrogen uptake as phosphorus is known to increase uptake of nitrogen. These results are in conformity with the findings of [3].

The highest length of inflorescence (7.10cm) was recorded in treatment T_{15} i.e., 80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB+ KSB + Azotobacter) whereas the lowest length of inflorescence (4.20cm) was recorded in treatment T_2 containing 60% RFD. (Table 2). It might be due to that Azotobacter accumulates nitrogen near the root zone of the plant and PSB convert unavailable phosphorus to available form and increase the availability of phosphorus to plants. These results conform with the findings of [2].

The maximum duration of flowering (18.33days) was recorded in treatment T_{15} i.e., 80% RFD + Vermicompost (12 tons ha^{-1}) +Biofertilizers (PSB+ KSB + Azotobacter) whereas the minimum duration of flowering (14.41days) was recorded intreatment T_2 containing 60% RFD (Table 2). It is due to the easy balanced availability of nutrients to plants by vermicompost for better root proliferation, enhanced microbial activity, excellent uptake of NPK due to improved biological characteristics, and enhancement of photosynthetic activity. These results are in conformity with the findings of [3].

Table-2.: Effect of integrated nutrient management on floral parameters of Hyacinth *(Hyacinthus orientalis)* cv. Yellow Stone

Treatment Symbol	Days to bud appearance	Days taken to Colour break	Days taken to complete flower formation	Number of florets per spike	Length of spike (cm)	Spike thickness (mm)	Diameter of inflorescence (cm)	Length of inflorescence (cm)	Duration of flowering (day)
T_1	100.25	111.41	121.75	15.16	13.26	5.45	4.46	4.55	15.08
T_2	98.16	109.33	119.83	14.91	12.56	5.03	4.16	4.20	14.41
T_3	99.41	110.33	120.75	15.25	12.93	5.28	4.26	4.37	14.58
T_4	94.16	104.83	115.83	15.91	13.76	5.72	4.56	4.90	15.16
T_5	95.58	106.91	117.25	16.08	14.10	5.97	4.76	5.16	15.58

T_6	94.66	105.5	116.66	16.41	14.33	6.04	5.00	5.44	15.66
T_7	97.33	108.33	118.83	16.83	14.73	6.30	5.16	5.82	15.91
T_8	96.25	107.41	117.91	17.08	15.10	6.61	5.36	6.22	16.08
T_9	95.16	106.25	116.66	17.91	15.46	6.79	5.66	6.37	16.16
T_{10}	93.75	104.75	115.08	18.08	15.80	6.94	6.03	6.46	16.41
T_{11}	92.08	102.75	113.58	18.50	16.30	7.17	6.26	6.54	16.66
T_{12}	91.25	102.00	113.00	19.00	16.66	7.33	6.46	6.66	16.83
T_{13}	90.25	101.25	111.58	19.25	16.95	7.66	6.63	6.75	17.16
T_{14}	89.33	100.66	111.00	19.91	17.20	7.74	6.83	6.83	17.58
T_{15}	88.33	99.58	109.83	20.33	18.06	7.90	7.06	7.10	18.33
C.D($p \leq 0.05$)	0.53	0.90	1.00	15.16	0.21	0.06	0.04	0.09	0.27

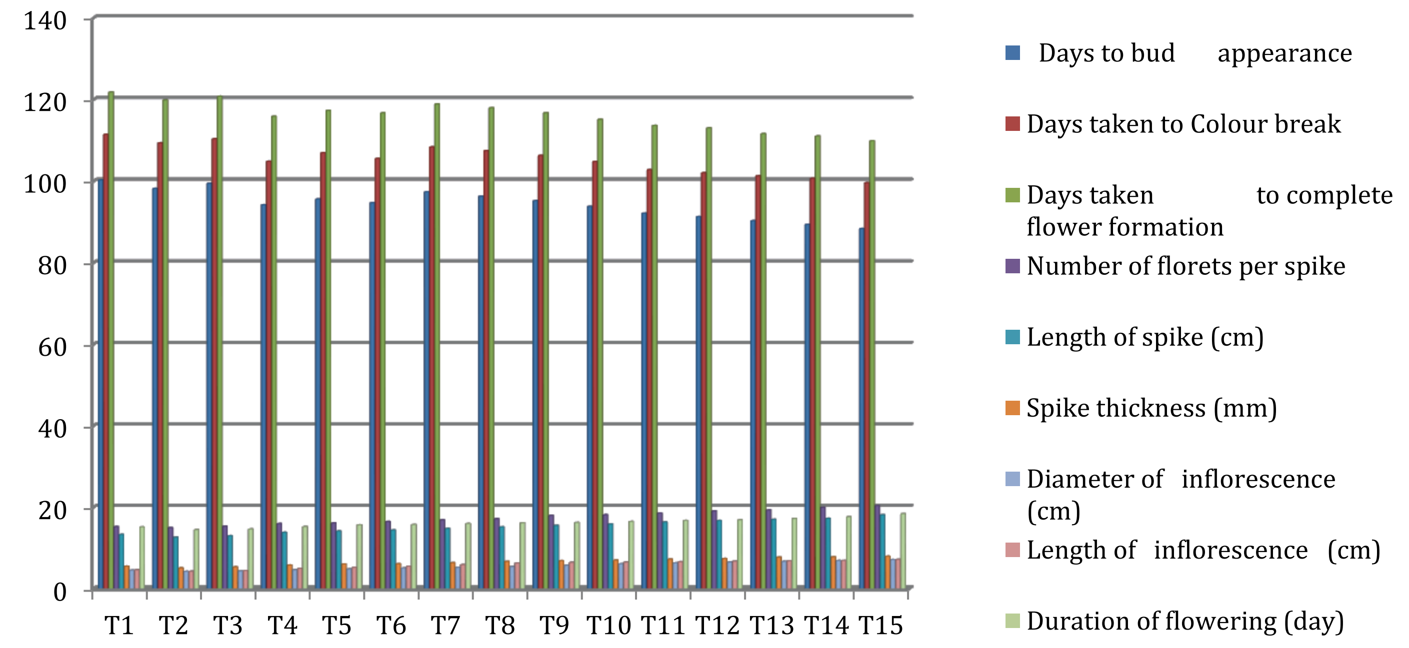

Fig. 2: Graphical representation of Effect ofintegrated nutrient management on Floral parameters of Hyacinth (Hyacinthus orientalis) cv. Yellow Stone

Bulb parameters

Bulb parameters were significantly influenced by various treatment combinations. Maximum bulb weight (40.22g), maximum bulb size (11.52cm), the maximum number of offsets per bulb (3.83), and maximum weight of offsets per bulb (20.17g) was recorded in treatment T_{15}whereas the minimum bulb weight (27.77g), minimum bulb size (7.12cm), minimum number of offsets (2.00), minimum weight of offsets per bulb (10.05g) was recorded in treatment T_2 (Table 3).

The dominance of treatment T_{15} i.e., 80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB+ KSB + Azotobacter) is due to the application of an optimum dose of phosphorus through PSB, vermicompost and inorganic sources resulting in more dry matter production by the plants and thus higher rates of transport and accumulation of metabolites in storage structures. Thus the integrated approach of optimum nutrient management through treatment (T_{15}) might have improved general growth characteristics and resulted with significant influence on bulb weight, bulb size, number of offsets per bulb and weight of offsets per bulb. The results are in close agreement with those obtained by [3], [11].

Table-3: Effect of integrated nutrient management on bulb parameters of Hyacinth (Hyacinthus orientalis) cv. Yellow Stone

Treatment Symbol	Bulb weight (g)	Bulb Size(cm)	Number of offsets per bulb	Weight of offsets(g)
T_1	29.25	7.59	2.08	10.17
T_2	27.77	7.12	2.00	10.05
T_3	28.40	7.34	2.16	10.09
T_4	29.85	7.90	2.33	12.10
T_5	30.44	8.30	2.41	13.49
T_6	30.86	8.73	2.50	14.56
T_7	31.53	9.03	2.58	14.94
T_8	32.61	9.30	2.66	15.15
T_9	33.63	9.63	2.91	15.39
T_{10}	34.87	9.90	3.00	15.79
T_{11}	36.07	10.31	3.16	16.11
T_{12}	37.08	10.60	3.25	16.49
T_{13}	38.66	10.83	3.41	17.28
T_{14}	39.26	11.22	3.50	18.17
T_{15}	40.22	11.52	3.83	20.17
C.D($p \le 0.05$)	0.76	0.05	0.18	0.49

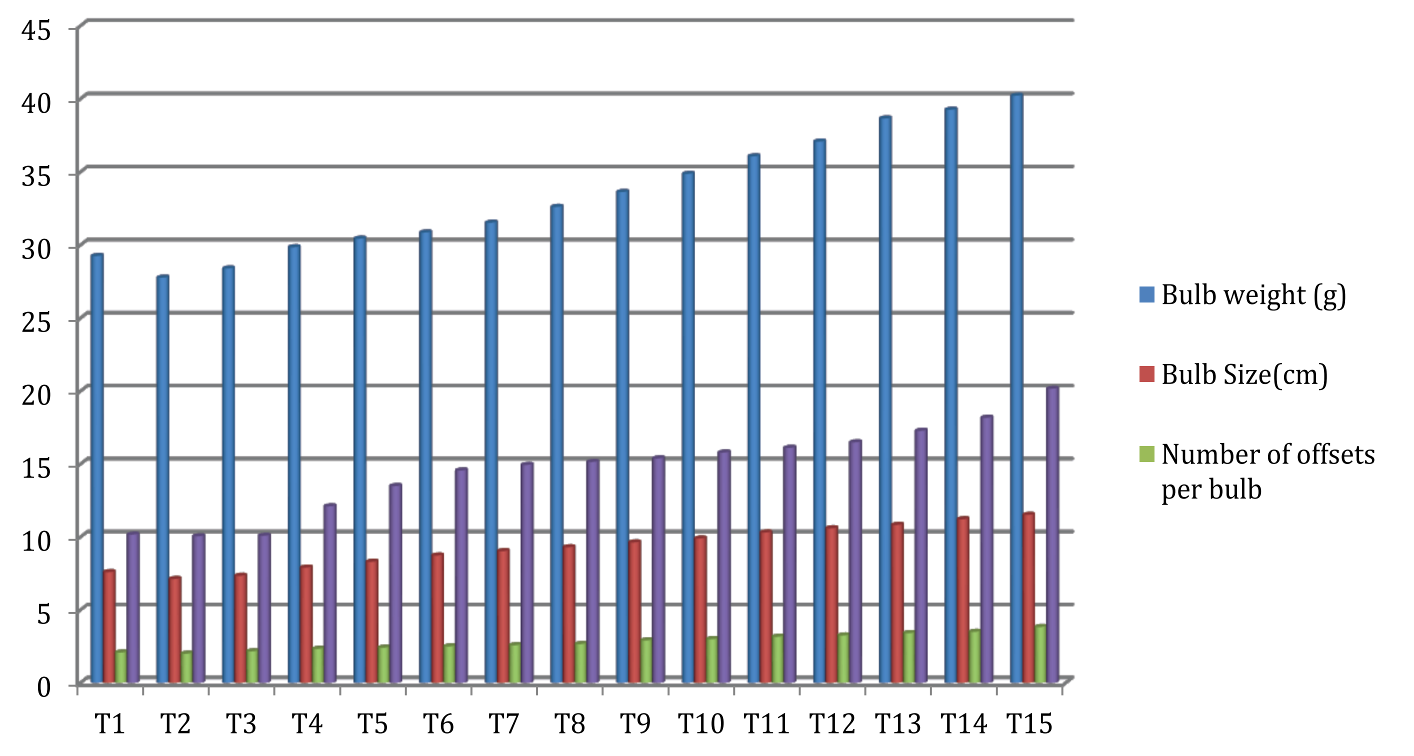

Fig. 3: Graphical representation of Effect ofintegrated nutrientmanagement on Bulb parameters of Hyacinth (Hyacinthus orientalis) cv. Yellow Stone

CONCLUSION

Present investigation led to conclude that treatment T_{15} [80% RFD + Vermicompost (12 tons ha^{-1}) + Biofertilizers (PSB + KSB + Azotobacter)] proved to be superior in terms of increasing vegetative, floral and bulb attributes in *Hyacinthus orientalis* cv. Yellow Stone

Colour Break **Full Bloom Stage**

REFERENCES

1. Ali, A., Mehmood, T., Hussain, R., Bashir, A., Raza, S., Najam-ud-Din and Ahmad, A. Investigation of Biofertilizers Influence on Vegetative Growth, Flower Quality, Bulb Yield and Nutrient uptake in Gladiolus (*Gladiolus grandiflorus* L.). International Journal of Plant, Animal and Environmental Sciences. 2013; 4: 94-99.

2. Ghisewad, S. K., Sable, P. B. and Rohidas, S. B. Effect of organic and inorganic fertilizers on growth and flower quality of gladiolus cv. H.B.PITT. Asian Journal of Horticulture. 2016;11(2): 275-279.

3. Hamid, M. N., Siddique, M. A. A., Fahmeeda. S., Shameen, I., Ahmad, W. M. Influence of different organic manures and bio-fertilizers on morphological, floral and bulb traits of Narcissus (Daffodil Cv. "Salome"). International Journal of Agriculture Sciences.2017; 9(10):3989-3992.

4. Jhon, A. Q., Mir, M. M., Nelofar., Khan, F. U. Response of organic manure and inorganic fertilizer on growth and bulb production in tulip (*Tulipa gesneriana* Linn.). Journal of Ornamental Horticulture. 2007;10(3): 157-1601.

5. Khan, A. G., Sajid, M., Zubair and Noor-ul-amin. Response of Dahlia pinnata to different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium. Sarhad journal of agriculture. 2007; 23(3).

6. Khan, F. U., Siddique, M. A. A., Khan, F. and Nazki, I. T. Effect of biofertilizers on growth, flower quality and bulb yield in tulip (*Tulipa gesneriana)*.Indian Journal of Agricultural Sciences. 2009; **79**(4): 248-251.

7. Kumar, M., Kasera, S., Mishra, S., Singh, V. N. and Singh, D. Effect of Organic Manure and Inorganic Fertilizer on Growth and Yield Traits of Gladiolus (*Gladiolus grandiflora* L.) cv. Plumtart. International Journal of Current Microbiology and Applied Science.2018; 7: 1430-1435.

8. Kumari, R.V., Kumar, D. P., Kumar, B. A. and Mahadevamma, M. Effect of integrated nutrient management on floral and cormal parameters in gladiolus (*Gladiolus hybridus* L.). International Journal of Agricultural Sciences.2014; 10(1): 15-22.

9. Kuotsu, N. R., Keditsu, R., Hemanta, L. Response of Organic and Inorganic Nutrient Sources on the Growth and Flowering of *Gladiolus primulinus* cv. Candyman. International Journal of Current Microbiology and Applied Sciences. 2018; 7(5): 2537-2547.

10. Pradeep, K., Manivannan, K., Kumar, S.R. Effect of organic nutrients on growth, flowering and yield of *Gladiolus grandiflorus* L. Asian Journal of Horticulture. 2014;9(2): 416-420.

11. Sharma, A., Chaudhary, S. V. S., Dilta, B. S., Gupta, Y. C., Sharma, B. P. Influence of different nutritional treatments on growth and bulb production of tuberose (*Polianthes tuberosa* L) cv. Double. International Journal of Farm Sciences. 2015;5(4): 186-192.

12. Singh, M. P. and Kumar, A. Effect of nitrogen and phosphorus levels on sprouting of bulbs, vegetative growth and bulb production of tuberose (*Polianthes tuberosa* L.). Research in Environment and Life Sciences. 2016;10(1): 47-49.

13. Sisodia, A. and Singh, A. K. Effects of Farmyard manure, Vermicompost and Trichoderma on flowering and corm attributes in Gladiolus. Bangladesh Journal of Botany. 2015;44(2): 309-314.

14. Tirkey, P., Kullur, L. R., Prasad, V. M. Effect of organic and Inorganic source of N.P.K on growth and yield parameters of gladiolus (*Gladiolus grandiflorus*) cv. Jester. Journal of Pharmacognosy and Phytochemistry. 2017;6(5): 1004-1006.