## Appeal to Readers

Effect of plant growth promoting bacteria on Glomus aggregatum activity and growth of *Albizia lebbeck* (L. Benth)

Althaf Hussain Sk, Srinivas P and Praveen Kumar V

Response of bio-fertilizers on gladiolus for corm attributing characters and soil fertility

Kishan Swaroop, T. Janakiram Narendra Chaudhary and Manisha Rani

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### Book Reviews

National and International Events

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From the desk of Chief Editor........

National Centre of Organic Farming, Ghaziabad and its seven Regional Centres at Ghaziabad (at HQ)Bangalore, Bhubaneshwar, Panchkula, Imphal, Jabalpur and Nagpur are presently playing major role in implementing the objectives of National Mission for Sustainable Agriculture in India. At present Indian agriculture production is declining due to non judicious use of synthetic fertilizers and chemicals. The soil organic carbon content of soil has reached critically low level. It is essential to improve the organic matter content in soil in order to improve soil carbon contents and other minerals required for high crop production. The organic farming restricts the use of synthetic chemicals and fertilizers for crop production. Thus use of organic products like biofertiliser, farm yard manure, compost, vemicompost and other organic input application to soil are recommended. Increasing soil organic carbon and soil fertility is primary concern. Application of biofertiliser like nitrogen fixing organisms, phosphorus solubilizing bacteria, potassium mobilizers, sulphur mobilizers and waste decomposers is not only increase soil health, fertility status but also promote crop growth by suppressing disease pathogens. Biofertilisers have a great potential in improving soil health conditions and sustainable agricultural production. Presently in the market solid and liquid carrier based different biofertilizer formulation products are available. Presently the liquid formulations of biofertiliser have been developed by various institute and organizations gaining more importance due to long shelf life and high population. Increase in crop growth and production is observed when applied these biofertiliser through seed or irrigation or soil application. It has been scientifically proven application of biofertiliser to soil has a beneficial to both crop plants and soil. Thus understanding the beneficial effects of biofertiliser microbial inoculants on different crops, identification of new fast growing strains, formulations of novel biofertiliser, and its application is subject of curiosity around the world. Thus government of India is making serious efforts to fill this gap by introducing new schemes and policies.

In the present issue articles on response of biofertilizers and effect of Plant growth promoting bacteria (PGPB) on Glomus sp is presented apart from this other columns are as usual.

I wish this edition will helpful to the researchers, scientists, administrators, farmers, industrialists and others to understand the importance of biofertiliser in agriculture.

Dr. Krishan Chandra
**Appeal to Readers**

Welcome readers – now you have opportunity to participate and be interactive with this publication.

All the time the readers are made to read whatever is published and there is no way to understand the level of satisfaction the readers come to attain after going through its contents on publication of an issue. We think that reader’s views are quite important to consider. The news / information being disseminated through this publication should have a reflection from the readers to complete the process of communication and to enable the readers to communicate if they expect any special reference or material. The choice of the readers should always be kept in mind while making efforts to give latest news / information on the subject. Thus to make it interactive, more informative and readers friendly we think that creating this column is quite important.

We welcome the communication from our valued readers for this column. The communication may contain views of readers on importance of material published and its extent of advantages to them beside the material they think to be given consideration for publication in the issue. The feedback so received from the readers would not only be accommodated in this column but also it would be considered to assess it if found significant to further improve the quality of material to be published. The communication may also be information about a particular event, news or literature on biofertiliser in the locality of the readers which could turn advantageous to other readers. Thus an interaction could be established among the readers through this publication. This would also inspire the others readers to be interactive and share their views / information and news which we think would ultimately benefit the all the stakeholders including farmers.

With this we again welcome the letters from the readers addressed to the editor. The readers must write their complete name and communication address, mobile no. and e-mail IDs while making communication with us for this column.
Effect of plant growth promoting bacteria on *Glomus aggregatum* activity and growth of *Albizia lebbeck* (L. Benth)

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*National centre of organic farming, Ghaziabad (UP)

Introduction
Agroforestry has been defined as: “a dynamic, ecologically based, natural resources management system that, through the integration of trees in farms and in the landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels” (Leakey, 1996; ICRAF, 1997). Agroforestry trees are numerous in number, due to multiple uses *Albizia lebbeck* is the tree of interest in the present investigation. *Albizia lebbeck* is a tree well known in the Indian subcontinent for its range of uses. It appears to have potential for increasing pastoral production in extensive systems in the wet-dry tropics where the major problem is low feed quality of the basal diet, mature tropical grasses. *Albizia lebbeck* addresses this problem in three ways: as a feed, as a supplement and by improving grass quality. *Albizia lebbeck* (L.) Benth (Mimosaceae) has a variety of vernacular names including siris, koko, vagai (India), tekik (Javanese), kitoke, tarisi (Sundanese), khago, ka se (Thai), East Indian walnut and Indian siris (timber trade). A number of names are trivial (mother-in-law’s tongue, rattle-pod (West Indies)) or misleading (acacia, raintree (northern Australia)). The Indian name siris is most commonly used (Anon. 1980).

Siris is indigenous to the Indian subcontinent. These indigenous populations are probably declining as seedlings cannot establish under continuous grazing by cattle. It has potential for use in silvopastoral systems with a number of benefits to graziers. Its foliage is of high quality for animals and the shade of its canopy is likely to benefit livestock directly, by reducing temperatures in hot environments, and indirectly by stimulating improved grass growth. Finally, the wood of Indian siris has value as a timber. Other species in the genus also show potential for exploitation. Against the huge benefits of the *A. lebbeck*, it was thought to estimate the effect of plant growth promoting bacteria on *Glomus aggregatum* activity and growth of *Albizia lebbeck* in terms height, P content and biomass in the present investigation.

Soil microorganisms are reported to influence mycorrhizal fungal survival and growth promoting activity in one way or other. Those microorganisms that help root colonizing mycorrhizae are generally termed as Mycorrhizal helper bacteria (Duponnois, R., and C. Plenchette, 2003; Frey, 2007). Recent investigations revealed beneficial effect of two or three membered association of organisms on plant growth and development (Sampath kumar and Ganesh kumar, 2003; Compant et.al. 2010;). Such synergistic associations are of ecological importance with amplified agricultural significance. The beneficial effects of inoculation of *Azotobacter*, *Azospirillum* and *Rhizobium* are well documented (Bhattacharyya, P. N., and D. K. Jha., 2012).

Mohamed, Amal A., et al (2014) reported that co-inoculation of sulphur oxidizing bacteria and AMF to maize and *Allium cepa* resulted significant improvement in growth and nutrient content of onion and maize. Inoculation of Arbuscular mycorrhizal fungi and green manure to tomato enhanced the plant growth and increased the yield of tomato. (Copetta, et al, 2011). Smith and Sally (2011) while discussing the significance of AM fungi in relation to the economically important plants stressed the
need to take up more detailed both laboratory and field oriented studies to exploit the potentials of these beneficial fungi. In the present observations tripartite symbiosis of forest species, and its effect on the growth and development of agroforestry tree species was studied. Althaf and Srinivas, (2013) also stressed for a detailed study on PGPR association on onization and spore population. Maximum in plants studies are required for decisive

Albizia lebbeck

Material and Methods

The test plant (Albizia lebbeck) was grown in polybags containing sterile soil. Soil was sterilized for three consecutive days at 15 lbs pressure for 30 minutes. Microorganisms in different combinations were added to the soil (Table-1) and the seeds of A. lebbeck were sown in polybags at the rate of 5-10 seeds. At least triplicate sets were maintained. The polybags thus prepared were regularly watered and all conditions were taken to maintain aseptic conditions. At the end of three months, the test plant was carefully separated from the polybags and recorded degree of AM colonization and spore population in the rhizosphere soils were extracted by wet sieving and decanting method (Gerdemann and Mosse, 1980). Resting spores in the rhizosphere soils were stained (Phillips and Hayman, 1970) and percentage of root infection was estimated by gridline intersect method (Giovnnetti and Nicolson, 1963 and Pacioni 1992).

Phosphorus content of soil and plant tissue was estimated by Jackson (1967) method.

Results and Discussion

Inoculation of G. aggregatum increased the percentage of root colonization and stimulation of growth of A. lebbeck (Table-1). Dual inoculation of G. aggregatum and Rhizobium further stimulated AM colonization and spore population in the rhizosphere soil. Similarly inoculation of Azotobacter along with G. aggregatum also promoted the AM colonization and spore population. Inoculation of three organisms (G. aggregatum, Azotobacter, Rhizobium) simultaneously resulted synergistic stimulation of AM colonization and spore population. When Pseudomonas aeruginosa was inoculated along with G. aggregatum and Azotobacter a similar effect was seen. On the other hand, inoculation of Pseudomonas aeruginosa along with Rhizobium and G. aggregatum was adversely affected the AM colonization and spore population. Similarly B. mycoides also adversely affected the efficacy of Rhizobium and G. aggregatum in promoting plant growth. P. aeruginosa and B. mycoides acted antagonistically to G. aggregatum resulting in the suppression of growth promotion activity.

Interestingly inoculation of Pseudomonas sp. and B. mycoides along with G. aggregatum promoted plant height to a maximum extent. The stimulatory effect of P. aeruginosa and B. mycoides on A. lebbeck growth may be due to the suppression of other competitive microorganisms in the root region. The adverse effect of P. aeruginosa when inoculated along with Rhizobium and G. aggregatum may be its antagonistic activity against Rhizobium. However detailed studies are required for decisive conclusions. When P. aeruginosa was inoculated long with G. aggregatum and Rhizobium, the promotion of plant height was minimum. Azotobacter and P. aeruginosa suppressed the nodulation in A. lebbeck, while inoculation of Rhizobium, the degree of nodulation remained. Thus, the interaction of these organisms appears to be more complex and several intrinsic and extrinsic factors are playing a role and needs more detailed systematic investigations. Biomass production was maximum when A. lebbeck was inoculated with G. aggregatum with Azotobacter and Rhizobium. No correlation could be observed between biomass production and height of the plant in relation to microorganism inoculated. Phosphorus accumulation was maximum in plants receiving G. aggregatum and Rhizobium. Maximum height was observed by the plants inoculated with G. aggregatum with Rhizobium and Azotobacter.

Acknowledgement

Thanks are due to Head, Department of Biotechnology, for providing necessary facilities. The financial assistance received in the form of UGC- MRP No: 39-302/2010(SR) Dated 27.10.2010 is gratefully acknowledged.
Table: Effect of PGPR on *Glomus aggregatum* activity and growth of *Albizia lebbeck*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Root Colonization</th>
<th>No Of spores/100g</th>
<th>Height of plant</th>
<th>No of nodules</th>
<th>Biomass (g)</th>
<th>Phosphorus content (mg/g)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F.W</td>
<td>D.W</td>
</tr>
<tr>
<td><em>G. aggregatum</em></td>
<td>52.3</td>
<td>120</td>
<td>62</td>
<td>18</td>
<td>28.2</td>
<td>19.5</td>
</tr>
<tr>
<td><em>G.a+ Az</em></td>
<td>63.4</td>
<td>152</td>
<td>70</td>
<td>0</td>
<td>23.2</td>
<td>18.2</td>
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<tr>
<td><em>G.a+ Rh</em></td>
<td>65.2</td>
<td>160</td>
<td>75</td>
<td>60</td>
<td>39.5</td>
<td>30.6</td>
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<tr>
<td><em>G.a+ Rh+Az</em></td>
<td>67.6</td>
<td>184</td>
<td>78</td>
<td>68</td>
<td>50.4</td>
<td>46.2</td>
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<tr>
<td><em>G.a+Az+Ps</em></td>
<td>64.5</td>
<td>168</td>
<td>70</td>
<td>0</td>
<td>49.6</td>
<td>36.2</td>
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<tr>
<td><em>G.a+Rh+Ps</em></td>
<td>66.2</td>
<td>150</td>
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<td><em>G.a+Rh+B.m</em></td>
<td>58.2</td>
<td>158</td>
<td>60</td>
<td>52</td>
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<td><em>G.a+Ps+B.m</em></td>
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<td><em>G.a+Ps</em></td>
<td>48.2</td>
<td>112</td>
<td>44</td>
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<tr>
<td><em>G.a+B.m</em></td>
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<td>102</td>
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<td>0</td>
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<td>Control</td>
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<td>86</td>
<td>35</td>
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</table>

ANOVA

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<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
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<td>Within the treatment</td>
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<td>918.9142</td>
<td>5.250025</td>
<td>1E-05</td>
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<td>Between The treatment</td>
<td>154197.6956</td>
<td>7</td>
<td>22028.24</td>
<td>125.8538</td>
<td>4.5E-37</td>
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<td>12252.13104</td>
<td>70</td>
<td>175.0304</td>
<td></td>
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<tr>
<td>Total</td>
<td>175638.9688</td>
<td>87</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Fig: *Albizia lebbeck* roots infected with *Glomus aggregatum* in triple inoculated plants (*Azotobacter + Rhizobium + G. aggregatum*).

References:


4. Copetta, A., et al. "Fruit production and quality of tomato plants (Solanum lycopersicum L.) are affected by green


Response of bio-fertilizers on gladiolus for corm attributing characters and soil fertility

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An experiment was conducted at the research farm of the Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi during 2011 to study the response of bio-fertilizers on gladiolus for corm attributing characters and soil fertility cv. Snow Princess. Eleven treatments involving different doses of inorganic, organic manure with bio-fertilizers were laid out in randomized block design with three replications. The data indicated that treatment (T11) i.e. application of 50% RDF of NPK+ FYM (10 t ha⁻¹) + vermicompost (10 t ha⁻¹)+ *Azospirillum* (2g/plant)+ PSB (2g/plant) had significantly recorded the maximum number of corms/plant(1.44), number of cormels/plant (37.11), weight of corms/plant (119.66 g), weight of cormels/plant (8.00g), weight of single corm (5.03 cm), organic carbon content (0.69%) and available K₂O (256.90 kg/ha) as compared to control and other treatments.

The maximum organic carbon content was also at par with the treatment T5. The available soil N (203.0 kg/ha) after crop harvest was recorded maximum with the application of 100% RDF+ FYM (20 t ha⁻¹), where as P₂O₅ was found maximum (45.90 kg/ha) in treatment (T9). The combined application of 75% RDF+ 10 tonnes ha⁻¹ each of FYM and vermicompost + 2g/plant each of Azospirillum and PSB had recorded maximum microbial biomass (885 ug g⁻¹) and dehydrogenase activity (7.97ug TPF g⁻¹ h⁻¹) respectively as compared to other treatments.

**Keywords:** Gladiolus, INM, Carbon content, available soil NPK and Microbial biomass

INTRODUCTION

Gladiolus is an important commercial flower crop. It is popular for its attractive spikes having florets of huge form, dazzling colours varying sizes, multiple use in flower arrangements, bouquets and long keeping quality. The demand of gladiolus cut flowers is increasing day by day in domestic as well as international market. It occupies fourth place and is next to rose, chrysanthemum and carnation. Multiplication of planting material of gladiolus is most important because the cut flower trade is lagging behind over the recent years, owing to the unavailability of sufficient quality planting material at large scale, (Barman et al. 2005). The yield and quality of flowers and corms can be improved by adopting integrated nutrient management practices which include judicious and combined use of vermicompost, FYM, inorganic fertilizers and bio-fertilizers. The judicious use of inorganic fertilizers with organic manure is the present day need (Singh et al. 2006) so; there is a need to develop sustainable production system, wherein chemical fertilizers can be minimized by using alternative sources of nutrients.

The integrated use of organic, inorganic and bio-fertilizers is an important factor in improving the corm production and soil fertility after crop harvest in gladiolus. Considering the recent concept of eco-technology and increase cost of inorganic fertilizer, use of cost effective and eco-friendly bio-fertilizers, which has currently a special significance in crop production to address the sustainability problem and tremendous success has been achieved in several other crops.
Use of bio-fertilizers reduces per unit consumption of inorganic fertilizers and increases the quality and quantity of flower (Shymal et al. 2006). The information on this aspect is very meager. In recent years, bio-fertilizers have emerged as an important component of integrated nutrient supply system and have shown promise to improve crop yields and nutrient supplies. Due to inadequate and imbalanced fertilizer application, farmers are not able to harness the full yield potential of gladiolus. Hence, investigation was carried out to study the response of INM on gladiolus for corm attributing characters and soil fertility.

MATERIAL AND METHODS

The study was conducted during winter season of 2011 at the Floriculture Research Farm of Indian Agricultural Research Institute, New Delhi-110012, India. The soil of the experimental plot was loam with pH 8.3, low in organic carbon content, low available nitrogen, medium available phosphorus and potash showing 0.48% percent organic carbon, 138.00 kg/ha N, 30.50 kg/ha P, and 187.90 kg/ha K.

The eleven treatments were laid out in a simple randomized block design with three replications. Well decomposed farm yard manure, vermicompost, *Azospirillum* and PSB were applied treatment-wise before planting. Recommended fertilizer doses of 120:80:80 kg/ha NPK were also given treatment-wise as 100%, 75% and 50%. These fertilizers were applied in the form of Urea, Single super phosphate and Muriate of potash. Uniform size of gladiolus corms (4.0 to 5.0 cm) of cv. Snow Princess were planted on 11th October, 2010. The row to row distance of 40 cm and plant to plant distance of 20 cm in a plot size of 3.0 x 2.0 m. was maintained. Soil samples were collected from each plot at 0-30 cm depth just after harvesting of gladiolus crop.

These soil samples were subjected to chemical analysis to determine the available nitrogen (kg/ha) by Subbiah and Asija Method (1956), available phosphorus \( P_2O_5 \) (kg/ha) by Olsen’s Method (1954), available potassium (\( K_2O \) kg/ha) by Ammonium Acetate Method and available organic carbon content by Walkley and Black Method (1934).

The observations were taken from random samples of five plants from each treatment on various corm characteristics. The available soil NPK, organic carbon content, microbial biomass carbon and dehydrogenase activity in the soil, after crop harvests were also determined. The data were subjected to analysis of variance (ANOVA) in order to test the significance of results.

RESULTS AND DISCUSSION

Statistically analyzed data represented significant difference in all corm characteristics with the application of various manures and fertilizers alone or in combination with bio-fertilizers (Table 1). It is interesting to note that no significant difference was observed for number of corms per plant, however, combined application of 50% recommended dose of fertilizers+ 10 tonnes/ha FYM+ 10 tonnes/ha vermicompost+ 2g/plant *Azospirillum*+ 2g/plant PSB, treatment (T11) had recorded (1.44) corms per plant as compared to control (1.11) corms per plant. It is evident from the data that most of the corms attributes were influenced significantly due to application of organic, inorganic and bio-fertilizers.

Maximum number of cormels (37.11), weight of corms per plant (119.66 g), weight of cormels per plant (8.08 g), weight of single corm(113.80 g) were recorded with the application of 50% recommended doses of fertilizers i.e. 60:40:40 kg/ha NPK+ 10 tonnes/ha FYM+ 10 tonnes/ha vermicompost+ 2 g/ plant *Azospirillum*+ 2 g/plant PSB, followed by treatment T8(i.e. 75%RDF+ 10 tonnes/ha FYM+ 10 tonnes/ha vermicompost+ 2 g/plant *Azospirillum*+ 2 g/plant PSB and minimum value of these characters was recorded under control treatment.

The beneficial effect of farmyard manure on corms characteristics in gladiolus might be due to additional supply of plant nutrients as well as improvement in physical and biological properties of the soil (Majumdar et al. 2002). The highest amount of organic carbon content (0.69%) was recorded in the treatment(T11) which was also at par with treatment (T8), where 100% recommended doses of NPK+ 20 tonnes/ha FYM and 50%
recommended doses of NPK+ 10 tonnes/ha each of FYM and vermicompost + 2g/plant each of Azospirillum and PSB were applied respectively. The available N content of the soil after crop harvest was found to increase over the initial value in all treatments. Maximum increase in available N (203.0 kg/ha) was observed when 100% RDF+ 20 tonnes/ha FYM was applied, followed by treatment T11 (199.40 kg/ha). The amount of available P and K in soil after crop harvest was also recorded highest with the application of 50% RDF+ 20 tonnes/ha FYM and 50% RDF + 10 tonnes/ha each of FYM and vermicompost + 2 g/plant each of Azospirillum and PSB respectively. The available P and K ranges from 22.30 to 45.90 and 172.10 to 256.90 kg/ha respectively (Fig. 4, 5 & 6).

Table 2 shows that microbial biomass was found maximum (885 ug g⁻¹) with the application of 75% RDF+ 10 t ha⁻¹ each of FYM and vermicompost+ 2g/plant each of Azospirillum and PSB followed by treatment (T11) i.e. 50% RDF+ 10 t ha⁻¹ each of FYM and vermicompost and 2g/plant each of Azospirillum and PSB as compared to control where it was only (219 µg g⁻¹). Among 11 treatments, significantly maximum dehydrogenase activity was recorded in treatment T8 which was also at par with treatment T11 where 50% RDF+ 10 tonnes ha⁻¹ each of FYM and vermicompost and 2g/plant each of Azospirillum and PSB was applied. The minimum dehydrogenase activity (2.29 µg TPF g⁻¹ h⁻¹) was found in control treatment.

It is clear from Table 2 that different treatments of inorganic, organic fertilizers with bio-fertilizers significantly improved the microbial biomass and dehydrogenase activity as compared to control. John et al. (2007) reported that application of organic manure improved bulb and bulblet production parameters in tulip (Tulipa gesneriana Linn.). J. Orna. Hort., 10(3):157-160.

These results get support from the findings of Nambisan and Krishnan (1983) in tuberose. (Shaktawat and Shekhawat, 2010) also reported that use of organic manures, especially FYM and balance use of nitrogen and phosphorus in combination may enhance the status of soil and productivity of crop. Increase in the organic carbon content might be due to the application of organic manure to the soil as also reported by Mathew and Nair (1997). The increase in P in soil might be explained by the release of P from the applied organic matter mineralization. There was build up of available soil NPK content after the crop harvest due to combination of inorganic, organic and bio-fertilizers and also due to more retention of nutrients especially P and K, which are added through organic manure (Ramesh et al. 2008, 2010). The result of present investigation clearly indicated improved fertility of soil due to increased value of available NPK and carbon content in all treatments over its initial value as well as control after the crop harvest and also in closed conformity with the above said workers.

REFERENCES


Majumdar, B., Venkatesh, M.S. and Kumar, K. (2002). Effect of nitrogen and farmyard manure on yield and nutrients uptake of Turmeric (Curcuma longa) and different forms of inorganic build up in an acidic alfisol of Meghalaya. Indian Journal of Agricultural Sciences, 72(9): 528-531.


**Table-1:** Effect of organic manure, biofertilizers and inorganic fertilizer application in gladiolus (*Gladiolus hybridus* L.) for corm characteristics.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of corms/plant</th>
<th>Number of Cormels/plant</th>
<th>Weight of Corms/plant (g)</th>
<th>Weight of Cormels/plant (g)</th>
<th>Weight of Single Corm (g)</th>
<th>Diameter of Corm (cm)</th>
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<tr>
<td>T₁</td>
<td>1.11</td>
<td>25.00</td>
<td>74.44</td>
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<td>34.44</td>
<td>101.44</td>
<td>7.33</td>
<td>102.5</td>
<td>4.43</td>
</tr>
<tr>
<td>T₁₀</td>
<td>1.11</td>
<td>32.66</td>
<td>108.66</td>
<td>5.00</td>
<td>110.5</td>
<td>4.46</td>
</tr>
<tr>
<td>T₁₁</td>
<td>1.44</td>
<td>37.11</td>
<td>119.66</td>
<td>8.00</td>
<td>113.8</td>
<td>5.03</td>
</tr>
<tr>
<td>C.D.</td>
<td>NS</td>
<td>4.08</td>
<td>17.01</td>
<td>1.84</td>
<td>15.96</td>
<td>0.51</td>
</tr>
</tbody>
</table>

(P=0.05)
**Table 2:** Effect of organic manure, bio-fertilizers and inorganic fertilizer application on available soil NPK, organic carbon content, microbial biomass and dehydrogenase activity in gladiolus (*Gladiolus hybridus* L.)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Organic carbon content (%) in soil</th>
<th>Available N (kg/ha)</th>
<th>Available P$_2$O$_5$ (kg/ha)</th>
<th>Available K$_2$O (kg/ha)</th>
<th>Microbial biomass carbon (ug g$^{-1}$)</th>
<th>Dehydrogenase activity (ug TPF g$^{-1}$ h$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T$_1$</td>
<td>0.44</td>
<td>126.90</td>
<td>22.30</td>
<td>172.10</td>
<td>219.00</td>
<td>2.29</td>
</tr>
<tr>
<td>T$_2$</td>
<td>0.66</td>
<td>183.00</td>
<td>40.20</td>
<td>247.20</td>
<td>310.00</td>
<td>3.77</td>
</tr>
<tr>
<td>T$_3$</td>
<td>0.56</td>
<td>140.60</td>
<td>29.00</td>
<td>209.00</td>
<td>307.00</td>
<td>3.84</td>
</tr>
<tr>
<td>T$_4$</td>
<td>0.57</td>
<td>145.40</td>
<td>33.90</td>
<td>205.10</td>
<td>437.00</td>
<td>4.64</td>
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<tr>
<td>T$_5$</td>
<td>0.69</td>
<td>203.00</td>
<td>44.30</td>
<td>228.20</td>
<td>522.00</td>
<td>6.38</td>
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<tr>
<td>T$_6$</td>
<td>0.62</td>
<td>194.30</td>
<td>35.30</td>
<td>219.50</td>
<td>570.00</td>
<td>6.72</td>
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<tr>
<td>T$_7$</td>
<td>0.65</td>
<td>188.80</td>
<td>41.90</td>
<td>247.80</td>
<td>657.00</td>
<td>5.43</td>
</tr>
<tr>
<td>T$_8$</td>
<td>0.62</td>
<td>189.70</td>
<td>42.40</td>
<td>226.00</td>
<td>885.00</td>
<td>7.97</td>
</tr>
<tr>
<td>T$_9$</td>
<td>0.63</td>
<td>190.10</td>
<td>45.90</td>
<td>235.90</td>
<td>712.00</td>
<td>6.99</td>
</tr>
<tr>
<td>T$_{10}$</td>
<td>0.67</td>
<td>189.40</td>
<td>42.70</td>
<td>253.50</td>
<td>762.00</td>
<td>6.45</td>
</tr>
<tr>
<td>T$_{11}$</td>
<td>0.69</td>
<td>199.40</td>
<td>45.80</td>
<td>256.90</td>
<td>884.00</td>
<td>7.95</td>
</tr>
<tr>
<td>C.D.(O=0.05)</td>
<td>0.076</td>
<td>12.25</td>
<td>8.41</td>
<td>23.60</td>
<td>41.66</td>
<td>0.37</td>
</tr>
</tbody>
</table>
National and International Events

BIOFACH FAIR – SUCCESSFUL PREMIERE IN KOCHI, 6-8 NOVEMBER, 2014

Considerably more visitors than previous years Stable number of exhibitors despite relocation.

Changing the venue of BIOFACH INDIA together with INDIA ORGANIC to Kerala has proven to be the right decision: from 6 to 8 November, 9,126 trade visitors – almost 2,000 more than in 2013 – gathered information from over 170 exhibitors from the organic sector (2013: 158). For three days, the focus was on all things organic at the ADLUX International Convention Centre in Kochi. At the same time, the government of Kerala and the Confederation of Indian industry (CII) hosted the “Global Agro Meet”, an international conference and exhibition about agriculture and food processing, which was also very well received. Yet again, BIOFACH INDIA together with INDIA ORGANIC, organised by NürnbergMesse India in collaboration with the International Competence Centre for Organic Agriculture (ICCOA), offered the ideal blend of trade fair, conference and networking platform.

Priya Sharma, Project Manager BIOFACH INDIA, is very satisfied with how the event went: "It was the ideal time to relocate to a state which in the near future aims to have converted its agriculture completely to an organic system. BIOFACH INDIA together with INDIA ORGANIC 2014 not only promoted business opportunities, it also enabled valuable knowledge sharing on issues such as education, career and culture. I am convinced that BIOFACH INDIA together with INDIA ORGANIC has paved for a sustainable future of Organic Farming in Kerala." According to Sharma, another important objective – to use interactive tools to enlighten consumers about food safety and the importance of an ecological way of life – had also been achieved. School children and university students, for example, were encouraged to take part in panel discussions, quizzes and hands-on activities during the show, all of which were a great success.

Platform for good business

Manoj Kumar Menon, Managing Director ICCOA, adds: “The development of new business opportunities is one of the main reasons for visiting BIOFACH INDIA together with INDIA ORGANIC. We estimate the value of business transactions initiated during this year’s event at more than 8 million US dollars, which is a new record. BIOFACH INDIA together with INDIA ORGANIC 2014 could not have gone better.” The B2B meetings organised during the show also had a hand in this positive development. There were 188 such meetings between organic exhibitors and 21 international purchasers from – USA, Germany, Italy, UAE, Hong Kong, Austria, France and Uganda during the three-day event.

Well attended conference “Livelihoods – Biovillages – Markets”

This year, visitors to BIOFACH INDIA together with INDIA ORGANIC were not only treated to pavilions from the Indian states Maharashtra, Himachal Pradesh, Chhattisgarh, Sikkim, Nagaland, Kerala and Kamataka. India’s most successful organic trade fair also impressed with its farmer workshops and a high-calibre programme of seminars. The speakers included international representatives of the International Federation of Organic Agriculture Movements (IFOAM), Agricultural and Processed Food Products Export Development Authority (APEDA) and government representatives from India and other countries. They explored issues currently of interest to the Indian organic sector: What are the opportunities for organic products from India on an international market? How can ecological farmland acreage be cultivated sustainably? How can organic agriculture also be managed effectively in conurbations?

Buyer’s Programme provided insights into Kerala’s organic sector

For the third time, there was also a tailored trade visitor tour of the BIOFACH INDIA together with INDIA ORGANIC fair – the International Buyer’s Programme.
Participants from Europe, the USA, Middle East and Asia dipped into India’s fascinating world of organic raw materials like tea, coffee, herbs and spices, fruit, pulses, soya, coconut or cotton. The objective was to forge contacts and encourage trade between exhibiting organic producers from Kerala and purchasers from all over the world.

INDIA INTERNATIONAL TRADE FAIR (IITF) - 2014, NEW DELHI
34th India International Trade Fair (IITF), a multi product show, was organized at Pragati Maidan, New Delhi from November 14-27, 2014 by India Trade Promotion Organisation (ITPO), A Govt. of India Enterprise. It remained a celebration of India’s intrinsic strength and achievements especially when the country is striving to become a manufacturing hub for rest of the world. Since inception, IITF has showcased India’s socio-economic progress. It has also played a significant role in catalyzing commercial convergence of technology with social and economic issues of the South-Asian region. The Fair has also been an excellent platform for small and micro enterprises to display their products and get the best from traders in India or importers from abroad. IITF has business, social, cultural and educational dimensions weaved together where the visitors and the exhibitors, cultural performers, media persons, marketing professionals, social activists, NGOs come together to explore their objectives. The Fair was adjudged as success by participants, business visitors, media and general public from whom appreciative comments were received. Significant improvements were achieved in terms of foreign business visitors, participants, visitor turnover, traffic management and cleanliness inside and outside Pragati Maidan.

The Fair was inaugurated by the Hon’ble President of India Shri Pranab Mukherjee on November 14, 2014. The other dignitaries present on the dais were Shri Kalraj Mishra, Cabinet Minister of MSMEs, Govt. of India, Smt. Nirmala Sitharaman, Minister of State for Commerce and Industry (Independent Charge), Her Excellency Ms. Elizabeth Thabethe, Deputy Trade and Industry Minister of South Africa, the Partner Country, His Excellency Deputy to The Ambassador of Thailand to India, Mr. Soonthorn Chaiyindeepum, Minister, Royal Thai Embassy, Thailand, the Focus Country, Shri Najeeb Jung, Lt. Governor of Delhi, the Focus State “Delhi”, Shri Rajeev Kher, Commerce Secretary, Govt. of India, Smt. Rita Menon, Chairperson and Managing Director, ITPO and Shri Malay Shrivastava, ED, ITPO.

The theme of IITF 2014 was “Women Entrepreneurs”. Women Entrepreneurs of India combine energy, initiative, determination and talent. They have made tremendous contribution to the progress of our nation. Therefore, the Fair provided new impetus to business transactions, joint ventures and investment opportunities in the country. A separate “Women Entrepreneurs Pavilion” outside Hall No. 7H was set up and 28 exhibitors in an area of 280 sqm. net displayed their exhibits in their respective stalls.

PARTICIPATION
As many as 299 foreign companies and over 6800 domestic companies participated in the trade Fair. 30 States and Union Territories also participated with a sizeable number of quality companies. Significant group participation of SMEs was organized by CAPART, NSIC, HUDCO, KVIC, MSME etc. 25 foreign countries participated in the Fair. The foreign representation can be categorized into two segments (a) At National level (the countries participated individually) where 15 countries figured: (Afghanistan, Iran, South Africa, South Korea, Kuwait, Thailand, Indonesia, China, Kyrgyzstan, Cuba, Tibet, Pakistan, Bangladesh, Sri Lanka and Japan).
Book Review

Biofertiliser Technology. Edited by S. Kannaiyan, K. Kumar and K. Govindarajan, Scientific Publishers, Jodhpur Pages 450 Price Rs. 2123 (online)--This book is the proceedings of National workshop on "Recent Developments in Biofertilisers for rice based cropping system" held at Tamil Nadu Agricultural University, Coimbatore during August 16-18, 2001 to develop a strong, workable and compatible package of nutrient management through organic and inorganic sources exclusively for rice based cropping system. The book consists of 56 chapters containing the research work/presentations/discussions that are deliberated by leading scientists and experts from different parts of India working on basic and applied aspects of various biofertilisers used in rice based cropping system.

The book is first of its kind in focusing the application of biofertilisers technology in rice based cropping system. It enables the use of living organisms for the nourishment of plants either by fixation of atmospheric nitrogen through the process of biological nitrogen fixation or by solubilization of mineral nutrients like phosphorous. It is clearly described about different biofertilisers that are associated with rice based cropping system. The book is completely confined to rice based cropping system as it is the major cropping system practiced in India which includes the rotation of crops involving rice, pulses, oil seeds, cotton, sugar cane, green manures etc. Rice-rice v/s most dominant cropping system under irrigated conditions in south and eastern India, while rice-wheat, rice-groundnut, rice-legumes, rice-mustard and rice-potato are some of the predominant rice based cropping systems with 200 % cropping intensity in different North Indian States.

The lucid way of presentation of the research articles helps even the young researchers to understand them completely. The quality of work done by the authors enhanced the standards of the book to multifold. The entire book is worth reading, the massive information is bounded in 450 pages would really satisfy the thirst for knowledge in the respective field, it will be a very good resources material for people in different walks of life viz. agricultural policy makers, crop management scientists, researchers, students, extension workers and literate farmers.

Biofertilizers and Organic Farming by Himadri Panda, Gene-Tech Books, Pages 397 Price Rs. 1,400 (online)-This book is greatly useful for agricultural planners, soil scientists, biologists, microbiologists, students, teachers, fertilizer industry, personnel research and development units, organisation engaged in biofertilizer production, training centres, all those interested in the efficient use and recycling of wastes, resource management and sustainable farming.

Contents Chapter 1: Integrated Plant Nutrition Systems; Chapter 2: Organic Manures: Their Nature and Characteristics; Chapter 3: Livestock and Human Wastes: Characteristics and Value; Chapter 4: Potential of Organic Materials and Plant Nutrients; Chapter 5: Preparation, Processing and Preservation of Organic Manures; Chapter 6: Biogas Potential from Livestock Wastes and Human

-Dr. V. Praveen Kumar