Integrated nutrient management induces flowering duration and flower quality of gladiolus

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Abstract: Integrated nutrient management (INM) is a tool for quality flower production in commercial cultivation of cut flowers. An experiment was laid out in randomized block design with a total of 10 treatments and replicated three times. Gladiolus corms were inoculated with Azospirillum and VAM alone and in combination of nitrogen, phosphorus and potash including application of 10 tonnes FYM ha⁻¹ in each treatment. The effect of INM was investigated on days taken for initiation of spike and opening of first floret, number and size of spike and spike floret and flowering duration during both years i.e. 2011-12 and 2012-13. Earliest spike initiations, first opening of floret, highest length and diameter of spike and highest number of spike per plant were observed with T₈ (Azospirillum + 75% N + 200 kg P₂O₅ + 200 kg K₂O) during 2011-12 and 2012-13, respectively. The treatment combination T₈ showed highest number of floret per spike (17.26 and 16.53 in 2011-12 and 2012-13, respectively). The duration of flowering was found to be enhanced maximum with the treatment T₈ (Azospirillum + 75% N + 200 kg P₂O₅ + 200 kg K₂O) being 15.16 days in 2011-12 and 15.30 days in 2012-13, respectively.

Key words: Gladiolus, Azospirillum, VAM, Nitrogen, Phosphorus, Potash, soil reaction

Introduction

The commercial cultivation of gladiolus is ever increasing due to its vivid colour, shape, size and long durability of spike in holding solution. Gladiolus responds well to balanced nutrition for maximum flower production and better growth. The requirement of fertilizers for gladiolus, like other crops has vital role in growth, quality of flowers and its yield. Nitrogen is considered to be most crucial among all the fertilizers because it is a constituent of protein and nucleic acid, which is helpful in plant growth (Haque and Jakhro, 2001). To improve the productivity adequate amount of fertilizers in balanced proportion should be used. Generally chemical fertilizers are applied for quick result to get more and more production but their unscrupulous use not only rob the soil, its texture and structure and nutrients status but also creates threat to soil health. Integrated Nutrients Management (INM) including use of organic manure and biofertilizers along with appropriate dosage of fertilizer is cost effective method to achieve more yield and better quality crop (Janakiram et al., 2013). The impend of integrated nutrient management aims at efficient and judicious use of all the major sources of plant nutrients in an integrated manner, so as to get economically feasible cost of cultivation and maximum flower yield without any deleterious effect on soil fertility and reduce the dependency on chemical fertilizers in crop production to certain extent (Rai, 1998). In the light of fertilizers shortage and escalating cost of production as well as atmospheric pollutions due to indiscriminate use of chemical fertilizers the intensive search for potential sources to supplement or substitute means has become imperative. Several investigations in the recent past years have indicated the beneficial effect of Azospirillum and VAM inoculants in the nitrogen and phosphorous economy in different crop plants. The present experiment revealed significant improvement in almost all the parameters studied during both the years i.e. 2011-12 and 2012-13. Several researcher’s reports have shown that bio-fertilizers viz. Azospirillum and VAM in combination with inorganic fertilizers have augmented the induced flower duration, flower quality and yield in a number of crops.

Materials and Methods

To examine the efficacy of INM experiment was conducted at the Main Experiment Station, Department of Horticulture, Narendra Nagar, Kumarganj, Faizabad, U.P. to examine the effect of integrated nutrient management on physico-chemical properties of soil during winter season of 2011-12 and 2012-13. Two bio-inoculants viz. Azospirillum and VAM were tested alone and in their combination along with graded dose of 50 or 75% N in case of Azospirillum application and with 50 or 75% P₂O₅ in case of VAM application including recommended dose of fertilizer (300 kg N + 200 kg P₂O₅ + 200 kg K₂O ha⁻¹) and control (10 tonnes FYM ha⁻¹). The effect of INM was evaluated on induced flowering duration viz. number of days taken for spike initiation and opening of first floret, diameter of floret and spike, length of spike, number of spikes per plant and hectare, number of florets per spike and duration of flowering. The statistical analyses of the collected data were made by procedure suggested by Gomez and Gomez (1984).

Results and Discussion

The perusal of data as observed for inoculation of corms with INM has significant effect on all the floral characters (Table 1 and Fig. 1 to 4). The earliest spike initiation (98.8 and 99.68 days in 2011-12 and 2012-13, respectively) was observed with the treatment combination Azospirillum + 75% N + 200 kg P₂O₅ + 200 kg K₂O (T₈) as compared to control (110.86 and 109.40 days in 2011-12 and 2012-13, respectively). This could be attributed due to better flow of various nutrients as well as improved availability and efficacy of these nutrients that induced the changes occurred during spike initiation. It is established fact that Azospirillum is capable of producing antifungal and antibacterial compounds, growth regulators
and siderophores (Pandey and Kumar, 1989). Therefore, the
treated corm with Azospirillum facilitated earliness in sprouting might
have influenced due to improved level of growth regulators. Thereby
it might have favoured for stimulation and production of auxiliary
buds resulting in formation of more number of branches. The above
results are also corroborated with findings of Kale et al. (1987) in

The earliness of flowering may be attributed to the presence
of bio-fertilizers specially inoculation with Azospirillum and VAM which
consequently lead to flower initiation and more flower duration. This
may be ascribed to easy uptake of nutrients and simultaneous
transport of growth promoting substances like cytokinins to the
auxiliary buds resulting in breakage of apical dominance. Ultimately,
they resulted in better sink for faster mobilization of photosynthates
and early transformation of plant parts from vegetative to reproductive
phase. Gladiolus corm treated with Azospirillum + 75% N + 200 kg
P2O5 + 200 kg K2O (T5) showed earliness in spike initiation and
days to opening of first florets as compared to VAM over the
un-inoculated corm during both the years of investigation. This finding
is in corroboration of the reports of Kathiresan and Venkatesha
(2002) in gladiolus with Azospirillum. The probable reason for early
spike initiation and days to opening of first florets may be due to
hormones, which enhanced early spike initiation flowering secreted
by Azospirillum and VAM. The inter relationship between bacteria
and phytohormone production and plant practices in association
has not clear, however, been investigated. Extensive reports have
also been in agreement with the findings in different crops viz. jasmine
(Vasanthi, 1994), Edward rose (Preethi et al., 1999), marigold
(Chandrikapure et al., 1999; Rajadurai and Beaulah, 2000) and
gladiolus (Dubey, 2003).

Significant early spike initiation, opening of first florets
increase in spike length, spike diameter, number of spike per plant,
number of spike per hectare, number of florets remaining open at a
time, and flowering were recorded under inoculation of corm with
Azospirillum as compared to VAM over the un-inoculated corm
during both the years. Inoculation of corm with Azospirillum followed
by VAM was observed equally effective increasing number of spike
per plant. It might be due to increase availability of nitrogen and
phosphorus as well as micronutrient like Zn which is precursor of
auxin, which improve the vegetative growth, dry matter accumulation
and their partitioning towards the developing spike. Similar findings
with regard to beneficial effect of bio-inoculants on floral characters’
have been reported by Kulkarni and Konde (1990) in aster, Preethi
et al. (1999) in carnation, Swaminathan et al. (1999) in tuberose,
Kathiresan and Venkatesha (2002), Dubey et al. (2003) in
Gladiolus, Dalve et al. (2009b) in gladiolus and Chaudhary et al.

Dalve et al. (2009a) suggested that Azospirillum with
reduced doses of nitrogen significantly influenced the flowering
parameters like days required for emergence of spikes, days
required for opening of first pair of florets, number of florets per
spike, number of spike per plant. The similar effects of Azospirillum
and VAM on tuberose spike length were reported by Wange et al.
(1995) and Swaminathan et al. (1999). The positive effects of
vermicompost in increasing stalk length have been reported in
gladiolus (Gangadharan and Gopinath, 2000), golden rod
(Kusuma, 2001) and Effect of organic manures and bio-fertilizers
on growth and flowering in standard carnation (Bhalla et al., 2006)
and Effect of bio-inoculants with graded doses of NPK on growth
and yield of gaillardia (Deshmukh et al., 2008). The increase in
number of floret per spike may be due to accumulation of more and
more reserved food towards spike of gladiolus. Similar opinions
have been reported by Johnson et al. (1982) in chrysanthemum,
and Barman et al. (2003) in tuberose.

A significant increase in number of spike per planted corm
(Fig. 3), spike diameter, day taken for opening first florets and
duration of flowering (Table-1) was obtained in corms inoculated
with Azospirillum. In conformity of results there are several findings
reported by Naggar and Mahmoud (1994) in narcissus, Kathiresan
and Venkatesha (2002), Dubey (2003), Dalve et al. (2009a) and

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**Table-1: Effect of integrated nutrient management on flowering characteristics of gladiolus**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Days taken for initiation of spike 2011-12</th>
<th>Days taken for opening of first floret 2011-12</th>
<th>Diameter of floret (cm) 2011-12</th>
<th>Duration of flowering (days) 2011-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 = Control</td>
<td>110.86</td>
<td>109.40</td>
<td>125.06</td>
<td>124.60</td>
</tr>
<tr>
<td>T2 = 300 kg N + 200 kg P2O5 + 200 kg K2O ha⁻¹ (RDF)</td>
<td>107.60</td>
<td>105.60</td>
<td>122.20</td>
<td>121.66</td>
</tr>
<tr>
<td>T3 = 5 kg VAM ha⁻¹</td>
<td>108.60</td>
<td>107.93</td>
<td>124.13</td>
<td>123.13</td>
</tr>
<tr>
<td>T4 = 5 kg Azospirillum ha⁻¹</td>
<td>108.70</td>
<td>107.53</td>
<td>123.53</td>
<td>124.93</td>
</tr>
<tr>
<td>T5 = VAM + Azospirillum</td>
<td>108.50</td>
<td>106.26</td>
<td>123.26</td>
<td>122.13</td>
</tr>
<tr>
<td>T6 = VAM + 300 kg N + 50% P2O5 + 200kg K2O</td>
<td>107.33</td>
<td>107.80</td>
<td>122.80</td>
<td>123.66</td>
</tr>
<tr>
<td>T7 = Azospirillum + 50% N + 200 kg P2O5 + 200 kg K2O</td>
<td>104.60</td>
<td>103.00</td>
<td>121.30</td>
<td>120.50</td>
</tr>
<tr>
<td>T8 = Azospirillum + 75% N + 200 kg P2O5 + 200 kg K2O</td>
<td>98.60</td>
<td>99.06</td>
<td>114.00</td>
<td>115.06</td>
</tr>
<tr>
<td>T9 = VAM + Azospirillum + 50% N + 50% P2O5 + 200 kg K2O</td>
<td>105.50</td>
<td>104.60</td>
<td>117.73</td>
<td>118.46</td>
</tr>
<tr>
<td>T10 = VAM + Azospirillum + 75% N + 50% P2O5 + 200 kg K2O</td>
<td>106.00</td>
<td>105.60</td>
<td>121.86</td>
<td>120.66</td>
</tr>
</tbody>
</table>

**SEm±:** 1.894, 1.788, 2.042, 1.877, 0.364, 0.366, 0.463, 0.458

**CD at 5%:** 5.628, 5.313, 6.067, 5.578, 1.080, 1.088, 1.375, 1.361
Nutrient management induces flowering duration

**Fig. 1**: Diameter of spike (cm); **Fig. 2**: Length of spike (cm); **Fig. 3**: Number of spike per plant; **Fig. 4**: Number of florent per spike
+ 75% N + 200 kg P_2O_5 + 200 kg K_2O (T_2) significantly increased number of florets per spike during experimentation (Fig. 4). Earlier, increase number of floret per spike was reported by Misra (1998) with application of Nafed culture containing Azospirillum along with other growth regulating substance in gladiolus.

Thus, application of Azospirillum + 75% N + 200 kg P_2O_5 + 200 kg K_2O (T_2) was found to be superior over other combination of treatment in respect of significantly highest percentage of increase in spike length and number of florets per spike (Fig. D) during both years of vase life studies.

References