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A Study on Compatibility of different Biofertilizers for Nutrient Management in Gladiolus

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Abstract—*A study was conducted at Precision Farming Development Center, Department of Horticulture, CCSHAU, Hisar during 2012-13 to evaluate the efficacy and compatibility of different biofertilizers for nutrient management in gladiolus variety Advance Red. The biofertilizers used were three different rhizobacterial strains viz., Azotobacter chroococcum (Mac27), Pseudomonas strain (WPS73) and PSB (P36). These were used in different combinations along with reducing levels of inorganic fertilizers (50 % and 75% of RDF 30:20:20 g NPK/m^2) making a total of nine treatment combinations laid out in Randomized Block Design and replicated thrice. The results revealed that the number of days taken for sprouting of corms was minimum (12.42 days) in T_7 (50% RDF + Pseudomonas strain (WPS73) followed by T_6 (50% RDF + Azotobacter chroococcum (Mac27) and all other treatments were on par with each other. Maximum per cent of sprouting of corms (100%) was also observed in T_7 whereas least sprouting percent (68.3%) was observed in T_4 (75% RDF + Azotobacter chroococcum (Mac27). +Pseudomonas strain (WPS73) which was on par with T_8 (50% RDF + Azotobacter chroococcum (Mac27) + Pseudomonas strain (WPS73) treatments. later it was observed that at an early stage of growth (within 30 days of sprouting) co-inoculation of Azotobacter chroococcum (Mac27) with Pseudomonas strain (WPS73) either at 50% RDF or 75% RDF resulted in complete mortality of plants. However the biofertilizers performed well when applied singly along with inorganic fertilizers. So it was suggested that a compatibility check has to be performed before recommending any biofertilizer inoculants as a nutrient package for the crop.*

1. INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* Ness*)* is considered to be the "queen of bulbous flowers". The genus Gladiolus belongs to family Iridaceae. It has gained popularity owing to its magnificent, unsurpassed beauty, attractive colours, various sizes and shapes of flowers with long lasting spikes. Among various factors, irrigation and mineral nutrition are important governing the yield and quality of gladiolus flowers. Cultivation of gladiolus is costly enterprise involving land, water, planting material, fertilizers, pesticides etc. In modern agriculture, use of inorganic fertilizer is essential for sustainable yields and chemical fertilizers play a key role by contributing 50-60% increase in productivity. Due to the excessive and imbalanced use of chemical fertilizers, problems of soil deterioration, ground water contamination and air pollution has been observed. Alternatively use of rhizobacterial strains as biofertilizers is in vogue to increase the productivity and quality in an eco-friendly way. But in few cases we observe in spite the use of these biofertilizers as co-inoculants in soil we fail to get the optimum results. So keeping this in view an experiment was conducted to evaluate the compatibility of different biofertilizers for nutrient management in gladiolus variety Advance Red.

2. MATERIALS AND METHODS

The experiment was conducted at Precision Farming Development Center, Department of Horticulture, CCSHAU, Hisar during 2012-13 in gladiolus variety Advance Red. The biofertilizers used were three different rhizobacterial strains *viz., Azotobacter chroococcum* (Mac27), *Pseudomonas* strain (WPS73) and PSB (P36). These were used in different combinations along with reducing levels of inorganic fertilizers (50 % and 75% of RDF 30:20:20 g NPK/m^2) making a total of nine treatment combinations laid out in Randomized Block Design and replicated thrice. The bacterial cultures used in the experiment were procured from the Department of Microbiology, Chaudhary Charan Singh Haryana Agricultural University, Hisar. The cultures of *Pseudomonas* and PSB bacterial strains were grown in LB broth and *Azotobacter* was grown in Jensen's broth for 3 days. The liquid biofertilizers were mixed according to the treatment combinations separately in plastic tubs with a little jaggery solution added to it to make the corms sticky and then corms were soaked in the liquid formulation for one hour. Later corms were removed from solution and planted immediately. The nine treatment combinations are T_1- 100% RDF (30:20:20 g NPK/m^2), T_2- 75% RDF +*Azotobacter chroococcum* (Mac27), T_3- 75% RDF + *Pseudomonas* strain (WPS73), T_4- 75% RDF + *Azotobacter chroococcum* (Mac27) + *Pseudomonas* strain (WPS73), T_5- 75% RDF + *Azotobacter chroococcum* (Mac27) + *Pseudomonas* strain (WPS73) + PSB (P36), T_6 - 50% RDF +*Azotobacter chroococcum* (Mac27), T_7 - 50% RDF + *Pseudomonas* strain (WPS73), T_8- 50% RDF + *Azotobacter chroococcum* (Mac27) + *Pseudomonas* strain (WPS73), T_9 - 50% RDF + *Azotobacter chroococcum* (Mac27) + *Pseudomonas* strain (WPS73) + PSB (P36). The compatibility among the inoculants was observed

depending upon the days taken for sprouting and sprouting percent.

3. RESULTS

The data presented in Table 1 revealed that days required for sprouting of corms ranged from 12.42 to 22.43 days among the various treatments. Among the biofertilizers *Pseudomonas* strain WPS73 took minimum number of days to sprouting of corms followed by *Azotobacter chroococcum* (Mac27) in combination with 50% and 75% recommended dose of inorganic fertilizers. However, the treatment combinations did not differ significantly and similar results were observed during both the years of study. Whereas percent sprouting of corms was significantly influenced by the treatment combinations and the results in the Table 1 revealed that Application of 75% RDF+ *Azotobacter chroococcum* (Mac27) *+Pseudomonas* strain (WPS73) recorded minimum per cent sprouting (56.12%) which was at par with 50% RDF + *Azotobacter chroococcum* (Mac27*)*+ *Pseudomonas* strain (WPS73) (61.12%) during the year 2011-12. Maximum sprouting of corms (88.15%) was observed in 75% RDF+ *Pseudomonas* strain (WPS73) which was at par with all other treatments. Similar trend was followed in the next year as well. Later it was noted that to note that at an early stage of growth (within 30 days of sprouting) co-inoculation of *Azotobacter chroococcum* (Mac27) with *Pseudomonas* strain (WPS73) either at 50% RDF or 75% RDF resulted in complete mortality of plants.

Table 1: Effect of biofertilizers on days to sprouting and per cent sprouting in gladiolus corms

Treatments	Days taken for sprouting		Per cent sprouting	
	2011-12	2012-13	2011-12	2012-13
100% RDF (30:20:20 NPK g /m2)	14.67	22.43	96.6 (82.61)	93.6 (77.73)
75%RDF+Azotobacter chroococcum (Mac27).	14.32	16.28	100 (88.15)	96.8 (80.75)
75% RDF + Pseudomonas strain (WPS73)	14.90	17.17	100 (88.15)	96.6 (82.78)
75% RDF + Azotobacter chroococcum (Mac27). +Pseudomonas strain (WPS73)	14.66	16.03	68.3 (56.12)	62.4 (52.33)
75% RDF + Azotobacter chroococcum (Mac27)+Pseudomonas strain(WPS73)+ PSB (P36)	13.52	17.02	100 (88.15)	91.6 (73.37)
50%RDF+Azotobacter chroococcum (Mac27).	12.82	16.82	100 (88.15)	98.0 (82.81)
50% RDF + Pseudomonas strain (WPS73)	12.42	17.18	100 (88.15)	98.3 (84.45)
50% RDF + Azotobacter chroococcum (Mac27) + Pseudomonas strain (WPS73)	14.04	20.40	76.6 (61.12)	83.6 (66.56)
50% RDF + Azotobacter chroococcum (Mac27). + Pseudomonas strain (WPS73) + PSB (P36)	13.13	18.87	95.0 (81.16)	95.0 (81.16)
SEm±	0.83	2.09	3.8	4.4
CD (P=0.05)	N.S.	N.S.	11.7	13.2

Values in parenthesis are angular transformed values.

4. DISCUSSION

The results in present investigation revealed that days to sprouting of corms were not affected but percent sprouting of corms differed significantly with the application of biofertilizers. A combination of *Azotobacter chroococcum* (Mac27) and *Pseudomonas* strain (WPS73) both at 75% and 50% RDF recorded minimum sprouting whereas all other treatments recorded nearly same percent sprouting of corms. Increased percentage sprouting can be attributed mainly due to availability of sufficient nutrients to the corms for its normal metabolic activities. Induced sprouting might be due to synthesis and secretion of thiamin, riboflavin, pyridoxine, nicotinic acid, pantothenic acid, indole acetic acid (IAA) and gibberellins like substances [5]. Combined application of chemical fertilizers, biofertilizers and biostimulants showed a significant influence on growth of gladiolus cv. Sancerre [3]. Similar findings were also reported by [4] in gladiolus cv.American Beauty and [2] in jasmine.

It was interesting to find that there was complete mortality of plants at an early stage in treatments containing a combination of *Azotobacter chroococcum* (Mac27) and *Pseudomonas* strain (WPS73) both at 75% and 50% RDF. This might be due to the incompatibility of the rhizobacterial strains used as biofertilizers or due to antagonistic effect and secretion of some toxic substances by the bacteria resulting in mortality of the plants. Further the major disadvantages in using the PGPR as biofertilizers include variability under field performance and the necessity for precautions to ensure survival and delivery of the product. Also, the effectiveness of a given biocontrol agent may be restricted to a specific location, due to the effects of soil and climate. Many soil edaphic factors, including temperature, soil moisture, plant height, clay content, interactions of biological control microorganisms with other rhizosphere bacteria and with pathogens also affects their viability and tolerance to adverse conditions once applied. During root colonization by introduced bacteria, introduced microorganisms have to compete with indigenous microflora for carbon source, mineral nutrients and infection sites on the roots. Sometimes, this competition is so severe that introduced microorganism fails to survive in the soil. Another factor that can contribute to inconsistent performance of PGPR is variable production or inactivation *in situ* of

bacterial metabolites responsible for plant growth promotion [1].

5. CONCLUSION

Therefore from the above experiment we can conclude that incompatibility of biofertilizers *Pseudomonas* strain (WPS73) and *Azotobacter chroococcum* (Mac27) resulted in complete mortality of plants. So, checking of compatibility of bacterial strains is required before recommending co-inoculation mixtures as biofertilizers. This area needs further research in detail (about the response of gladiolus with these two bacterial strains when used together) to know the actual cause behind the mortality of plants with the use of these two strains in combination as biofertilizers.

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