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Development of foliar concoction for improving flower yield in jasmine (*Jasminum sambac*)

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ABSTRACT : A field study was conducted for development of foliar concoction to increase the flower yield in jasmine by correcting the nutrient deficiency symptoms at field level. The effect of different combinations of nutrient solutions and two foliar concoction formulations on physiological parameters and yield of jasmine was investigated under field conditions in the farmer's field. Three sprays were given during the month of January, February and March. Experiment was laid out by adopting RBD with three replications and nine treatments. Among the treatments, Formulation II (Ferrous sulphate (0.5%), zinc sulphate (0.3%), magnesium sulphate (0.3%), salicylic acid (100 ppm), citric acid (0.1%), borax (0.3%), K_2SO_4 (0.5%) and NAA (20 ppm)) increased the yield up to 5424 kg per hectare with the BC ratio of 4.23. The chlorophyll index, soluble protein content and NRase activity were also found to be improved over control by the foliar treatment of Formulation II.

KEY WORDS : Foliar concoction, SPAD, Soluble protein, NRase activity, Flower bud yield

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Jasmine is one of the oldest fragrant flowers cultivated by man. The flower is used for making garlands, bouquet, decorating hair of women, religious offering etc. It is also used for production of Jasmine concrete which is used in cosmetic and perfumery industries. Tamil Nadu is the leading producer of jasmine flowers in the country with an annual production of 77,500 tonnes from the cultivated area of around 10,000 hectares. Generally, nutrient deficiencies affect yield and quality of flower crops. The primary symptoms of nutrient deficiency is interveinal chlorosis by iron and magnesium, reduced leaf size by zinc, flower abortion by boron, leaf edge burns by potassium. In severe cases, the entire leaf turns yellow or white and the outer edges may scorch and turn brown as the plant cells die. In addition, chlorotic plants often produce smaller flower with poor quality.

The causes of nutrient chlorosis are complex and not clearly understood. Many reactions govern nutrient availability and contribute to the complexity of nutrient chemistry in soil. Micro nutrient chlorosis frequently occurs in soils that are alkaline (pH greater than 7.0) and that which contain lime; most soils contain abundant levels of iron; however, deficiencies develop because soil chemical reactions render this iron unavailable to plants. Several methods are available for treating the nutrient deficiencies. Among the methods, foliar spray of ferrous sulphate gives better result to correct the iron deficiency (Koenig and Juhns, 2010). However, two or three micro nutrients deficiencies occurring simultaneously in the same crop is very difficult to be corrected by spraying a single nutrient or multiple sprays with different nutrients especially in a perennial crop like jasmine.

The effect of amending a foliar applied spray containing (N, P, K, Mg, Zn, Fe, Mn, Cu and B) improved the growth, yield, fruit quality and nutritional status of vines and with respect to the nutrients applied (Ahmed *et al*., 1997). Foliar spray of 0.5 per cent boron, 1.5 per cent zinc and 1 per cent iron increased the number of flowers per plant, flower stalk length, bud diameter, flower diameter, as well as fresh and dry weight of rose flower. Leaf chlorophyll contents, leaf B and Fe content, flower quality and flower stalk diameter were found to be maximum when plants were sprayed with a combination of all micronutrients used in the experiment (Iftikhar *et al.*, 2010).

Application of salicylic acid induced early flowering in wheat was observed by Jagadish *et al.* (1995). Spraying of 30 ppm NAA improved the flower bud opening, vase life and reduced floret abscission in lily flower (Yoram Mor *et al.*, 1984). Based on this background, an attempt was carried out to develop specific foliar concoction that contains nutrients and growth regulators essential for jasmine for increment of flower yield.

RESEARCH METHODS

The study was undertaken to find out the effect of different nutrients and combinations of nutrient formulations (Concoction) with growth regulators on physiological parameters and yield in jasmine (*Jasminum sambac*) in the farmer's field at Mathampalayam village, Karamadai, Coimbatore, Tamil Nadu during 2012-13. The experiment was conducted with jasmine variety Ramanathapuram local and nine treatments *viz.*, control (T_1), ferrous sulphate (0.5%) with NAA (20 ppm) (T_2), Ferrous sulphate (0.5%) + citric acid + NAA (20 ppm) (T_3), Zinc sulphate (0.3%) + NAA (20 ppm) (T_4), Magnesium sulphate (0.3%) + NAA (20 ppm) (T_5), Salicylic acid (100 ppm) + NAA (20 ppm) (T_6), Citric acid (0.1%) + NAA (20 ppm) (T_7), Formulation I (T_3 + T_4 + borax (0.3%) + K_2SO_4 (0.5%) (T_8) and Formulation II (T_5 + T_6 + T_8) (T_9) with three replications each. The field was laid out in Completely Randomized Block Design with the plot size of 148 square meters. Three sprays were given during the month of January, February and March, 2013 after pruning was done during the month of November 2012. Crop was supplied with fertilizers and other cultivation practices including plant protection measures were carried out as per the recommended package of practices of Tamil Nadu Agricultural University, Coimbatore.

The physiological parameters were recorded 15 days after the third spray. Chlorophyll index was recorded using Chlorophyll Meter (SPAD 502) designed by the Soil Plant Analytical Development (SPAD) section, Minolta, Japan. The data were recorded as described by Peng *et al.* (1996). Soluble protein content of the leaf was estimated using the method of Lowry *et al*. (1951) and expressed as mg g^{-1} fresh weight.

Nitrate reductase activity (NRA) was estimated by following procedure. Leaf samples were kept in 10 ml of assay medium contains substrate (KNO_3) for 1 hour reaction (Nicholas *et al*., 1976). After 1 hour, amount of NO_2 produced by the enzyme was quantified by adding sulphanilamide and NEDH. The absorbance was measured at 540 nm. The quantity of NO_2 produced by the enzyme was calculated using a standard curve. Flower characters and flower bud yield were recorded during each harvest and pooled together. The data on various parameters were analyzed statistically as per the procedure suggested by Gomez and Gomez (1984).

RESEARCH FINDINGS AND DISCUSSION

The data on flower characters (Table 1) shows that the treatment T_9 (formulation II) recorded more number of flower buds per cyme followed by T_8 (formulation I) and T_3 *viz*., 5.28, 4.79 and 4.60, respectively. Also the treatments T_9 followed by T_8 have the longest corolla tube length (1.36; 1.35, respectively), flower bud length (2.91; 2.80, respectively) and flower bud diameter (0.60; 0.55, respectively) when compared to the control flowers. The data on 100 bud weight (g) also showed that T_9 (formulation II) had the highest weight of 19.31g followed by T_8 with 18.87g whereas the control flowers had a very less weight of 17.17 g. Thus the treatment T_9 was found to have a significant improvement in the flower characteristics over all other treatments. The superiority of the flower characters is due to the improvement of soluble protein content and NRase activity by formulation II, which has the concoction of nutrients and growth regulators essential for jasmine.

The experiments on biochemical parameters (Table 2) indicated that there was significant difference between the treatments. The treatment T_9 (Formulation II) has the highest SPAD value of 50.7 followed by the treatment T_8 (Formulation I) 49.4 than all other treatments. The increment of bud weight is might be due enhanced photosynthesis by increasing the chlorophyll index (SPAD Value). The intensity of the greenness in terms of SPAD values of the plant had influenced the photosynthetic rate and thereby the efficiency of the plant for increased biomass production. Ma *et al*. (1995) reported a highly significant correlation of SPAD readings with photosynthetic rate in soybean. Efficient translocation of photosynthates to the flower is also one of the reasons for the increment of 100 bud weight. Potassium, boron and salicylic acid present in the formulation are responsible for better translocation of assimilates. Chandra *et al*. (2007) reported that application of salicylic acid increased total soluble sugar and soluble protein of cowpea plants. This can be attributed to the role of salicylic acid to improve membrane permeability, absorption and utilization of mineral nutrients. This would also contribute towards enhancing the capacity of the treated plants for biomass production as is reflected in the observed increase in fresh and dry weight of plants (Javaheri *et al.*, 2012).

The soluble protein content (mg g^{-1}) was found to be higher in the treatment formulation II (14.10) followed by T_5 which has the combination of Magnesium Sulphate + NAA (13.23). Maintenance of soluble protein content could be attributed to higher RuBisCO activity leads to more carbon fixation and ultimately to higher photosynthetic efficiency. Diethelm and Shibles (1989) opined that the RuBisCO content per unit leaf area was positively correlated with that of soluble protein content of the leaf. The increment of soluble protein content by the application of formulation II and magnesium sulphate is might be due to the magnesium present in the spray, which is a cofactor nutrient for the RuBisCO enzyme and essential for assembly of RuBisCO.

The data showed that the NRase activity (µg NO_2 g^{-1} h^{-}

Table 1 : Effect of nutrients and PGR's on flower characters in jasmine

Treatments	Flower buds / cyme	Corolla tube length (cm)	Flower bud length (cm)	Flower bud diameter (cm)	100 bud weight (g)
T_1: Control (Water Spray)	3.85	1.27	2.60	0.49	17.17
T_2: Ferrous sulphate + NAA	4.54	1.31	2.69	0.51	18.12
T_3: Ferrous sulphate + citric acid + NAA	4.60	1.33	2.69	0.51	18.07
T_4: Zinc sulphate + NAA	4.16	1.30	2.63	0.50	17.71
T_5: Magnesium sulphate + NAA	4.50	1.31	2.65	0.50	17.99
T_6: Salicylic acid + NAA	4.26	1.32	2.67	0.51	17.89
T_7: Citric acid + NAA	4.05	1.28	2.61	0.49	17.25
T_8: Formulation I (T_3 + T_4 + borax + K_2SO_4)	4.79	1.35	2.80	0.55	18.87
T_9: Formulation II (T_5 + T_6 + T_8)	5.28	1.36	2.91	0.60	19.31
S.E.±	0.062	0.016	0.045	0.007	0.277
C.D. (P=0.05)	0.143*	0.035*	0.103*	0.015*	0.567*

* indicate significance of value at P=0.05

Table 2 : Effect of nutrients and PGR's on biochemical parameters and yield in jasmine

Treatments	SPAD value	Soluble protein ($mg\ g^{-1}$)	NRase activity ($\mu g\ NO_2\ g^{-1}h^{-1}$)	Flower bud yield (kg $plot^{-1}$)	Flower bud yield (kg ha^{-1})	BC ratio
T_1: Control (Water Spray)	41.1	10.08	17.01	85.42	4725	3.74
T_2: Ferrous sulphate + NAA	47.4	11.17	18.21	92.00	4874	3.88
T_3: Ferrous sulphate + citric acid + NAA	47.7	11.18	18.31	92.43	4895	3.92
T_4: Zinc sulphate + NAA	44.1	10.67	17.80	89.48	4739	3.81
T_5: Magnesium sulphate + NAA	47.3	13.23	18.29	91.02	4796	3.84
T_6: Salicylic acid + NAA	43.1	10.96	20.68	89.26	4770	3.85
T_7: Citric acid + NAA	41.3	10.15	17.43	87.86	4755	3.77
T_8: Formulation I (T_3 + T_4 + borax + K_2SO_4)	49.4	12.16	19.75	95.22	5042	4.05
T_9: Formulation II (T_5 + T_6 + T_8)	50.7	14.10	23.35	98.14	5254	4.23
S.E.±	0.707	0.174	0.302	1.33	65.65	
C.D. (P=0.05)	1.491*	0.373*	0.636*	2.74**	135.28**	

* and ** indicate significance of value at P=0.05 and 0.01, respectively

^{1}) was highest in T_9 (23.35) followed by T_6 - Salicylic acid + NAA (20.68) while the control recorded the lowest activity of (17.01). Nitrate reductase (NRase) is an important enzyme for nitrogen assimilation ultimately protein synthesis and to productivity. Salicylic acid protects the NRase enzyme activity was reported by several workers. Bhupinder and Usha (2003) reported that SA protects NRase activity and maintains protein and nitrogen content and increases the chlorophyll, photosynthetic rate and RuBisCO activity of wheat plants. In the present study, salicylic acid present in the formulation II improved the NRase activity and ultimately yield.

The yield data, shows that the treatment T_9 (formulation II) recorded the highest flower bud yield (kg $plot^{-1}$) of 98.14 followed by the treatments T_8 (Formulation I), T_3 with the yield of 95.22 and 92.43, respectively. The highest flower bud yield was recorded by the treatment T_9 (5254) with a BC ratio of 4.23 followed by T_8 (Formulation I) yield of 5042 kg ha^{-1} with the BC ratio of 4.05. The overall yield increment by the formulation II (iron, magnesium, potassium, zinc, born and NAA) is might be due to improvement of chlorophyll by iron, magnesium and zinc, improvement of soluble protein by magnesium, enhanced activity of NRase by salicylic acid, better translocation of photosynthates by potassium boron and salicylic acid and reduced flower drop by NAA.

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