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Off season flower induction through fertigation and biostimulant spray in *Jasminum sambac* Ait.

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ABSTRACT : An investigation was undertaken at the Botanical Garden, Tamil Nadu Agricultural University, Coimbatore to study the influence of fertigation and biostimulant spray on offseason flower production in *Jasminum sambac* cv. RAMANATHAPURAM GUNDUMALLI. The crop was grown under precision method of cultivation by following fertigation at weekly intervals and the plants were sprayed with biostimulant *viz.*, humic acid (0.4%) and panchagavya (3%) at monthly intervals and the effect of these on off season flower production was evaluated. The results indicated that drip fertigation with 125 per cent recommended dose of fertilizer in combination with foliar spray of humic acid (0.4%) and panchagavya (3%) produced flowers throughout the year with a production of 14.78 t ha^{-1}. This was closely followed by the treatment with 100% recommended dose of fertilizer in combination with humic acid (0.4%) and panchagavya (3%) with production of 14.14 t ha^{-1}. However, this treatment showed its superiority by registering highest BCR over other treatments.

KEY WORDS : Precision, Conventional, Fertigation, Biostimulant, *Jasminum sambac*

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Jasminum sambac Ait. is one of the most important commercial traditional flower crops of South India belonging to the family Oleaceae. It is considered as a spiritual flower since time immemorial. It is also an important source of jasmine concrete and perfume extraction. Jasmine concrete is now being produced industrially in India and it is a highly profitable venture and the demand is increasing in the world market because of its unique fragrance which cannot be imitated by synthetic chemicals.

In *Jasminum sambac*, the crop produces good yield during the months starting from March to August. The remaining months are considered as off season in case of *Jasminum sambac*. Hence, it is important to produce flowers during the lean season also in order to meet out the market demand of flowers and to get good income to the growers. By introducing fertigation, it is possible to increase the yield potential by three times with the same quantity of water, by saving about 45 to 50 per cent of irrigation water and increasing the productivity by about 40 per cent. When fertilizer is applied through drip irrigation, it was observed that the yield has been increased and about 30 per cent of the fertilizer could be saved (Sivanappan, 1998). By this method the period of flowering can also be extended. Panchagavya and humic acid are used as organic biostimulants as they are from biological origin (Schnitzer, 2000) and they contain beneficial microorganisms, growth hormones and vital nutrients for plant growth and yield. With this background, the present research was undertaken with the objective to study the effect precision technologies including fertigation and biostimulant sprays on off season flower production in *Jasminum sambac*.

RESEARCH METHODS

The experiment was conducted at the Botanical Gardens, Tamil Nadu Agricultural University, Coimbatore during the year 2011 - 2012. A local type of *Jasminum sambac* named Ramanathapuram gundumalli was selected for the experiment. The experiment was laid out in Factorial Randomized Block Design with 13 treatments and three replications. The first 12 treatments (fertigation) comprised of precision technology and the 13th one was the conventional system wherein conventional flood irrigation was followed. In precision farming system, planting was done at spacing of 1x1m and in

conventional method, it was done at 1.25x1.25m. The treatments included two factors *viz.*, fertilizer and biostimulant with three levels of fertilizers *viz.*, NPK 75%, 100% and 125% RDF and four levels of biostimulant spray *viz*., no biostimulant spray, humic acid 0.4%, panchagavya 3% and humic acid 0.4% + Panchagavya 3% spray. The water soluble fertilizer sources for supplying NPK through drip irrigation in precision system were urea (46% N), potassium nitrate (13:0:45) and polyfed (19:19:19), respectively. At the time of field preparation 75 per cent of P_2O_5 was applied in pits as basal dose through single super phosphate, a straight fertilizer. Fertigation was done using water soluble fertilizer starting from seven days after planting at weekly intervals. Recommended dose of fertilizers (60:120:120 g NPK/plant/yr) were applied manually in two splits during 4th and 8th month after planting under conventional system. Biostimulants *viz.*, humic acid and Panchagavya at given concentrations were sprayed at monthly intervals. Observations were recorded on the yield of the plants for one year from November 2009 to October 2010. The yield of flowers harvested from each treatment plot was recorded daily in terms of weight and the cumulative yield for each month was expressed in grams per plant and further the yield per hectare was estimated and expressed in kg per hectare. Finally the benefit cost ratio was also worked out.

RESEARCH FINDINGS AND DISCUSSION

Data of the present investigation are presented in Tables 1, 2, 3, 4, 5 and 6. The results indicated that maximum flower bud yield ha^{-1} (344, 476, 575, 742, 1108, 1409, 1457, 1752, 1762, 1761, 1708 and 1689 kg) was recorded in the interaction treatment having (F_3B_3) 125 per cent of RDF with humic acid 0.4 per cent + Panchagavya 3 per cent spray from November 2011 to October 2012, respectively with a cumulative yield of 14783.29 kg ha^{-1} $year^{-1}$ and this was followed by (F_2B_3) 100 per cent of RDF with humic acid 0.4 per cent + Panchagavya 3 per cent spray (311, 443, 525, 708, 1053, 1354, 1393, 1688, 1698, 1697, 1644 and 1629 kg) from November 2011 to October 2012, respectively with a cumulative yield of 14142.84 kg ha^{-1} $year^{-1}$. The control (100% RDF with soil application of fertilizer and flood irrigation) recorded lowest yield $plant^{-1}$ (0, 84, 305, 403, 741, 1052, 1153, 1095, 852, 785, 562 and 454kg) from November 2011 to October 2012, respectively with a cumulative yield of 7485.30 kg ha^{-1} $year^{-1}$. It was observed that the fertigated and biostimulant sprayed plants have consistently produced higher yield even during off season period ie. from October to February as compared to control.

The increased yield in fertigated plot was due to the increased performance in all the growth parameters and yield attributing characters. This may be due to the better availability

Table 1 : Effect of fertigation and biostimulants on yield ha^{-1} (kg) of *J.sambac* from November 2011 to January 2012

Treatments	November 2011					December 2011					January 2012				
	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean
F_1	131	199	169	245	186	252	331	301	377	315	336	414	384	469	401
F_2	225	282	255	311	268	357	414	387	443	400	440	496	469	525	482
F_3	249	308	296	344	299	381	430	428	476	429	473	522	510	575	520
Mean	202	263	240	300		330	392	372	432		416	477	454	523	
Control			0					84					305		
	F		B		F x B	F		B		F x B	F		B		F x B
S.E.+	2.553		2.948		5.107	2.603		3.006		5.206	2.709		3.128		5.419
CD (P=0.05)	5.296		6.115		10.592	5.399		6.234		10.798	5.619		6.488		11.238

Table 2 : Effect of fertigation and biostimulants on yield ha^{-1} (kg) of *J.sambac* from February 2012 to April 2012

Treatments	February 2012					March 2012					April 2012				
	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean
F_1	458	537	507	584	521	753	860	822	880	829	1054	1160	1123	1181	1130
F_2	564	635	594	708	625	860	931	890	1053	933	1160	1232	1191	1354	1234
F_3	588	684	650	742	666	884	1020	946	1108	990	1185	1321	1247	1409	1291
Mean	536	619	584	678		832	937	886	1014		1133	1238	1187	1315	
Control			403					741					1052		
	F		B		F x B	F		B		F x B	F		B		F x B
S.E.+	3.419		3.948		6.838	4.126		4.764		8.252	4.136		4.765		8.263
C.D. (P=0.05)	7.091		8.188		14.182	8.557		9.880		17.114	8.558		9.881		17.116

F_1 – 75%RDF F_2- 100% RDF F_3 – 125% RDF
B_0-No Biostimulant B_1- Humic acid 0.4% B_2-Panchagavya 3% B_3- Humic acid 0.4% + Panchagavya 3%

Table 3 : Effect of fertigation and biostimulants on yield ha^{-1} (kg) of *J.sambac* from May 2012 to July 2012

Treatments	May 2012					June 2012					July 2012				
	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean
F_1	1103	1209	1172	1229	1178	1060	1168	1136	1190	1139	1074	1178	1146	1195	1148
F_2	1209	1281	1239	1393	1280	1184	1468	1264	1688	1401	1194	1478	1274	1698	1411
F_3	1233	1322	1296	1457	1327	1216	1616	1608	1752	1548	1226	1626	1618	1762	1558
Mean	1182	1271	1236	1360		1153	1417	1336	1543		1165	1427	1346	1552	
Control			1153					1095					852		
	F		B		F x B	F		B		F x B	F		B		F x B
S.E.±	3.929		4.537		7.859	10.050		11.605		20.101	10.046		11.600		20.092
C.D. (P=0.05)	8.150		9.410		16.300	20.844		24.069		41.689	20.834		24.057		41.668

Table 4 : Effect of fertigation and biostimulants on yield ha^{-1} (kg) of *J.sambac* from August 20012 to October 2012

Treatments	August 2012					September 2012					October 2012				
	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean	B_0	B_1	B_2	B_3	Mean
F_1	1069	1177	1145	1225	1154	1016	1124	1092	1172	1101	990	1104	1063	1150	1077
F_2	1193	1477	1273	1697	1410	1140	1424	1220	1644	1357	1111	1385	1191	1629	1329
F_3	1225	1625	1617	1761	1557	1172	1572	1564	1708	1504	1143	1543	1535	1689	1477
Mean	1162	1426	1345	1561		1109	1373	1292	1508		1081	1344	1263	1489	
Control			785					562					454		
	F		B		F x B	F		B		F x B	F		B		F x B
S.E.±	9.987		11.532		19.974	9.987		11.532		19.974	10.044		11.597		20.088
C.D. (P=0.05)	20.712		23.916		41.425	20.712		23.916		41.425	20.830		24.052		41.660

F_1 – 75%RDF F_2- 100% RDF F_3 – 125% RDF
B_0-No Biostimulant B_1- Humic acid 0.4% B_2-Panchagavya 3% B_3- Humic acid 0.4% + Panchagavya 3%

Table 5 : Effect of fertigation and biostimulants on cumulative yield ha^{-1} (kg) of *J.sambac* for one year from November 2011 to October 2012

Treatments	Cumulative yield ha^{-1} (kg) from Nov'11 – Oct'12 (1yr)				
	B_0	B_1	B_2	B_3	Mean
F_1	9295.46	10460.91	10059.40	10896.40	10178.04
F_2	10635.51	12502.58	11246.41	14142.84	12131.84
F_3	10974.11	13588.17	13315.24	14783.29	13165.20
Mean	10301.69	12183.89	11540.35	13274.18	
Control			7485.30		
	F		B	F X B	
S.E.±	72.430		83.635	144.861	
C.D. (P=0.05)	150.212		173.450	300.425	

Table 6 : Effect of fertigation and biostimulants on cost economics of *J.sambac*

Treatments	Yield (kg ha^{-1}y^{-1})	Total cost of cultivation (Rs.)	Gross return (Rs.)	Net return (Rs.)	BCR
$F_1 B_0$	9295.46	5.24	10.26	5.38	2.03
$F_1 B_1$	10460.91	5.27	11.97	6.70	2.27
$F_1 B_2$	10059.40	5.25	1151	6.25	2.19
$F_1 B_3$	10896.40	5.28	12.50	7.21	2.37
$F_2 B_0$	10635.51	5.84	12.19	6.34	2.08
F_2B_1	12502.58	5.87	14.40	8.52	2.45
F_2B_2	11246.41	5.85	12.91	7.05	2.20
F_2B_3	14142.84	5.88	16.30	1.04	2.77
$F_3 B_0$	10974.11	6.45	12.58	6.13	1.95
$F_3 B_1$	13588.17	6.48	15.66	917	2.42
$F_3 B_2$	13315.24	6.46	15.36	8.90	2.38
$F_3 B_3$	14783.29	6.49	17.04	1.05	2.62
Control	7485.30	3.37	6.48	6.14	1.91

F_1 – 75% RDF F_2- 100% RDF F_3 – 125% RDF B_0-No Biostimulant B_1- Humic acid 0.4%
B_2-Panchagavya 3% B_3- Humic acid 0.4% + Panchagavya 3%

of soil moisture environment and availability of plant nutrients throughout the crop growth period under drip fertigation system. This is in concordance with the findings of Vijayselvaraj (2007) in *J.grandiflorum*, Shrikant (2008) in gerbera and Swapna (2010) in marigold. Similarly at the same level of fertilizer dose through conventional method of application, the drip irrigated plots produced higher flower yield throughout the year over surface irrigation. Drip fertigation maintains the soil moisture at field capacity level between two irrigation intervals, whereas, surface irrigation had higher fluctuation in soil moisture retention between field capacity and permanent wilting point, thus resulting in lower flower yield. These results corroborate with the findings of Veeranna (2000) in chillies.

The higher production of auxin and growth substances by humic acid at early phase of growth would have contributed to the formation of more floral buds. This might be due to the activity of humic acid consisting of active phenolic group that might have inhibited oxidase activity and promoted the prolonged persistence of IAA in plants which might have contributed to formation of increased number of flowers (Balumahendran, 2008). Moreover, the presence of cytokinin in coconut water, a constituent of Panchagavya might have increased the biomass and flower yield (Muthamizhselvi, 2006). In surface irrigation, the flower bud yield of *J.sambac* especially during off season was much lower than the drip fertigated plot. Decreased yield in surface irrigated plots might be due to lower available soil moisture throughout the crop growth which led to reduction in plant height, plant spread, number of branches and dry matter production.

In the present study, though the application of 125 per cent RDF was found to be the best in respect of higher production of flower buds during off season, regarding the cost economics, the application of 100 per cent RDF secured highest benefit cost ratio of 2.77 with a net return of Rs. 10,41,724/- per hectare and this was followed by 125 per cent RDF with benefit cost ratio of 2.62. The prime reason is, in case of treatment with 125 per cent RDF, 25 per cent extra WSF is applied than that of 100 per cent RDF. Due to the increased cost of water soluble fertilizers, automatically the input cost of this treatment has increased. Further the yield of flower buds under 100 per cent RDF was at par with 125 per cent RDF. This caused an increased BCR in the treatment with 100 per cent WSF and foliar spray of humic acid 0.4 per cent and Panchagavya 3 per cent under drip fertigation than the treatment with 125 per cent RDF. Similar effect of increased BCR in drip fertigation over control was observed by Vijayselvaraj (2007) in *J.grandiflorum* and Swapna (2010) in marigold.

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