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Efficacy of biostimulants on growth and flowering of China aster var. Arka Archana

Srushti Pandya, Bhavesh Patel and Mallika Sindha

Abstract
The study revealed significant differences among all the levels of biostimulants. The results indicate that the vegetative attributes were differed with various treatments at 45 and 60 DAT. Among different concentrations of biostimulants, T6 (Humic acid 0.2% + Seaweed extract 0.5%) was found numerically highest plant height (28.63 cm and 32.63 cm, respectively), plant spread at E-W direction (21.43 cm and 27.30 cm, respectively) and plant spread at N-S direction (21.43 cm and 25.00 cm, respectively), leaf area (25.93 cm^2) and number of primary branches per plant (9.73 and 11.20, respectively). With respect to flowering parameters, an advanced first bud appearance (36.20 days) and 50% flower bud appearance (40.33 days) were recorded with the application of Humic acid 0.2% + Seaweed extract 0.5% (T6). Other floral characters *viz.*, flower diameter (5.52 cm), shelf life (5.67 days) and weight of ten flowers (27.67 g) were also found maximum with T6 (Humic acid 0.2% + Seaweed extract 0.5%).

Keywords: Biostimulants, china aster, humic acid and seaweed extract

Introduction
China aster (*Callistephus chinensis*) is one of the important commercial loose flowers as well as cut flower belonging to family Asteraceae. It is believed to have originated in China. The genus *Callistephus* is derived from two greek words, *Kalistos* meaning 'most beautiful' and *Stephus* meaning 'a crown' referring to flower head. The original plant had single flowers with two to four rows of blue, violet or white ray florets. China aster is winter annual flower plant. There are wide range of cultivars suitable for different purposes *viz.*, Tall and erect growing varieties with long stem flowers are used as a cut flower. Dwarf varieties with spreading habit having small and short stem flowers are suitable for the purpose of loose flowers, pot plants and bedding plants in landscape. It is very popular flower crop because of more diversity in colours than any other annual flowering plant. They are often used in bouquets and flower arrangements. China aster is gaining fast popularity in India because of easy cultural practices, diversity of colours and varied uses (Ahir *et al.*, 2021) [1]. It is a short duration crop propagated by seeds. It can be grown in various agro-climatic zones and easy to cultivate with less plant protection measures.

'Arka Archana' variety of China aster was released from IIHR, Bangalore and it is developed through individual plant selection method. It is a loose flower variety also suitable for bedding purpose. It is spreading type, semi double with white-coloured flowers, floriferous and early flowering type with high loose flower yield having extended blooming period and tolerance to lodging.

Biostimulants have emerged as a supplement to mineral fertilizers and hold a promise to improve yield as well as quality of the crop (Sankari *et al.*, 2015) [22]. It can be defined as an organic material and/or micro-organism that is applied to enhance an organic nutrient uptake, stimulate growth, Enhance stress tolerance or crop quality. They have become common practice in agriculture because they are providing a number of benefits in stimulating growth and protecting against stress.

Humic acid is a commercial product which is produced by decaying organic compounds. It contains elements that improve soil fertility and reduces soil nutrient deficiency. It positively affects root growth in plants and increases water and nutrient availability by forming chelates of various nutrients.

Seaweed extract is most commonly used for application in agriculture and horticulture. It is extracted from a species of brown algae *Ascophyllum nodosum*. It contains multiple growth regulators such as cytokinin, auxins, gibberellins, betaines, as well as presence of macronutrients like Ca, P, K and micronutrients like Fe, Cu, Zn, B, Mn, Co and Mo which are

necessary for plant growth and development. The importance of seaweed extract on germination, growth and flowering by maintaining C:N ratio with high quality flowers has been explained by Hegde *et al.*, 2016 [10].

Panchgavya is a single organic input, which can act as a growth promoter and immunity booster. It has significant role in providing resistance to pest and diseases and in increasing the yield and shelf life (Sendhilnathan *et al.*, 2017) [24]. It is a mixture of five ingredients derived from cow *i.e.,* cow dung, urine, milk, curd, ghee and other ingredients. These are mixed in proper ratio and allowed to ferment. Naturally occurring beneficial microorganisms *viz.,* nitrogen fixers, phosphorus solubilizers, photosynthetic bacteria and actinomycetes are present in panchgavya because of fermentation, which supports the plant to absorb more macro and micro nutrients from the soil (Praveen *et al.*, 2020) [20]. It is very helpful tool in organic agriculture.

Novel Organic Liquid Nutrients is patented product of Navsari Agricultural University under National Agricultural Innovation Project. It is banana pseudostem based product which is used as agro inputs in all crops. Banana pseudostem sap is extracted from banana fibers. Novel Organic Liquid Nutrients can increase crop yield significantly with reduction in use of chemical fertilizers. It is best source of macro and micro nutrient along with soluble sugars, phenols, amino acids and plant growth hormones like gibberellic acid (110.2 – 205.0 ppm) and cytokinin (137.8 – 244.3 ppm). Gibberellic acid is known for increasing cell elongation, cell division, delayed senescence, break seed dormancy, initiation of root, stimulate flowering, height of plant, number of leaves, chlorophyll content and reduce the juvenile period required for flowering and also for improving quality and yield. Cytokinins increase cell division, leaf growth, stem diameter, root and bud differentiation. Cytokinins and gibberellins tend to retard flower senescence.

Vermiwash is a rich source of vitamins, hormones, enzymes, macro and micronutrients when applied to plants help in efficient growth. It also improves the physiochemical property of soil and reduced insect-pest infestation which would result in increased uptake of the nutrients by the plants resulting in higher growth and yield with sustainable production. It is a watery extract of vermicompost, extracted in the presence of rich population of earthworms and contains several enzymes, plant growth hormones and vitamins along with micro and macronutrients.

Materials and Methods

The present study was undertaken at Floriculture Research Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India during September-2021 to February-2022. The treatments were applied as foliar spray to the plants at 30 and 45 days after transplanting. The experiment was laid out in Randomized Block Design (RBD) with three replications in china aster var. 'Arka Archana'. The experiment comprised of 10 treatments of biostimulants and their combinations *i.e.,* Humic acid 0.2%, Seaweed extract 0.5%, *Panchgavya* 3%, Novel Organic Liquid Nutrients 1%, Vermiwash 3%.

Preparation of solutions for biostimulants

Humic Acid

Humic acid of 0.2% solution was prepared by dissolving 2 ml humic acid in one litre of water.

Seaweed Extract

Seaweed extract of 0.5% solution was prepared by dissolving 5 ml seaweed extract in one litre of water.

Panchgavya

For preparing 20 litres of *panchgavya*, 5 kg fresh cow dung and 500 g cow's ghee were mixed thoroughly in a plastic can and kept for 3 days. This mixture was stirred twice a day. On the 4th day, cow's urine (3 litres), cow's milk (2 litres), cow's curd (2 litres), sugarcane juice (3 litres), tender coconut water (2 litres) and meshed ripened 6 banana fruits were mixed thoroughly. This solution was kept for 18 days with stirring twice a day for about 20 minutes to facilitate aerobic microbial activities. On the 19th day stock solution of *panchgavya* was ready to use. The solution was stored in plastic container and covered with a muslin cloth. *Panchgavya* 3% solution was made by dissolving 30 ml of *panchgavya* from stock solution into water and final volume was made up to one litre in a volumetric cylinder.

Novel Organic Liquid Nutrients

Novel Organic Liquid Nutrients of 1% solution was prepared by dissolving 10 ml Novel Organic Liquid Nutrients in one litre of water.

Vermiwash

Vermiwash of 3% solution was prepared by dissolving 30 ml vermiwash in one litre of water.

Results and Discussion

Effect on Vegetative Attributes

The findings (Table 1) showed that application of Humic acid 0.2% + Seaweed extract 0.5% increased the plant height (28.63 cm and 32.63 cm), plant spread in East-West direction (21.43 cm and 27.30 cm) as well as in North-South direction (21.43 cm and 25.00 cm), maximum number of primary branches (9.73 and 11.20) at 45 and 60 DAT, respectively. Maximum leaf area 25.93 cm^2 was obtained with an application of humic acid 0.2% + seaweed extract 0.5% at 60 DAT.

Increase in plant height might be due to acceleration of hormonal activity due to humic acid. It positively affects growth by providing carbon as a food source to plants as it is made from decaying organic materials. It creates a microclimate condition for root growth and proliferation and absorption of more nutrients from soil which leads to increased cell division and higher meristematic activity resulting in better plant height. Presence of auxin and cytokinin precursors in seaweed extract might be responsible for increased plant height due to cell elongation Similar results regarding the effect of humic acid and sea weed extract on plant height were also reported by Bashir *et al.* (2016) [3], Pansuriya *et al.* (2018) [18], Sankari *et al.* (2015) [22] in gladiolus, Gawade *et al.* (2019) [8] in chrysanthemum, Karthiraj *et al.* (2008) [13] in china aster, Dhutraj (2002) [6] in gaillardia, Bhargavi *et al.* (2018) [4] and Hegde *et al.* (2016) [10] in chrysanthemum. Foliar application of seaweed extract may have helped in better absorption of nitrogen leading to increased number of leaves through photosynthesis process. Presence of growth regulatory substances such as IAA, GA and cytokinin in humic acid and seaweed extract might had increased the number of leaves and branches with rapid increase in internodal growth. Both increase in leaves and

branches along with increase in internodal length may contribute to increased plant spread in East-West and North-South direction. Results are corroborated with the findings of Muraleedharan *et al.* (2017) [16] in *Anthurium andreanum*, Karthiraj *et al.* (2008) [13] in china aster, Gaurav *et al.* (2016) [7] in African marigold and Bhargavi *et al.* (2018) [4] in chrysanthemum. Foliar application of seaweed extract might have enhanced the cytokinin level and thereby cause manifold increase in cell division resulting in enhanced leaf area. It is also due to improved nutrient absorption capacity and increased the photosynthetic activity of the plants. These are in line with the results of research work done by Dhutraj (2002) [6] in gaillardia, Karthiraj *et al.* (2008) [13] in china aster and Khan *et al.* (2016) [3]. Seaweed extracts are involved in formation and maintenance of apical and axillary meristems promoting the growth. Number of primary branches were increased due to cytokinin and GA3 present into seaweed extract which might have resulted in breakage of apical dominance and promoted higher number of branches. Humic acid favors the absorption of more carbon from root zone resulting into more number of productive branches. These results are supported by the findings of Khandelwal *et al.* (2003) [14] in African marigold, Violeta *et al.* (2010) [31], Bhargavi *et al.* (2018) [4] and Hegde *et al.* (2016) [10] in chrysanthemum, Dhutraj (2002) [6] in gaillardia and Karthiraj *et al.* (2008) [13] and Kadam *et al.* (2002) [12] in china aster. Similar results of foliar application of seaweed extract were also found by Praveen *et al.* (2020) [20] in rose, crossandra and Sendhilnathan *et al.* (2017) [24] in gomphrena.

Effect on flowering and quality attributes

Data of several flowering and quality Attributes indicated a considerable impact across all treatments (Table 1). Least days to first bud appearance (36.20 days), 50% flower bud appearance (40.33 days), maximum flower diameter (5.52 cm), more shelf life of flowers (5.67 days), maximum weight of ten flowers (27.67 g) were recorded in humic acid 0.2% + seaweed extract 0.5%.

Early flower bud appearance might be due to auxin and other growth substances present into humic acid. The higher production of auxin and growth substances by humic acid at early phase of growth would have contributed to early flowering. Seaweed extract increases nutrient uptake. Early production of florigen and other flower inducing substances were found in seaweed extract treated plants which might be responsible for early flower bud appearance in plants. Similar results regarding early flower bud appearance were also reported by Bashir *et al.* (2016) [3], Sankari *et al.* (2015) [22], Saryu Trivedi (2020) [23] in gladiolus and Palanisamy *et al.* (2015) [17] in gerbera. Seaweed extract increases nutrient uptake. The increase in phosphorus is found to be involved in flower bud initiation. Results are in conformity with Mahawer *et al.* (2010) [15] in tuberose and Harshvardhan *et al.* (2014) [9] in carnation. Flower size in terms of flower diameter is the important parameter which decide the quality of flower. These results were in accordance with Shinde *et al.* (2010) [25] in marigold, Hegde *et al.* (2016) [10] in chrysanthemum and Karthiraj *et al.* (2008) [13] in china aster who stated that the enlargement in size of the flower might be due to production of more food which was diverted to flowering area as seaweed extract and humic acid are precursor of auxin, cytokinin and micronutrients. Entry of seaweed extract into the plant, which might have mediated the respiration by acting as a hydrogen acceptor and thus altering the carbohydrate metabolism of plants promoting the accumulation of sugar as inferred by Cacco and Dell Agnola (1984) [5]. Humic acid and seaweed extract contain cytokinin and auxin that might have increased the antioxidant levels and resistance to senescence leading to enhanced shelf life. The results are in close conformity with findings of Gawade *et al.* (2019) [8] and Hegde *et al.* (2016) [10] in chrysanthemum and Aminifard *et al.* (2012) [2] in capsicum. The increase in weight of flower might be due to effect of GA3 present into seaweed extract which increases uptake of nutrients leading to production and accumulation of more photosynthates from source to sink which ultimately leads to increase in flower weight and quality. These results were supported by Russo *et al.* (1994) [21] and Khandelwal *et al.* (2003) [14] in marigold, Karthiraj *et al.* (2008) [13] and Jemini Patel (2021) [11] in china aster and Hegde *et al.* (2016) [10] in chrysanthemum.

Table 1: Effect of biostimulants on growth and flowering of china aster var. Arka Archana

Treatments	Plant height (cm)		Plant spread (East-West) (cm)		Plant spread (North-South) (cm)		Leaf area (cm^2)	Number of primary branches		Days to first bud appearance	Days to 50% flower bud appearance	Flower diameter (cm)	Shelf life (days)	Weight of ten flowers (g)
	45 DAT	60 DAT	45 DAT	60 DAT	45 DAT	60 DAT		45 DAT	60 DAT					
T_1: Humic acid 0.2%	21.40	24.27	15.00	20.03	16.00	19.00	19.02	7.27	8.73	44.73	46.33	4.79	3.6	21.33
T_2: Seaweed extract 0.5%	24.93	27.57	18.40	22.93	19.60	22.30	22.54	8.93	10.20	40.40	44.33	5.11	5.33	25.67
T_3: *Panchgavya* 3%	23.13	25.20	15.80	20.80	16.43	19.63	19.41	8.13	9.00	43.13	45.00	4.88	5.00	22.00
T_4: Novel Organic Liquid Nutrients 1%	22.27	23.63	14.20	19.70	15.23	18.50	18.12	7.00	8.53	45.47	48.00	4.63	4.00	20.67
T_5: Vermiwash 3%	19.67	21.17	13.50	18.53	13.67	17.90	17.08	6.60	8.47	46.67	50.33	4.43	4.33	19.33
T_6: Humic acid 0.2% + Seaweed extract 0.5%	28.63	32.63	21.43	27.30	21.43	25.00	25.93	9.13	11.20	36.20	40.33	5.52	5.67	27.67
T_7: Humic acid 0.2% + *Panchgavya* 3%	26.27	30.17	19.63	25.97	20.57	23.53	23.94	9.73	10.80	39.53	42.67	5.14	5.00	26.00
T_8: Humic acid 0.2% + Novel Organic Liquid Nutrients 1%	24.23	26.10	17.67	22.30	17.86	20.87	21.40	8.13	9.73	41.20	45.00	5.02	4.67	23.33
T_9: Humic acid 0.2% + Vermiwash 3%	23.57	25.70	16.13	21.40	17.15	20.70	20.41	8.00	9.33	43.00	45.67	4.92	3.33	22.67
T_{10}: Control (No spray)	17.10	18.40	12.97	18.10	12.43	16.30	16.16	6.53	8.13	46.80	53.67	4.07	2.33	18.00
S.Em.±	1.22	1.45	0.97	1.42	1.05	1.34	1.44	0.51	0.49	1.99	2.30	0.23	0.29	1.33
C.D. @ 5%	3.62	4.30	2.88	4.21	3.12	3.98	4.27	1.51	1.46	5.92	6.84	0.68	0.87	3.96

Conclusion

On the basis of results obtained, it can be concluded that foliar application of Humic acid 0.2% + Seaweed extract 0.5% at 30 and 45 days after transplanting gives better vegetative growth and flower quality in china aster.

References

1. Ahir TR, Chawla SL, Bhatt ST, Dipal S Bhatt, Patel GD, *et al*. Response of various planting dates and varieties on performance of china aster under South Gujarat. Int J Microb Appl Sci. 2021;10(2):2025-2033.
2. Aminifard MH, Aroiee H, Azizi M, Nemati H, Jaafar ZE. Effect of humic acid on antioxidant activities and fruit quality of hot pepper (*Capsicum annuum* L.). J Herbs Spices Med Plants. 2012;18(4):360-369.
3. Bashir M, Qadri RWK, Khan I, Zain M, Rasool A, Ashraf U, *et al*. Humic acid application improves the growth, floret and bulb indices of gladiolus (*Gladiolus grandiflorus* L.). Pak J Sci. 2016;68(2):121-127.
4. Bhargavi SP, Naik HB, Chandrashekhar SY, Ganapathi M, Kantharaj Y. Efficacy of biostimulants on morphology, flowering and yield of chrysanthemum (*Dendranthema grandiflora*) cv. Kolar Local under fan and pad greenhouse. Int J Chem Stud. 2018;6(5):1831-1833.
5. Cacco G, Agnola GD. Plant growth regulator activity of soluble humic complexes. Can J Soil Sci. 1984;64(2):225-228.
6. Dhutraj SV. Effect of various bioenzymes on growth, flower yield and vase life of gaillardia. Thesis M.Sc. (Agri.). Marathwada Agricultural University, Parbhani, India; c2002.
7. Gaurav S, Naresh PS, Neeraj S. Effect of bioorganic and inorganic nutrient sources on growth and flower production of African marigold. Hort J. 2016;3(11):1-5.
8. Gawade NV, Varu DK, Devdhara U. Effect of biostimulants and biofertilizers on growth and flowering of chrysanthemum cv. Ratlam Selection. Int J Chem Stud. 2019;7(5):3423-3428.
9. Harshvardhan M, Kumar DP, Sajjan R, Rajesh AM, Yathinra HA. Influence of INM on flower quality, yield and vase life of carnation (*Dianthus caryophyllus* L.) under polyhouse. Green Farming. 2014;6(3):435-438.
10. Hegde PP, Naik HB, Beeraligappa. Growth, yield, quality and economics of chrysanthemum as influenced by foliar application of biostimulants under naturally ventilated polyhouse. Int J Curr Res. 2016;8(11):41552-41555.
11. Jemini Patel. Influence of plant growth regulators on growth, flowering and yield of china aster var. Arka Archana. Thesis M.Sc. (Horti.). Navsari Agricultural University, Navsari, India; c2021.
12. Kadam RE, Bankar GJ, Bhosale AM, Rathod RP. Effect of growth regulators on growth and flower yield of china aster. Annuls Plant Physiol. 2002;16(1):44-47.
13. Karthiraj K, Patil RF, Vasmate SD, Digrase SS, Manolikar RR. Effect of bioenzyme on growth, flower yield and vase life of china aster. Asian J Hortic. 2008;3(1):178-179.
14. Khandelwal S, Jain N, Singh P. Effect of biozymes and pinching on growth and yield of African marigold (*Tagetes erecta* L.). J Ornament Hortic. 2003;6(3):271-273.
15. Mahawer LN, Bairwa HL, Shukla A. Response of biostimulants as pre-harvest management of tuberose cut spike (*Polianthes tuberosa* L.) cv. Phule Rajani. Prog Hortic. 2010;42(1):54-57.
16. Muraleedharan A, Karuppaiah P, Joshi JL. Impact of humic acid along with growing media combination with Azospirillum and FYM on the growth, flowering and quality of *Anthurium andraeanum* plants. Int J Emerg Tech Innov Res. 2017;4(1):596-602.
17. Palanisamy, Kannan D, Sharma R, Bhatt SS, Singh A. Fertigation studies on gerbera (*Gerbera jamesonii* Bolus Ex Hooker F.) for growth and yield under cover in southern hills. Int J Trop Agric. 2015;33(1):31-36.
18. Pansuriya PB, Varu DK, Viradia RR. Response of biostimulants and biofertilizers on corm, cormels and spike yield of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty under greenhouse condition. Int J Chem Stud. 2018;6(2):2659-2663.
19. Patel RJ, Patil SJ, Bhanderi DR, Tandel BM, Patel AH. Effect of different pH levels, micronutrients and banana pseudostem sap on flowering of mango (*Mangifera indica* L.) cv. Kesar. Int J Chem Stud. 2018;6(3):1374-1376.
20. Praveen TM, Patil SR, Patil BC, Seetharamu GK, Rudresh DL, Pavankumar P, *et al*. Influence of biostimulants on growth and yield of floribunda rose cv. Mirabel. J Pharmacogn Phytochem. 2020;10(1):2701-2705.
21. Russo R, Poincelot R, Berlyn P. Use of commercial organic biostimulant for improved production of marigold cultivars. J Home Consum Hort. 1994;1(1):83-93.
22. Sankari A, Anand M, Arulmozhiyan R. Effect of biostimulants on yield and post harvest quality of gladiolus cv. White Prosperity. Asian J Hort. 2015;10(1):86-94.
23. Trivedi S. Effect of biostimulants on growth and yield in gladiolus. Thesis M.Sc. (Horti.), Navsari Agricultural University, Navsari, India; c2020. p. 33.
24. Sendhilnathan R, Velmurugan V, Manimaran P. Effect of bio regulators along with organics on growth and yield of gundumalli (*Jasminum sambac* Ait.). J Pharmacogn Phytochem. 2017;6(5):234-238.
25. Shinde D, Naik M, Bhosale A. Effect of bioenzymes on flowering, yield and vase life of marigold (*Tagetes erecta* L.). Asian J Hort. 2010;5(2):420-422.
26. Shrikant M, Jawaharlal M. Effect of fertigation level and biostimulants on yield parameters of gerbera (Gerbera jamesonii bolus ex hooker f.) Var. Debora under Poly House Conditions. Trends Biosci. 2014;7(11):1157-1161.
27. Rakesh S, Poonguzhali S, Saranya B, Suguna S, Jothibasu K. Effect of Panchagavya on Growth and Yield of Abelmoschus esculentus cv. Arka Anamika. Int J Curr Microbiol Appl Sci. 2017;6(9):3090-3097.
28. Sumangala K, Srikrishnah S, Sutharsan S. Roses growth and flowering responding to concentration and frequency of seaweed (*Sargassum crassifolium* L.) liquid extract application. Curr Agric Res J. 2019;7(2):236-244.
29. Sundararasu K, Jeyasankar A. Effect of vermiwash on

growth and yield of brinjal (*Solanum melongena*). Asian J Sci Technol. 2014;5(3):171-173.

30. Trivedi H, Kumar A. Response of bio-enhancers on growth and flowering in rose (*Rosa hybrida*) cv. Grand Gala. Int J Basic Appl Agric Res. 2015;13(1):31-37.
31. Violeta T, Lucia D, Irina S. The influence of some fertilizers and biostimulants upon the stem anatomy of *Chrysanthemum indicum* L. J Plant Dev. 2010;17(1):3-12.