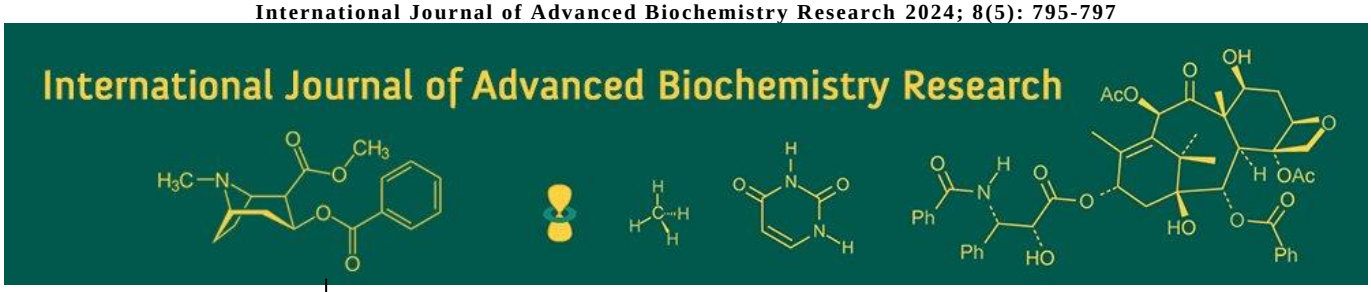

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Effect of biostimulants on growth, flowering and yield of rose (*Rosa x hybrida*) cv. Mainu Parle

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Abstract
Roses are the most popular flower in the floriculture sector globally because of their remarkable quality and quantity. They are used for cut flower production, yard beautification, and pot plant growing, among other things. Jharkhand has a burgeoning floriculture industry that grows five commercial varieties of roses, gladiolus, gerberas, marigolds, and Chrysanthemums in open fields. In Jharkhand, there are over 1.20 lakh hectares planted with flowers; the industry is expanding. (Database NHB, 2021). But since the green revolution, there are serious ecological and environmental concerns associated with the extensive use of chemical pesticides and fertilisers. There is a movement in favour of organic agricultural methods to address this problem. As a possible addition to mineral fertilisers, biostimulants have gained popularity since they may increase crop quality and production.
The effects of several biostimulants in conjunction with recommended fertiliser dosages (RDF) on the development and flowering of Mainu Parle rose cultivars were evaluated through an experiment. Out of all the therapies that were tried, RDF with humic acid (T_3) showed some significant results. The maximum plant height (86.50 cm), highest leaf count (104.68), highest number of flowering shoots per plant (11.40), longest shoot length at first flower bud appearance (34.38 cm), highest number of flowers per plant (28.20), and largest flower diameter (11.75 cm) were all displayed by plants treated with RDF + humic acid. These results demonstrate how humic acid may be used as a helpful biostimulant in rose culture, providing encouraging opportunities to increase growth and flower output while lowering dependency on chemical inputs.

Keywords: Biostimulants, growth, flowering, yield, rose, *Rosa x hybrida*

Introduction
The Rosaceae family and Rosa genus include the rose, which is frequently referred to as the "Queen of Flowers." Although there are many species in this genus, contemporary roses are the result of intentional or natural crosses between 12 well-known species. The rose is the most popular cut flower in the world's floriculture commerce because of its beauty, scent, and long blooming period. Its adaptability encompasses a range of uses, such as the production of cut flowers, garden décor, and potted plant growth.
India grows an astounding 472.86 thousand tonnes of roses per year on 37.50 thousand hectares of land. With an annual flower yield of 8.62 thousand MT from an area of 1.20 thousand hectares, Jharkhand makes a substantial contribution to this. This production shows the growing market demand for roses as it includes both cut flowers (3.81 thousand MT) and loose flowers (4.81 thousand MT). The growing demand for roses and the expanding area under production have piqued farmers' interest in improving bloom quality and yields. However, there are concerns to the environment and ecology associated with the increased use of chemical pesticides and fertilisers after the green revolution. However, a move towards more frequent but smaller-dosage fertiliser application has demonstrated promise in encouraging improved rose growth and flower output.
With their ability to stimulate a variety of physiological processes that improve plant development and nutrient utilisation, biostimulants have become a viable option for sustainable agriculture. These organic treatments, which support plant health, vitality, and growth while protecting against diseases, include fulvic and humic acids, nitrogen compounds, seaweed extracts, helpful fungi, and bacteria. They are derived from plant or animal sources and are used in both horticulture and agricultural crops.
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They can be applied topically or subsurfacely. In light of these factors, a study was carried out to determine how biostimulants affected the development and flowering of Mainu Parle rose varieties.

Materials and Methods

The experiment, conducted from October 2021 to March 2022 during the Rabi season, aimed to investigate the impact of biostimulants on the growth, flowering, and yield of rose (*Rosa x hybrida*) cv. Mainu Parle at the AICRP on Floriculture unit of the Department of Horticulture, Birsa Agricultural University, Kanke, Ranchi. It followed a Randomized Block Design with five treatments, each replicated four times. The treatments' details are as follows:

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S.N.	Annotation	Treatments	Dose
1	T_1	Recommended Dose of Fertilizers (RDF) Control	60:120:120 kg/ha NPK, FYM 20t/ha
2	T_2	RDF + Fulvic acid	3 ml/lt
3	T_3	RDF + Humic acid	3 ml/lt
4	T_4	RDF + Sea weed extract (IFFCO Sagarika)	3 ml/lt
5	T_5	RDF + IIHR – Arka Microbial Consortium (AMC)	20 g/lt

- The experiment included three foliar sprays conducted at 15, 30, and 45 days after pruning.
- AMC soil drenching was performed at 10 days after pruning, followed by subsequent applications at 4-month intervals.

Results and Discussion

In the RDF treatment, the addition of humic acid produced impressive outcomes across a range of plant growth and development metrics. The RDF + Humic acid treatment produced the maximum plant height and spread (86.50 cm), indicating that the humic acid may have promoted cell elongation and functioned as a growth regulator.

According to earlier research by Cacco and Dell Angola (1984) [3], this impact might be explained by the direct action of soluble humic complexes and the rise in endogenous hormone content, possibly through the inhibition of catabolic enzymes such IAA oxidase.

Additionally, the treatment produced the most leaves per plant (104.68), which is probably because humic acid contains auxins and cytokinins that boost antioxidant levels and delay senescence, in line with Zhang and Schmidt's findings (2000) [10].

Additionally, the RDF + Humic acid treatment produced the largest number of flowering shoots per plant (11, 40) and shoot length (34, 38 cm) at the onset of floral bud emergence. This may be explained by the gradual release of nutrients from the soil, which increases nutrient intake. It may also be caused by humus components in humic acid, which may mobilise stored food items to the sink by increasing enzyme activity.

The RDF + Humic acid treatment resulted in a higher number of blooms per plant (28.20), which may have been caused by the active phenolic groups in humic acid suppressing oxidase activity and extending the half-life of IAA in plants.

Additionally, inhibition of peroxidase activity by humic acid could contribute to this effect by preventing auxin breakdown, in line with findings by Muscolo *et al*. (1993) [6] and Aghera *et al*. (2019) [1].

Moreover, improved nutrient uptake—particularly of gibberellin-like compounds found in humic acid—may be responsible for the greatest blossom diameter (11.75) seen in the RDF + Humic acid treatment. Other research on a variety of flowering plants, including those by Ahmad *et al*. (2013) [2] and Khodakhah *et al*. (2014) [4], have shown similar results.

Table 1: Effect of biostimulants on growth and flowering of rose cv. Mainu Parle.

Treatments	Plant height (cm)	Number of leaves per plant	No. of flowering shoots/plant	Shoot length at first flower bud appearance (cm)	Number of flowers per plant	Flower diameter (cm)
T_1 : Control - Recommended Dose of Fertilizer (RDF), NPK@ 60:120:120 kg/ha, FYM@ 20 t/ha	82.25	95.26	8.80	26.42	20.13	9.00
T_2 : RDF + Fulvic acid	68.75	78.12	9.31	28.10	21.60	8.75
T_3 : RDF + Humic acid	86.5	104.68	11.40	34.38	28.20	11.75
T_4 : RDF + Sea weed extract (IFFCO Sagarika)	85.25	96.56	11.35	33.25	27.70	10.75
T_5 : RDF + IIHR – Arka Microbial Consortium (AMC)	69.25	87.81	10.32	32.25	23.40	9.75
S.E.m±	4.80	5.55	0.61	1.83	1.50	0.63
C.D. at 5%	14.80	17.09	1.88	5.65	4.62	1.94
C.V. %	12.25	11.99	11.89	11.88	12.40	12.58

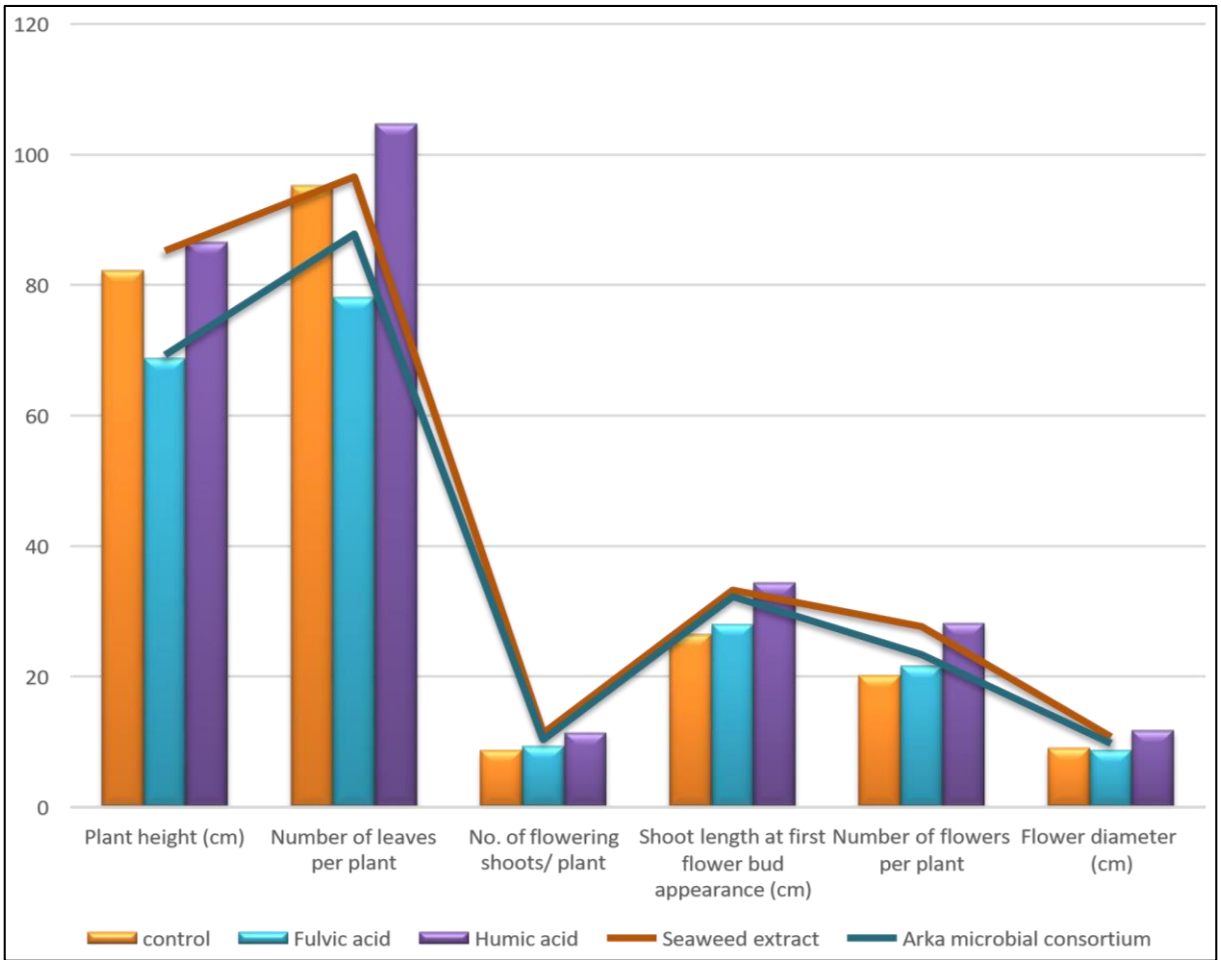

Fig 1: Effect of biostimulants on growth and flowering of rose cv. Mainu Parle

Conclusion

The Mainu Parle rose cultivar's growth and flowering properties were significantly enhanced by the use of biostimulants. The application of RDF + humic acid (HA) in T3 was the treatment that showed the greatest improvements in terms of a number of parameters, including plant height, leaf count, flowering shoot count, shoot length at the onset of flower bud appearance, flower count, and flower diameter. As a polymeric organic molecule that occurs naturally, humic acid has great promise as a natural resource to promote plant development, nutrient availability, and production.

Consequently, based on the findings, it can be inferred that the RDF + Humic acid treatment stands out as the most effective approach for enhancing both the growth and quality of roses.

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