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Influence of nano urea on growth and yield of Jamun cv. AJG-85 under HDP system

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Abstract
A field experiment was conducted to study the Influence of nano urea on growth and yield of jamun cv. AJG-85 under HDP system during the year 2021-22 at Department of Fruit Science, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot. The study revealed that treatment T_8 was shown to be the best, with the maximum incremental plant height of 0.42 m, incremental stem girth (0.48 cm), incremental plant spread [(E-W) and (N-S) of jamun *i.e*., 0.80 m and 0.53 m respectively] and incremental canopy volume (8.70 m^3) was recorded 9 months after foliar (MAF) spray. However, minimum incremental plant height was recorded under T_6 (0.16 m), incremental stem girth in T_4 (0.18 cm), incremental East-West canopy spread in T_5 (0.23 m), incremental North-South canopy spread in T_1 (0.26 m) and incremental canopy volume noticed under T_3 (3.53 m^3) treatment at 9 MAF spray. The maximum yield in kg per plant (4.93) and yield in tonnes per hectare (5.48) was noticed in plants applied with foliar spary of T_2 (100 per cent RDN through nano urea at 0.4 per cent) which was found at par with T_5 (50% RDN through urea + 0.4% nano urea) treatment. Overall concluded that application of 50 per cent RDN through urea + 0.4 per cent nano urea foliar spray was as good as 100 per cent RDN through nano urea, thereby saving 50 per cent RDN through urea.

Keywords: Nano urea, AJG-85, HDP system

Introduction
Jamun [*Syzygium cumini* (L.) Skeels] is a underutilized fruit bearing tree of Indian origin. It is also known by other common names like jambul, black plum, java plum, Indian blackberry *etc*. (Ali *et al*., 2013) [2]. It is found naturally growing in Thailand, Philippines, Madagaskar and it has been successfully introduced in many other tropical countries including West Indies, California, Algeria and Israel. Among different countries, India is the world's second-largest producer of jamun (Patil *et al*., 2012) [14]. The state of Maharashtra produces the most jamun, followed by Uttar Pradesh, Tamil Nadu, Gujarat, Assam and other states. It is one of the most hardy fruit crop and can easily be grown even in marshy areas where other fruits fail to establish (Singh *et al*., 2007) [18]. It grows well in semi-arid regions having annual rainfall of about 500 mm. The fruit is a good source of iron, sugars, minerals, proteins, carbohydrates etc. Fully ripe fruits are eaten fresh and can be processed into beverages like jelly, jam, squash, wine and vinegar. The fruit has a sub-acidic spicy flavour and makes a very refreshing squash. A little quantity of fruit syrup is useful in curing diarrhoea. Fruits are used as an effective medicine against diabetes, heart and liver troubles (Singh, 2006) [17].
Nano urea (liquid) supplies nitrogen, which is a critical ingredient for a plant's normal growth and development. The use of nano-fertilizers is the most important application of nanotechnology in agriculture so far (Agrawal and Rathore, 2014; Naderi *et al*., 2011) [1, 13]. Nano-fertilizers are aimed to make nutrients more available to leaves, consequently increasing nutrient use efficiency (Suppan, 2013) [20]. Some characteristics of nanoparticles, including the large specific surface area, unique magnetic/optical properties, electronic states and catalytic reactivity confer nanoparticles a better reactivity than the equivalent bulk materials (Agrawal and Rathore, 2014) [1]. Regarding N fertilizers, the application of nanotechnology can provide fertilizers that release N leaching and emissions and long-term incorporation by soil microorganisms (Naderi and Danesh-Shahraki, 2013; Suman *et al*., 2010) [12, 19].
In recent years, the jamun cultivation has been challenged by excessive vegetative growth, poor fruit set and fruit yield and failure to manipulate production periods and yields. Since no studies have been carried out to evaluate the effects of nano urea spray on jamun trees so far. In the light of the above facts the present investigation was carried out at Department of Fruit Science, Kittur Rani Channamma College of Horticulture, Arabhavi to study "Influence of nano urea on growth and yield of jamun cv. AJG-85 under HDP system".

Materials and Methods

Experimental details

The present investigation was carried out during the year 2021-22 at Kittur Rani Channamma College of Horticulture, Arabhavi in Belagavi district of Karnataka. Arabhavi is situated in Northern Dry Zone (Zone-3) of Karnataka. It lies between 16°15' N latitude and 74°45' E longitude, at an altitude of 612 m above mean sea level (MSL) which receives mean annual rainfall of 522 mm. The trail was set up in a randomized complete block design having 8 treatments with 3 replications. Treatment details like T_1 (100% RDN through urea), T_2 [100% RDN through nano urea (0.4%)], T_3 (50% RDN through urea + 0.2% nano urea), T_4 (50% RDN through urea + 0.3% nano urea), T_5 (50% RDN through urea + 0.4% nano urea), T_6 (75% RDN through urea + 0.2% nano urea), T_7 (75% RDN through urea + 0.3% nano urea), T_8 (75% RDN through urea + 0.4% nano urea). The present study used 9-year-old jamun trees of the variety AJG-85 (Arabhavi Jamun Gilihour-85) grown under similar cultural techniques. In general, 5 kg FYM, 50 g N, 25 g P_2O_5, and 50 g K_2O per plant per year has to be applied to one year old plant. The treatment T_2 (100% RDN through nano urea at 0.4%) was given 3 times at the concentration of 0.4 per cent [after vegetative flush (September), before flowering (February) and after fruit set (April)]. Remaining treatments from T_3 to T_8 was given 2 times at the concentration of 0.4, 0.3 and 0.2 per cent as per the treatment after vegetative flush (September) and after fruit set (April). The vegetative parameters such as incremental plant height (m), incremental plant spread (m) (E-W and N-S), incremental stem girth and incremental canopy volume (m^3) were measured at the start of the experiment and then growth parameters was measured at three months interval and these growth parameters worked out with respective units under different treatments and were compared. Canopy volume was calculated by following Castle's Formula.

$$\text{Canopy volume} = \left[\frac{NS + EW}{2}\right]^2 \times \text{Canopy height (m)} \times CF$$

Where,
NS = Plant spread in North-South direction (m)
EW = Plant spread in East-West direction (m)
CF = Correction factor *i.e.*, 0.5239

The yield parameter such as fruit yield (kg/plant) and fruit yield (t/ha) were all successfully measured to determine the best treatment combination for jamun cultivation.

Results and Discussion

Growth attributes

Effect of different levels of foliar spray of nano urea on incremental plant height (m), incremental plant spread (m) (E-W and N-S), incremental stem girth and incremental canopy volume (m^3) of jamun was depicted in Table 2. Treatment T_8 was recorded best, with the maximum incremental plant height of 0.42 m, incremental stem girth (0.48 cm), incremental plant spread [(E-W) and (N-S)] of jamun *i.e.*, 0.80 m and 0.53 m respectively and incremental canopy volume (8.70 m^3) at 9 MAF spray. However, minimum incremental plant height was recorded under T_6 (0.16 m), incremental stem girth in T_4 (0.18 cm), incremental East-West canopy spread in T_5 (0.23 m), incremental North-South canopy spread in T_1 (0.26 m) and incremental canopy volume in T_3 (3.53 m^3) at 9 MAF spray. This increase in growth parameters might be due to both soil and foliar application which leads to vigorous growth. These findings are in agreement with those of Chadha (1969) [5], Rawat (1974) [15] and Badyal (1980) [3] who also found that the growth of plum trees was improved with the increase in N doses. Increased growth of tree with N application may be attributed to increased formation and accumulation of proteins in the plants. Significant increase in leaf area with the increased N rates has also been reported by Rawat (1974) [15] and Joon (1989) [7] in plum. When sprayed on leaves, nano urea easily enters through stomata and other openings and is assimilated by the plant cells. It is easily distributed through the phloem from source to sink inside the plant as per its need. Unutilized nitrogen is stored in the plant vacuole and is slowly released for proper growth and development of the plant.

Yield attributes

Different levels of foliar spray of nano urea showed significant variation in number of fruits per plant (Table 2). The maximum fruit yield in kg per plant (4.93) and yield in tonnes per hectare (5.48) was noticed in plants applied with foliar spary of 100 per cent RDN through nano urea at 0.4 per cent which was found at par with T_5 (50% RDN through urea + 0.4% nano urea) treatment. This might be due to foliar spary of nano urea increased photosynthesis resulting in better plant growth and dry matter accumulation in addition to increase in number of flowers, fruit volume and fruit weight. The urea has helped in more fruit retention per shoot, which resulted in increasing number of fruits per plant. Similar results were found by Syamal *et al*. (2008) [21] in Kagzi lime and Dudi *et al*. (2004) [6] in Kinnow Mandrin. Kotur *et al.* (1997) [9], Khattak *et al.* (2005) [8], Kundu (2007) [11], Kumar *et al.* (2009) [10] and Cardoso *et al.* (2011) [4] were also reported similar results in guava.

Table 1: Effect of different levels of foliar spray of nano urea on incremental plant height in jamun cv. AJG-85

Treatments	Incremental plant height (m)			Incremental stem girth (cm)			Incremental E-W spread (m)			Incremental N-S spread (m)		
	3 MAF	6 MAF	9 MAF	3 MAF	6 MAF	9 MAF	3 MAF	6 MAF	9 MAF	3 MAF	6 MAF	9 MAF
T_1	0.05	0.11	0.22	0.11	0.24	0.46	0.11	0.24	0.40	0.04	0.10	0.26
T_2	0.07	0.13	0.24	0.06	0.13	0.22	0.16	0.46	0.53	0.10	0.20	0.36
T_3	0.09	0.17	0.26	0.07	0.18	0.26	0.09	0.22	0.39	0.09	0.14	0.29
T_4	0.10	0.24	0.38	0.05	0.11	0.18	0.14	0.44	0.67	0.07	0.27	0.50
T_5	0.08	0.14	0.25	0.08	0.16	0.27	0.07	0.17	0.23	0.11	0.24	0.47
T_6	0.04	0.08	0.16	0.09	0.22	0.31	0.12	0.25	0.50	0.06	0.18	0.41
T_7	0.06	0.12	0.23	0.10	0.23	0.32	0.10	0.25	0.37	0.12	0.22	0.38
T_8	0.12	0.25	0.42	0.14	0.25	0.48	0.17	0.57	0.80	0.13	0.33	0.53
Mean	0.08	0.16	0.27	0.09	0.19	0.31	0.12	0.32	0.49	0.09	0.21	0.40
S.Em±	0.01	0.02	0.03	0.01	0.02	0.03	0.02	0.03	0.04	0.01	0.03	0.04
CD at 5%	0.03	0.06	0.08	0.03	0.07	0.08	0.06	0.08	0.12	0.04	0.08	0.14

MAF: Months after foliar spray of nano urea

Table 2: Effect of different levels of foliar spray of nano urea on incremental canopy volume and yield attributes in jamun cv. AJG-85

Treatments	Incremental canopy volume (m^3)			Fruit yield (kg/plant)	Fruit yield (t/ha)
	3 MAF	6 MAF	9 MAF		
T_1: 100% RDN through urea	1.32	2.48	4.51	2.71	3.01
T_2: 100% RDN through nano urea (0.4%)	1.91	4.71	6.32	4.93	5.48
T_3: 50% RDN through urea + 0.2% nano urea	1.03	1.94	3.53	2.75	3.05
T_4: 50% RDN through urea + 0.3% nano urea	1.38	3.83	6.26	2.47	2.75
T_5: 50% RDN through urea + 0.4% nano urea	1.94	3.36	5.22	4.74	5.27
T_6: 75% RDN through urea + 0.2% nano urea	1.37	2.66	5.27	2.51	2.79
T_7: 75% RDN through urea + 0.3% nano urea	1.47	2.81	4.31	2.62	2.91
T_8: 75% RDN through urea + 0.4% nano urea	2.28	5.92	8.70	2.68	2.97
Mean	1.59	3.46	5.51	3.18	3.53
S.Em±	0.04	0.06	0.07	0.22	0.29
CD at 5%	0.12	0.18	0.20	0.69	0.90

MAF: Months after foliar spray of nano urea

In growth parameters, T_8 (75% RDN through urea + 0.4% nano urea) treatment recorded higher values for growth pararmetres but showed lesser yield and yield attributing characters because the vigorous growth of the plants resulted in intermingling of branches and leads to poor penetration of sunlight and aeration. This resulted in reduced flower production and fruit setting which was ultimately resulted in poor yield.

Conclusion

From the present investigation it may be concluded that application of 50 per cent RDN through urea + 0.4 per cent nano urea foliar spray was as good as 100 per cent RDN through nano urea, thereby saving 50 per cent RDN through urea.

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