Original Research Article

EFFECT OF FOLIAR APPLICATION OF GA_3, NAA AND UREA ON FRUIT PHYSIOLOGICAL CHARACTERSTICS OF BER *(Zizyphus mauritiana* Lamk.*)* cv. BANARASI KARAKA

ABSTRACT

Among subtropical fruits Ber (*Zizyphus mauritiana* L.) one of the most common fruit crop, grown under neglected soil types. It is a drought hardy and can grow under the most hazardous conditions of soil, water and climate and thus it has rightly been recommended for the arid and desert area of India **(Pareek, 1983)**. It is found growing wild as well as in cultivated forms throughout the warmer regions up to an altitude of 1500 metres above Mean Sea Level. The experiment comprised 13 treatments consisting of foliar spray of GA_3, NAA, Urea and control. The treatments are as follows- T_0 Control (water spray), T_1 (GA_3 @10 ppm), T_2 (GA_3 @20 ppm), T_3 (NAA @20 ppm), T_4 (NAA @40 ppm), T_5 (Urea @1.0%), T_6 (Urea @1.5%), T_7 (GA_3 @10 ppm + NAA @20 ppm + Urea @1.0%), T_8 (GA_3 @20 ppm + NAA @40 ppm + urea @1.5%). Mentioned solutions with different concentration were sprayed by foot sprayer in the morning hours and selected branches were fully drenched. On the basis of sprays of plant growth regulators i.e. GA_3 and NAA and urea as well as their combined treatments influenced different parameters in this research trial. The combined treatments of GA_3 20 ppm + NAA 40 ppm + urea 1.5% maximized initial fruit set, fruit retention, fruit volume, length of fruit, fruit diameter, fruit weight, pulp weight, pulp/stone ratio and minimized the fruit drop, stone weight content. The second effective treatment was GA_3 10 ppm + NAA 20 ppm + urea 1.0% identified in present investigation.

Key words: GA_3, NAA, Urea, PGR, Ber and Growth

1. INTRODUCTION

Ber (*Zizyphus mauriatiana*), a member of the Rhamnaceae family of tropical fruit trees, is also known as the Chinese date, Ber, Chinese apple, Jujube, Indian plum, Regipandu, Indian jujube, Dunks (in Barbados), and Masau. The ber (*Zizyphus mauritiana Lamk*.), a significant indigenous fruit of China and India, has long been connected with Indian culture. The Puranas, the Vedas, and other works of literature like the Kautilya Arthasastra, Charak Samitha, and others all make use of Ber. The sage Ved Vyas, author of "Purana" and "Mahabharat," really established his home on one of the main fruits under the Ber tree, which is why he was given the name "Badrayan" (A person living in a forest of Ber tree).

It may be found in cultivated and wild forms up to a height of 1500 meters above mean sea level throughout the tropics. Even in the subtropics and tropics' most vulnerable habitats, it may be grown effectively **(Pareek, 2001)**. Due to its strong economic returns, cheap cultivation costs, wider adaptability, and capacity to endure drought, ber is widely used **(Pareek, 1983, Chadha and Pareek, 1993)**.

The Indian jujube is indigenous to Afghanistan, Malaysia, and Queensland, Australia, all of which are located in the southern Chinese province of Yunnan. In India, Ber has been used for about 4,000 years. In spite of the fact that it regularly escapes cultivation and turns into a pest, it is planted to some extent across its native habitat, but mostly in India where it is produced commercially. The Bahamas, Colombia, Venezuela, Guatemala, Belize, the dry West Indies, and southern Florida are among the places where specimens may be found. The tree has become indigenous in Barbados, Jamaica, and Puerto Rico, where it grows in thickets in uncultivated places. In practically every region of India, it grows under a wild or semi-wild state as well as in cultivation. Uttar Pradesh, Bihar, Madhya Pradesh, Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, and Andhra Pradesh are the states that are expanding the fastest. Varanasi, Aligarh, Faizabad, Agra, and Raebareli district are major Ber-growing regions in Uttar Pradesh. It is one of the most popular and historically significant sub-tropical fruits, coming from India. Due to its hardiness and capacity for weight, it is frequently grown in a variety of soil types and weather conditions, including drought. Not many people are aware of the link between nutrition and finances. It has a great deal of promise.

It is an 8–10 m tall, spiky, tiny tree or shrub with stipular spines, a spreading crown, and numerous drooping branches. The trunk is at least 40 cm in diameter. The size and form of the fruit vary. Depending on the type, it can range in shape from oval to ovulation to round and be up to 2.5 cm (1 inch) long. Crispy white meat is present. This fruit has a lovely scent when it is somewhat underripe and is a touch moist. Smooth, shiny, thin, and tight describe the fruit's skin.

Numerous genetic, physiological, dietary, hormonal, and environmental variables have an impact on the growth of the fruit. In this context, plant growth regulators are crucial. These are employed in vegetative propagation, the artificial induction of seed lessness, the increase in fruit, the avoidance of preharvest fruit drop, the regulation of blooming, the suppression of growth, and the thinning of flowers and fruits. For enhancing blooming, fruit set, fruit drop, size, and quantity of fruit, many types of plant regulators like NAA, 2,4-D, 2,4,5-T, GA_3, and TIBA are utilized **(Bonnar, 1950; Van Overbreak, 1959)**. By stifling the pedicle, NAA (Auxin) also prevents fruit drop. The fruit pedicle has improved visibility. High auxin levels in the abscission zone stop the fruit from falling **(Brigs and Leopide, 1958; Addicot and Lynch, 1955).** Despite the fact that several scientists have occasionally worked on various fruit crops, Ber is also included in this approach. But in this aspect, they fell short.

Gibberellins are primarily utilized for controlling physiological processes and are economically employed to enhance the fruit quality of crops as Ber, Grapes, Citrus, Cherries, and Apple. It has affected the lengthening of rachis cells, thinning of flowers, and expansion of berries in grapes, three physiological processes. Citrus has also taken advantage of the impact of delayed fruit senescence caused by GA3, and more recent research reveals that GA_3 may stimulate apple blooming**. [Bankar and Prashad (1990), Kale et al. (1999), Godara et al. (2001), and Gill and Bal (2013)]** found that GA3 causes fruit set to increase and fruit drop to decrease in Ber.

2. MATERIALS AND METHODS

The present investigation entitled "Influence of foliar application of plant growth regulators and urea on fruit drop, fruit retention, growth and quality of Ber (*Zizyphus mauritiana* Lamk.) cv. Banarasi Karaka" was carried out in the Horticulture Garden Department of Fruit Science, College of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during October 2018-march 2019.

For the aim of the experiment, Banarasi Karaka Ber cultivar trees that were well-established, healthy, and uniform were chosen. The trees were kept in good condition by following appropriate fertilizer dosages and other horticultural procedures; they were around 47 years old. The entire orchard was kept tidy and uniformly maintained during the study. Nine Ber trees were harvested, and on each tree, three distinct branches were chosen and used as a single unit (for one treatment). As a result, 27 units were chosen on 9 Ber trees, and the experiment was carried out in accordance with the plan. The experiment comprised 9 treatments consisting of foliar spray of GA_3, NAA, Urea and control. The treatments are as follows- T_0 Control (water spray), T_1 (GA_3 @10 ppm), T_2 (GA_3 @20 ppm), T_3 (NAA @20 ppm), T_4 (NAA @40 ppm), T_5 (Urea @1.0%), T_6 (Urea @1.5%), T_7 (GA_3 @10 ppm + NAA @20 ppm + Urea @1.0%), T_8 (GA_3 @20 ppm + NAA @40 ppm + urea @1.5%). Mentioned solutions with different concentration were sprayed by foot sprayer in the morning hours and selected branches were fully drenched. For control there was only water spray is allowed. On November 27, 2018, during the fruit setting stage, plant growth regulators and urea were sprayed over the leaves of each treatment to deliver a homogeneous spray across the whole Ber plant treatment.

2.1 Standard Error of Mean

The standard error (S.E.) and critical difference (C.D.) values were calculated by the following method as described below,

Formula:

$$\mathbf{SE(Mean)} \pm = \sqrt{\frac{\mathbf{2MSE}}{\mathbf{r}}}$$

Where,

MSE = Mean sum of square due to error

r = Number of replications

2.2 Critical Difference

The critical difference at 5% at level of probability was workout to compare treatments means wherever "F" test will be significant.

The calculation of C.D. at 5% was calculated with the help of following formula:

C. D.= SEm ± $\sqrt{2}$ X tabulated value error d.f. at 5%

Where, C. D.= Critical difference

SE (m) ± = Standard error of mean

3. RESULTS AND DISCUSSION

On fruit drop, fruit retention, growth, and quality features, the effects of various doses of gibberellic acid, naphthalene acetic acid, and urea were examined both alone and in combination with these growth regulators. Specifically, GA_3 and NAA, two plant growth regulators. The GA_3 concentrations were maintained at 10 and 20 ppm, while NAA similarly had two values, at 20 and 40 ppm. 1.0% and 1.5% of urea are also used as treatments. Growth regulators and urea were used as a therapy combination. Water spray was used to control. In this experiment, there were 9 treatments: T_0 was the control (water spray), T_1 was GA_3 10 ppm, T_2 was GA_3 20 ppm, T_3 was NAA 20 ppm, T_4 was NAA 40 ppm, T_5 was urea 1 %, T_6 was urea 1.5 %, T_7 was GA_3 10 ppm + NAA 20 ppm + urea 1 %, and T_8 was GA_3 20 ppm + NAA 40 As a result, a total of 9 treatments were used in the experiment, evaluated against the control, and three replications in a perfectly randomized design (RBD). The findings demonstrate that all treatments, with the exception of GA_3 10 ppm (T1), which showed 157 fruit set, were shown to significantly increase fruit set compared to control (154) in all cases. The treatment T_8(GA_3 20 ppm + NAA 40 ppm + Urea 1.5 %), which resulted in a maximum 166 fruit set, was followed by T_7(GA_3 10 ppm + NAA 20 ppm + Urea 1.0 %), which produced 164 initial fruit set. Maximum fruit drop of 91.93 % was evident under the impact of control (To), and a minimal fruit set of 85.11 % was disclosed during investigation by a combination spray of T_8($GA_3$20 ppm + NAA 40 ppm + urea 1.5 ppm). Treatment T_7 (GA_3 10 ppm + NAA 20 ppm + urea 1%) was closely behind, showing a fruit decline of 85.29 %. Fruit drop rates ranged from 85.11 to 91.93 %. Maximum fruit drop was seen under the impact of treatment with T_8 (GA_3 20 ppm + NAA 40 ppm + Urea 1.5%), with a 7.42 % lower decrease than the control. Similar findings have been reported by **Umashankar *et al***. and **Zang and Lei (2000)** in guava. Under the influence of T_8, the combination of (GA_3 20 ppm + NAA 40 ppm + urea 1.5%) exhibited a maximum fruit retention of 14.89%. The control plants had a fruit retention rate of 8.07 % throughout the study year, which was notably low. When compared to control, there was an improvement of 84.51 % in the range of fruit retention, which was 8.07 to 14.89 %. Fruits treated with T_8 (GA_3 20 ppm + NAA 40 ppm + urea 1.5 %) had maximum values of 4.46 cm, 2.87 cm, and 18.28 g, respectively, for length, diameter, and weight. In this regard, the tiniest fruits measured 3.18 cm in length, 2.12 cm in diameter, and 11.02 g in weight while they were under control (T_0). The fruits ranged in size from 3.18 to 4.46 cm in length, 2.12 to 2.87 cm in diameter, and 11.02 to 18.28 g in weight, respectively. As a result, improvements in length, diameter, and weight were seen to the tune of 40.25 %, 35.38 %, and 65.88 %, respectively. The plants treated with treatment T_7 (GA_3 10 ppm + NAA 20 ppm + urea 1.0 %) showed a considerably maximum (15.47) cc fruit volume, followed closely by treatment T_8 (GA_3 20 ppm + NAA 40 ppm + urea 1.5 %), which recorded a 15.40 cc fruit volume. The untreated plants, or control (T_0), reported that the minimum 10.56 cc fruit volume was noteworthy when compared to all the other treatments. Fruit volumes ranging from 10.56 to 15.47 cc were recorded. Treatment of T_8(GA_3 @20 ppm+NAA @40 ppm +Urea @1.5%), demonstrated a significant maximum pulp weight of 17.09 g whereas the control showed a minimum pulp weight of 9.51 g during the research. The weight of the pulp ranged from 9.51 to 17.09 g. Regarding, with untreated plants(control), the greatest stone weight of 1.99 g was attained. The investigation's treatment of T_8 (GA_3 20 ppm + NAA 40 ppm + urea 1.5 %) demonstrated that the worst 0.89 g stone weight was substantial. In comparison to treatment T_8, treatments T_6 and T_7 had non-significant effects on stone weight, exhibiting 0.96 and 0.92 g of weight respectively. As compared to the therapy of T_8 as well as the control, other therapies showed a significant difference. Between 0.89 and 1.19 g were the weight range of the stones. Maximum 19.20 pulp/stone ratio was seen, which was noteworthy under the T_8 treatment (GA_3 20 ppm + NAA 40 ppm + urea 1.5%), while a much lower 7.99 pulp/stone ratio was expressed with the untreated plants (control). The range of the pulp/stone ratio was 7.99 to 19.20. Numerous genetic, physiological, nutritional, hormonal, and environmental variables have an impact on the growth of the fruit. Plant growth regulators are important in this context. These are employed in vegetative propagation, artificial seed lessness induction, fruit increase, preharvest fruit drop avoidance, flower management, growth inhibition, and thinning of flowers and fruits. Plant regulators of various kinds, such as NAA, 2,4-D, 2,4,5-T, GA_3 and TIBA, are used to enhance flowering, fruit set, fruit drop, size, and fruit quantity **(Van Overbreak, 1959; Bonner, 1950)**. NAA (Auxin) prevents fruit dropping by enlarging the pedicle and increased fruit pedicle visibility. Fruit drop is prevented by a high auxin level in the abscission zone **(Brigs and Leopide, 1958; Addicot and Lynch, 1955)**. Although there have been several studies on various fruit crops, including Ber, many scientists have also sometimes worked on this subject. However, they fell short in this area. Gibberellins are economically utilized to enhance the quality of fruit in crops as Ber, Grapes, Citrus, Cherries, and Apple. Gibberellins have primarily been employed for altering in numerous physiological events. Three physiological processes, including rachis cell elongation, floral thinning, and berry expansion, have been modified in grapes. Citrus has also taken use of GA_3's ability to prolong fruit senescence, and more recent research reveals that GA_3 may even encourage apple blooming. According to studies by **Bankar and Prashad (1990), Kale et al. (1999), Godara et al. (2001), and Gill and Bal (2013)**, GA_3 causes a rise in fruit set and a decrease in fruit loss in Ber.

Table 1. EFFECT OF FOLIAR APPLICATION OF GA3, NAA AND UREA ON Fruit set, Fruit drop (%) and Fruit retention (%)

Sr. No.	Treatments	Fruit Set	Fruit drop (%)	Fruit retention (%)
1.	T_0 Control (water spray)	154	91.93	8.07
2.	T_1 GA3 10 ppm	157	88.79	11.21
3.	T_2 GA3 20 ppm	160	88.31	11.69
4.	T_3 NAA 20 ppm	163	87.88	12.12
5.	T_4 NAA 40 ppm	164	87.43	12.57
6.	T_5 Urea 1.0 %	161	89.86	10.14
7.	T_6 Urea 1.5 %	162	89.61	10.39
8.	T_7 GA3 10 ppm + NAA 20 ppm + Urea 1.0 %	164	85.29	14.71
9.	T_8 GA3 20 ppm + NAA 40 ppm + Urea 1.5 %	166	85.11	14.89
SEM (±)		1.9048	1.5395	0.4396
C.D. at 5%		4.00	3.24	0.92

Table 2. EFFECT OF FOLIAR APPLICATION OF GA3, NAA AND UREA ON Fruit Volume, Fruit Length, Fruit Diameter and Fruit weight

Sr. No.	Treatments	Fruit volume	Fruit Length	Fruit Diameter	Fruit Weight
1.	T_0 Control (water spray)	10.56	3.18	2.12	11.02
2.	T_1 GA3 10 ppm	15.24	4.31	2.64	14.89
3.	T_2 GA3 20 ppm	14.13	4.13	2.41	15.21
4.	T_3 NAA 20 ppm	14.08	4.24	2.58	14.86
5.	T_4 NAA 40 ppm	14.03	4.10	2.38	14.65
6.	T_5 Urea 1.0 %	13.96	4.03	2.29	13.29
7.	T_6 Urea 1.5 %	14.01	4.07	2.34	13.41
8.	T_7 GA3 10 ppm + NAA 20 ppm + Urea 1.0 %	15.47	4.42	2.79	18.08
9.	T_8 GA3 20 ppm + NAA 40 ppm + Urea 1.5 %	15.40	4.46	2.87	18.28
SEM (±)		0.5440	0.1693	0.0966	0.4486
C.D. at 5%		1.14	0.36	0.20	0.94

Table 3. EFFECT OF FOLIAR APPLICATION OF GA3, NAA AND UREA ON Stone Weight, Pulp Weight, Pulp/Stone Ratio

Sr. No.	Treatments	Stone Weight	Pulp Weight	Pulp/Stone Ratio
1.	T_0 Control (water spray)	1.19	9.51	7.99
2.	T_1 GA3 10 ppm	1.09	13.49	12.38
3.	T_2 GA3 20 ppm	1.12	13.80	12.32
4.	T_3 NAA 20 ppm	1.04	13.52	13.00
5.	T_4 NAA 40 ppm	1.06	13.27	12.52
6.	T_5 Urea 1.0 %	1.01	11.98	11.86
7.	T_6 Urea 1.5 %	0.96	12.14	12.64
8.	T_7 GA3 10 ppm + NAA 20 ppm + Urea 1.0 %	0.92	16.85	18.31
9.	T_8 GA3 20 ppm + NAA 40 ppm + Urea 1.5 %	0.89	17.09	19.20

SEM (±)	0.0516	0.65	0.6147
C.D. at 5%	0.11	1.37	1.30

Conclusion

In this study, many parameters were altered by the application of plant growth regulators, specifically GA3, NAA, and urea, as well as by their combination treatments. The combined treatments of GA3 20 ppm + NAA 40 ppm + urea 1.5 % maximized initial fruit set, fruit retention, fruit volume, length of fruit, diameter, fruit weight, pulp weight, pulp/stone ratio, total soluble solids content, ascorbic acid, and total sugar and minimized fruit drop, stone weight, and acidity content. In the current study, GA3 10 ppm + NAA 20 ppm + urea 1 % was shown to be the second efficient therapy. The scenario of findings shown that the combination therapy of GA3 20 ppm + NAA 40 ppm + urea 1.5 % was discovered to be more successful in the current experiment. Therefore, it is suggested that researchers, orchardists, farmers, and students spray this therapy on Ber trees in order to increase productivity and earn more money.

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