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Research Article

EFFECT OF FOLIAR APPLICATION OF NAA ON YIELD AND ECONOMICS OF BER (*Ziziphus mauritiana* Lamk.) Cv. GOLA

SINGH D.* AND CHANDRA Y.S.

[1]College of Agriculture, Kumher, 321201, Bharatpur, Sri Karan Narendra Agriculture University, Jobner, 303329, Jaipur, Rajasthan, India
[2]ICAR-Krishi Vigyan Kendra, Navgaon,301025, Alwar, Sri Karan Narendra Agriculture University, Jobner, 303329, Jaipur, Rajasthan, India
*Corresponding Author: Email - dsingh.kvk.dholpur@sknau.ac.in

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Abstract: The experiment was conducted to find out the effect of foliar application of NAA on yield and economics of ber (*Ziziphus mauritiana* Lamk.) cv. Gola at Bharatpur, Rajasthan. Foliar application of plant growth regulator Nephthalene acetic acid (NAA of an auxin group) @ 10 ppm twice in second week of October and November recorded higher yield of fruits (136.5 q/ha) as compared the yield (121.68 q/ha) recorded in control (farmer's practice). There was 12.18 % increase in yield over control. The technology gap in productivity (13.5 q/ha) was computed. The Technology index value (9.0 %) was recorded. By conducting on-farms testing of proven technology of foliar application of plant growth regulator NAA, yield potential of ber can be increased by reduction in flower and fruit drop.

Keywords: *on farm- testing, Ber, NAA, Auxin, Technology gap and Technology index*

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Introduction

Ber (*Ziziphus mauritiana* Lamk.) is an important indigenous sub-tropical fruit crop of India and China that belongs to the family Rhamnaceae. It is well known for its specificity on hardiness and adaptive capacity in the adverse soil and climatic condition. It is one of the fruit crops which can give good returns even under rainfed conditions and can be grown in a variety of soils and climatic conditions [1]. It is popularly known as 'king of arid fruit' and 'poor man's fruit'. It is considered as religious fruit of India, grown at various religious places of Hindus, Muslims and Sikhs. The tree is associated with Lord Shiva, whose worship is considered incomplete without offering of jujube fruits especially during Mahashivaratri. This fruit crop is commonly grown in India, China, Afghanistan, Iran, Russia, Syria, Myanmar, Australia and USA. India ranks first among the ber growing countries of the world with an area of 52000 ha area producing 6.39 lakh MT of fruits [2].The major growing regions are Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana, Punjab, Gujarat, Bihar, Maharashtra, Andhra Pradesh and Tamil Nadu. Ber is a nutritious and delicious table fruit. It is more nutritious than apple. The fruit is a rich source of ascorbic acid, vitamin B- complex and minerals and the root, stem bark, flower and seed are used in Ayurveda to treat indigestion, headache, cough etc. Ripe fruits are eaten fresh and utilized in the preparation of jam, jelly, preserve and candy and it can be dried to prepare a product similar to "chuhhara". Ber juice can be prepared from the fresh fruit and can be used for making squash. The fruit is born in the axils of leaves on the young growing shoot of the current year. Hence, a regular annual pruning is necessary to induce a good healthy growth which will provide maximum fruit bearing area on the tree. The tree as a whole has multipurpose uses .The leaves are used as fodder for sheeps, cattle and camels and to feed tassar silk-worms. The ber tree can serve as a host to lac insects, bark is used in tanning industry, wood is used for making charcoal etc. Moreover, there is huge scope for ber fruit processing, as several products like chutney, dried ber, murabba, candy, squash, nectar, beverage and jam can be prepared.

The ber is a hardy plant and shows summer deciduous nature (dormancy) and can grow under low inputs which makes the plant sustain salinity and drought and becomes a popular fruit crop of arid and semi-arid regions. It needs proper care and adequate plant management. Generally, ber growers faced various problems like flower and fruit drops, poor fruit setting and low and inferior quality yield . These problems occur due to various factors, *i.e.*, improper nutrition management, inadequate cultivation practices, disease, pest and changes in environment variables. Plant nutrition help in the production of raw materials that require to the plant to sustained normal growth. However, the hormones help in translocation of raw materials and regulate the normal physiological process in plants. Imbalance of hormones in the plant altered normal physiological processes [3] that directly affects on the reproductive response of the plants. Plant growth regulators play a great role in the regulation of physiological phenomena, growth, yield and quality of various fruit crops [4]. Dropping of immature flower and fruit from the mature tree is a natural tendency of the ber crop. It is a major constraint in ber production. Normally in ber, the number of fruit set is very high, but the extent of fruit retention varies according to the cultivar type and on the level of production of endogenous plant hormones [5]. Generally, fruit drop occurs due to imbalance of auxin in the plants. If auxin level reduces and the concentration of Abscisic acid (ABA)increases that results in the formation of the abscission layer and dropping of the fruits. Exogenous applications of plant growth regulator can effectively control the fruit drop in ber (14). These findings are in line with Choudhary, *et al*., (2020) [6], Naseem, *et al*., [7] in ber. Hence, to popularize the use of NAA amongst farmer an on- farm testing was conducted.

Material and Methods

An on-farm testing was conducted in Bharatpur district of flood prone eastern plain (3b) zone of Rajasthan to see the effect of foliar application of NAA on yield and economics of ber during 2018-19 and 2019-20 at 5 farmer's field. Soils of experiential fields were sandy loam in texture, medium in nitrogen, phosphorus & potash with saline reaction. The 20 trees of more than 20 years of age, having uniform growth were selected for the experiment at each farmer's field. The standard cultural operation were practiced commonly in the both treatments. For preparation of NAA solutions, a stock solution was made. In first 20 mg NAA was dissolved in minute quantity of absolute alcohol and then the volume was made upto 1000 ml by adding distilled water. In the treatment T_2 (technology demonstration) foliar application of NAA @ 10 ppm twice in second week of October and November was also done additionally by a power sprayer having very fine nozzle in morning hours to fully cover completely the whole tree.

Table-1 Yield, technology gap, extension gap and technology index

Variable	Yield (q/ha)	Increase over farmers' practice (%)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
T_1. Farmer's practice	121.68				
T_2 .The foliar application of NAA @ 10 ppm twice in second week of October & November	136.5	12.18	14.82	13.5	9
Additional in T_2 treatments application	14.82				

Table-2 Economics (average of 2 years) of ber production under on-farm testing

Technology option	Yield q/ha)	Cost /ha (₹)	Gross return ₹/ha	Net return ₹/ha	Benefit : cost ratio
T_1- Farmer's practice	121.68	18500	182520	164020	01:09.9
T_2 -The foliar application of NAA @ 10 ppm twice in second week of October & November	136.5	19500	204750	185250	01:10.5
Additional in T_2 treatment application	14.82	1000	22230	21230	* 21.25

The data on cost of cultivation, production, productivity, total return and net return were collected in both treatments as per schedule. Average of cost of cultivation, yield and net returns were analyzed by formula.

Average = [F_1+ F_2+F_3.....Fn]/N

Where, F_1 = Farmer

N = Number of farmers

Technology index was operationally defined as the technical feasibility obtained due to implementation of demonstration (on- farm testing) in fennel. To estimate the technology gap, extension gap and technology index following formula was used [8].

Technology gap = Pi (Potential yield) - Di (Demonstration yield)

Extension gap = Di (Demonstration Yield) - Fi (Farmers yield)

Technology index = [(Potential yield-Demonstration yield) / Potential yield] X 100

Results and Discussion

Performance of on farm testing

Foliar application of NAA @ 10 ppm twice in second week of October and November recorded the higher yield (136.5 q/ha.) than farmer's practice (121.68 q/ha). The percentage increase in the yield (12.18 %) over farmer's practice was recorded. Reduction in yield under farmer's practice might be due to dropping of immature flowers and fruits from the mature tree is a natural tendency of the ber crop. This problem might be caused due to imbalance of hormones in the plant altered normal physiological processes [9] that directly affects the reproductive response of the plants. If the activity of the plant growth promoter auxin decreases and activity of the plant growth inhibitor Abscisic acid (ABA) increases in plants, might have caused formation of abscission layer which might have caused flower & fruits drop ultimately decreased the fruit yield. Maximum fruit drop occurred during early fruit development stage in ber [10].

Exogenous application of the growth promoter like NAA is known to involve in the initiation of cell division in the cambium, inhibition of cellulose and pectinase activities and Abscisic acid (ABA) production which might have reduced the premature flower drop thus, retention of fruit is increased. Plant sprayed with growth regulators remained physiologically more active to build up sufficient food reserve (source) for developing flowers and fruits (sink). The application of plant growth promoter NAA exhibited significant influence on fruits yield. NAA might be responsible for increase in photosynthetic activities within the plant which might resulted in more production of carbohydrates and related products responsible for increase in growth and yield.

These findings are in accordance with others findings Bankar and Prasad (1990) [11], Ghosh, *et al*., (2008) [12] in ber. Moreover, the spraying of auxins prevented the dropping of fruit by maintaining the cells at the zone of abscission, preventing the synthesis of hydrolytic enzymes, such as cellulase, which decomposed the cell walls. Similarly, Agrawal and Dikshit (2008) [13], Gill and Bal (2009) [14] observed that NAA (30 ppm) spray was better for fruit retention. Reduction in fruit drops in ber with NAA applications have also been reported by National Horticulture Board (2019), Bal, *et al*., (1984) [15]. Foliar application of NAA 40 ppm as well as 30 ppm minimized the fruit drop and maximized the fruit yield of ber [16]. Das, *et al*., (2020) [17] concluded that NAA 20 ppm increased fruit set, fruit retention, least fruit drop of ber fruits. Endogenous auxin which prevents the formation of abscission layer possibly through the inhibition of enzymatic activity such as pectinase, cellulose and also poly alactauronase in ber.

There is correlation between fruit drop and endogenous hormonal status, and existence of high level of internal auxin prevents fruit drop [18-23].

Thus, it is evident that performance of technology tested was found to be better than the farmers practice under the same environmental conditions. The farmers were motivated by seeing the results in term of productivity and they are adopting the technology. The yield under on- farm testing and potential yield of crop was compared to estimate the yield gaps which were further categorized into technology index and technology gap.

The technology gap showed the difference between potential yields over demonstration (on- farm testing) yield of the technology. The potential yield of the variety is 150 q/ha. The technology gap 20 q/ha was recorded. The on-farm testing was laid down under the supervision of Krishi Vigyan Kendra's specialists at the farmers' field, there exist a gap between the potential yield and demonstration yield. This may be due to the soil fertility and weather conditions. Comparative high extension gap (12.5 q/ha) indicates that there is need to educate the farmers and help them for optimizing the yield by adopting improved practices. More use of improved technologies by the farmers will subsequently change existing trend of extension gap. Technology index shows the feasibility of technology at farmers' field. The lower value of technology index, more is feasibility of particular technology. The result revealed that technology index value 9.0 % [Table-1]. It means the technology is suitable for Bharatpur district of flood prone eastern plain zone of Rajasthan.

The economic analysis of ber production revealed that treatment T_2, Foliar application of NAA @ 10 ppm twice in second week of October and November recorded higher gross return (Rs. ₹ 2,04,750/ha) and net return (₹ 1,85,250/ha) with higher benefit: cost ratio (1:10.5) as compared to farmer's practice. Initial fruit set, fruit retention and yield were profoundly hastened due to spraying of GA3 40 ppm + NAA 20 ppm, with minimized fruit drop [24-27]. Highest fruit yield promoted cost benefit ratio for obtaining more return. An additional cost of ₹ 1000/ha has increased additional net return ₹ 21,230/ha with incremental benefit : cost ratio 21.25 suggesting higher profitability and economic viability [Table-2].

Application of research

To popularize the technology of application of NAA among ber growers to reduce flowers and fruis drop to increase yield and return.

Research Category: Farm testing, Agriculture economics

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****Principal Investigator or Chairperson of research: Dr Dilip Singh**
University: Sri Karan Narendra Agriculture University, Jobner, 303329, India
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Study area / Sample Collection: Bharatpur district

Cultivar / Variety / Breed name: Ber (*Ziziphus mauritiana* Lamk.) Cv. Gola

Conflict of Interest: None declared

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Ethical Committee Approval Number: Nil

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