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Study on the Growth of Seedlings and the Establishment of Bael Varieties under Prayagraj Agro-climatic Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The objective of the experiment was to work out the studies on the growth of seedlings and the establishment of Bael varieties under Prayagraj agro-climatic conditions. So, a field experiment was conducted during session 2023-2024 at, the Department of Horticulture, Sam Higginbottom University Agriculture, Technology and Sciences, (SHUATS), Prayagraj (U.P). The experiment was conducted in a randomized block design with 6 varieties (treatments). The treatments were V1 Narendra Bael-7, V_2 Narendra Bael-6¸V3 Narendra Bael-4, V4 Narendra Bael-5¸V5 Narendra Bael-9 and V6 Banarashi.V6 was found to be superior in term of survival percentage (94.60%) and mortality percentage (5.40 %). Plant height (71.29 cm), length (13.50 cm), width (9.80 cm), number

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of leaves plant -1(81.52), number of branches plant-1(8.76), leaf area (85.00 cm2) leaf area index (106.20), plant spread (7.27 cm2), chlorophyll content (68.33) The research will help the farmers to select superior a variety of Bael under Prayagraj agro-climatic conditions.

Keywords: Bael; varieties; different; planting; banarashi.

1. INTRODUCTION

Bael (*Aegle marmelos*) an important underutilized indigenous fruit crop of India, belongs to the family Rutaceae. It is a subtropical and deciduous tree, that is very hardy and can thrive well under diverse agro-climatic conditions [1]. The fruit is very hardy and can grow even under adverse agro-climatic conditions. Most tropical and subtropical fruits have poor keeping quality but bael fruit can be kept for a longer period because of its hard outer shell and as, it can easily withstand transport and marketing hazards [2]. It can easily be grown on eroded soil in adverse climatic conditions where most of the other fruits cannot be grown easily. It is a sacred tree in Hinduism, and is offered in prayers of Hindu deities Lord Shiva and Parvati; thus, the tree is also known by the name 'Shivaduma' (The Tree of Shiva).

Farmers are experiencing the challenges of identifying cultivars as they are unfamiliar with the characteristics of many varieties of bael. In order to identify distinct characters of various bael cultivars, the morphological characters are equally important to the fruit characters. In the absence of a suitable genotype, desirable growth, flowering and fruit set have not been accomplished. Identification of suitable genotype for the region is necessary for promoting the productivity, production and quality of the fruits under semi-arid conditions. However, enormous variability in bael still remains unexploited and awaits proper attention on exploration, collection and maintenance of germplasms for conserve them from the available genetic diversity of bael in the nature.

Traditionally, morphological characters have been used to identify and characterize the bael. However, there is a high level of genetic variability which can sometimes be used accurately to distinguish each tree. When morphological traits are used for determining diversity and relationships among plant species, they are not sufficient because of environmental influences. Thus, the usefulness of molecular markers has been investigated as a means of characterizing and discriminating against different species more precisely [3]. The degree of similarity between the banding patterns provides information about genetic similarity and relationships between the samples studied. The application largely depends on the type of markers employed, the distribution of markers in the genome the types of loci they amplify, the level of polymorphism and the reproducibility of the products. Among the molecular markers, RAPD and ISSR markers have been extensively used to study genetic diversity and relationships. These markers can detect polymorphism in a single reaction [4].

2. MATERIALS AND METHODS

This experiment was laid out from July 2023 to January 2024 at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The horticulture research farm is situated at 25^0 39" 42" N latitude, 81^0 67" 56" E longitude and at an altitude of 98 m above mean sea level. The treatment consisted of V_1 Narendra Bael-7, V_2 Narendra Bael-6¸V_3 Narendra Bael-4, V_4 Narendra Bael-5¸V_5 Narendra Bael-9, V_6 Banarashi. The experiment was laid out in a randomized block design with six treatments. Data recorded on different aspects of the fruit crop, *viz.,* growth and establishment were subjected to statistical analysis by the analysis of variance method. (Gomez and Gomez, 1984) and economic data analysis using mathematical methods.

3. RESULTS AND DISCUSSION

3.1 Survival Percentage

The data of survival percentage of Bael as well as the growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 1.

The data reveals that the survival percentage of Bael increased significantly by the application of different bael varieties essence under experiment over the control. The maximum survival percentage of Bael in V6 (94.60) was recorded with treatments V1 (NB7) recorded, while the

minimum (66.67) was recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced the survival percentage of Bael.

Variation in survival percentage may be due to the genetic makeup of the genotypes, environment and edaphic factor as well. These lines are in conformity with the results of Dhaker et al. [5] and reported Parihar and Pandey [6].

3.2 Mortality Percentage

The data of mortality percentage of Bael as the growth of seedlings of different Bael varieties in Prayagraj agro-climatic region is summarized in Table 1.

The data reveals that the mortality percentage of Bael increased significantly by the application of different Bael varieties essence under experiment over the control. The maximum mortality percentage of Bael (33.33) was recorded with treatment V5 (NB9) recorded, while the minimum (5.40) was recorded treatment V6. Further, the interaction effect of *varieties* significantly influenced the mortality percentage of Bael.

This variation in mortality percentage might be governed by the genomic character associated with the genotypes and also by favorable climatic condition. Similarly results are also found in Uddin et al. [7].

3.3 Bud Breaks

The data on Bud breaks of Bael as growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 1.

The data reveals that the Bud breaks of Bael increased significantly by the application of different Bael varieties essences under experiment over the control. The maximum Bud breaks of Bael length and width (13.50 and 9.80) were recorded with treatment V6 (Banarashi), while the minimum length and width (11.50 and 7.00) were recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced the bud breaks of Bael.

This variation in length and width might be due to the genotypic and phenotypic characteristics associated with the genotypes and also to existing environmental condition. The result was in agreement with previous authors Parihar and Pandey [6].

3.4 Leaf Area (cm^2)

The data of leaf area unit of Bael as the growth of seedlings of different Bael varieties in Prayagraj agro-climatic region are summarized in Table 1.

The data reveals that the Leaf area unit of Bael increased significantly by the application of different Bael varieties essences under experiment over the control. The maximum leaf area unit of Bael with (85) were recorded with treatment V6 (Banarashi), while the minimum (67) were recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced the leaf area unit of Bael.

Variation in leaf area may be due to their genetic variability and also might be due to physiological and metabolic changes in the growth and development of tree. This study is also in accordance with the result of Parihar and Pandey [6].

3.5 Leaf Area Index

The data of leaf area index of Bael as the growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 1.

The data reveals that the leaf area index of Bael increased significantly by the application of different Bael varieties essence under experiment over the control. The maximum leaf area index of Bael with (106.20) were recorded with treatment V6 (Banarashi), while the minimum (76.52) were recorded with treatment V2. Further, the interaction effect of *varieties* significantly influenced the leaf area index of Bael.

The difference in leaf area index might be due to the varietal character associated with the genotypes. Similar results have been reported by Bhawna and Misra [8].

3.6 Chlorophyll Content (SPAD Value)

The data of chlorophyll content (SPAD value) as well as the growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 1.

The data reveals that the chlorophyll content (SPAD value) of Bael increased significantly by the application of different Bael varieties essence under experiment over the control. The maximum chlorophyll content (SPAD value) of Bael (68.17) were recorded with treatment V6 (Banarashi), while the minimum (55.54) were recorded with treatment V4. Further, the interaction effect of *varieties* significantly influenced the chlorophyll content (SPAD value) of Bael.

An increase in chlorophyll content could have been positively associated but it's negatively associated with leaf area. Similar variation in chlorophyll content could be due to the inherited genetic makeup of the genotypes. The findings are in agreement with the findings of Nagar et al., [9].

3.7 Plant Spread Area (cm^2)

The data on plant spread area of Bael as well as the growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 2.

The data reveals that the Plant spread area of Bael increased significantly by the application of different Bael varieties essences under experiment over the control. The maximum plant spread area of Bael (7.27 cm^2) were recorded with treatment V6 (Banarashi) at 180 DAP, while the minimum (4.34 cm^2) at 180 DAP of were recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced the plant spread area of Bael.

The difference in plant spread area may be due to the plants inherited genetic character and also might be due to physiological and metabolic changes like chlorophyll and photosynthetic activity involved in the color variation of the leaf. The observations were in agreement with the results of Abhilash et al., [10].

3.8 Number of Branches

The data numbers of branches of Bael as well as the growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 2.

The data reveals that the numbers of branches of Bael increased significantly by the application of different bael varieties essence under experiment over the control. The maximum numbers of branches of Bael (8.76) were recorded with treatments V6 (Banarashi) at 180 DAP, while the minimum (6.44) at 180 DAP of were recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced the numbers of branches of Bael.

A greater variation in the numbers of branches among the genotypes might be due to the abundance of genetic variability associated with their genotypes. These observations were in conformity with the results of Parihar and Pandey [6].

3.9 Numbers of Leaves

The data numbers of leaves of Bael as well as growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 2.

The data reveals that the numbers of leaves of Bael increased significantly by the application of different Bael varieties essence under experiment over the control. The maximum numbers of leaves of Bael (81.52) were recorded with treatments V6 (Banarashi) at 180 DAP, while the minimum (56.50) at 180 DAP were recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced the numbers of leaves of Bael.

Such variation in the numbers of leaves may be due their better photosynthetic activity and their utilization for building up new cells and it also might be due to the genomic constitution of individual genotypes. Such variation in leaf shape was previously reported by Jana et al. [11].

3.10 Plant Height after Transplanting

The data plant height after transplanting of Bael as well as the growth of seedlings of different Bael varieties in the Prayagraj agro-climatic region are summarized in Table 2.

The data reveals that the plant height after transplanting of Bael increased significantly by the application of different bael varieties essences under experiment over the control. The maximum plant height after transplanting of Bael of (71.29 cm) was recorded with treatments V6 (Banarashi) at 180 DAP, while the minimum (57.70 cm) at 180 DAP were recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced the Plant height after transplanting of Bael.

Table 1. Study on establishment of seedlings of Bael varieties under Prayagraj agro climatic conditions

Varieties Notation	Varieties Name	Bud Break						
		Survival Percentage	Mortality percentage	Length (cm)	Width (cm)	Leaf area (cm^2)	Leaf area index	Chlorophyll content (SPAD value)
T_1	NB7	91.89	8.11	13.20	9.60	82.00	105.42	68.17
T_2	NB6	91.40	8.60	11.60	9.50	76.00	79.58	56.54
T_3	NB4	90.79	9.30	11.50	8.00	79.00	94.34	64.42
T_4	NB5	88.89	11.11	12.10	9.50	75.00	98.67	60.22
T_5	NB9	66.67	33.33	11.50	7.00	67.00	76.52	55.54
T_6	BANARASHI	94.60	5.40	13.50	9.80	85.00	106.20	68.33
	F-test	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	SEm(±)	2.17	2.17	0.53	0.39	3.36	4.22	0.15
	CD (p=0.05)	7.64	3.47	1.09	0.80	6.92	8.69	0.34

Table 2. Study on growth of seedlings of Bael varieties under Prayagraj agro climatic conditions

Varieties Notation	Varieties Name	Plant spread area (cm^2) 180 DAT	Number of branches 180 DAT	Number of leaves 180 DAT	Plant height (cm) 180 DAT
T_1	NB7	6.83	8.53	76.55	70.07
T_2	NB6	5.83	8.35	74.30	69.38
T_3	NB4	5.69	8.43	73.37	65.11
T_4	NB5	4.60	7.56	56.55	60.53
T_5	NB9	4.34	6.44	56.50	57.70
T_6	BANARASHI	7.27	8.76	81.52	71.29
	F-test	**S**	**S**	**S**	**S**
	SEm(±)	0.26	0.31	3.02	2.60
	CD (p=0.05)	0.53	0.64	6.22	5.36

This variation in plant height might be due to plant inherit genetic character and existing climatic condition. Similar findings are in agreement with the results of Singh et al., [12], [13,14].

4. CONCLUSION

From the present investigation it may be concluded that Bael (*Aegle marmelos*) Variety Banarashi resulted in the highest survival percentage and vegetative growth parameters like plant height, number of leaves per plant, number of branches per plant, plant spread (e-w), plant spread (n-s), leaf area, leaf area index and chlorophyll content (SPAD value).

The research will help the farmers to select superior variety of Bael under Prayagraj agro-climatic condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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