Original Research Article

Study on thegrowth of seedlings and establishment of Bael varieties under Prayagraj ~~agro~~ agro-climatic conditions

Abstract

The objective of the experiment was to work out the ~~Studies~~ studies on the growth of seedlings and the establishment of Bael varieties under Prayagraj ~~agro~~ agro-climatic conditions. So, a field experiment was conducted during session 2023-2024 atthe~~,~~ Department of Horticulture,Sam Higginbottom University Agriculture, Technology, and Sciences~~,~~ (SHUATS), Prayagraj (U.P.). The experiment was conducted in a randomized block design~~Randomized Block Design~~ with6~~Variety~~ variety (treatments) replicated thrice. The treatments were 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, and V_6 Banarashi.V_6 was found to be superior in ~~the~~ term of ~~Survival~~ survival ~~Percentage~~ percentage (94.60%)~~,Mortality~~ and mortality percentage (5.40%). Plant height (71.29 cm), length (13.50 cm), width (9.80 cm), ~~Number~~ number of leaves plant $^{-1}$(81.52), ~~Number~~ number of branches plant^{-1}(8.76), leaf area (85.00 cm^2),leaf area index (106.20), ~~Plant~~ plant spread (7.27 cm^2), ~~Chlorophyll~~ chlorophyll content (68.33) The research ~~conduct~~ will help the farmers to select a superior variety of Bael under Prayagraj agro-climatic conditions.

Keyword: Bael, Varieties,Different, Planting, Banarashi

INTRODUCTION

Bael (*Aegle marmelos*)~~,is~~ animportant underutilized indigenous fruit crop of India, belongs to the family Rutaceae. It is a subtropical and deciduous tree~~,which~~ thatis very hardy and can thrive well under diverse agro-climatic conditions **(Singh *et al.*, 2020).** The fruit is very hardy and can grow even under adverse agro-climatic conditions. Most ~~of the~~ tropical and subtropical fruits have ~~a~~ poor keeping quality, but bael fruit can be kept for a longer

period because of its hard outer shell and because ~~as,~~ it can easily withstand transport and marketing hazards **(Singh *et al.*, 2018).** It can easily be grown on eroded soil ~~and~~ inadverse 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 ~~and~~ ;thus, the tree is also known by the name 'Shivaduma' (The Tree of Shiva).

Farmers are experiencing the challenges of identifying the 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 ~~has~~ havenot been accomplished. Identification of suitable genotypes for the region is necessary for promoting ~~its~~ theproductivity, production, and quality of the fruits under semi-arid conditions. However, enormous variability in bael still remains unexploited, and ~~awaited~~ proper attention is awaited on the exploration, collection, and maintenance of germplasms ~~for~~ to conserve the ~~conserving them from~~ 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 ~~the~~ 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 **(Benharrat *et al.*, 2002).**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~~type~~ 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.~~relationship.~~ These markers can detect polymorphism in a single reaction **(Mahantheshkumar*et al.*, 2020).**

MATERIALS AND METHODS

This experiment was laid out from~~during the~~July2023 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.

Theexperimentwaslaidoutina~~Randomized~~randomized~~Block~~block~~Design~~design with~~6~~six treatmentsand replicated three times~~thrice~~.Datarecordedondifferentaspectsof the fruit crop,*viz.*,growth and establishment,were subjected to statistical~~statistically~~ analysis by the analysis of variance method. (**Gomez and Gomez, 1984)** and economic data analysis using mathematical methods.

RESULTSANDDISCUSSION

Survival percentage

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

The data reveals that the ~~Survival~~ survival percentage of Bael increased significantly by the application of different bael varieties essence under experiment over the control. The maximum s~~urvival~~survival percentage of Bael~~of~~ inV6(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~~ survival percentage of Bael.

Variation in survival percentage may be due to the genetic makeup of the genotypes, environment,and edaphic factor as well~~also~~. These lines are in conformity with the results of**Dhaker *et al*. (2019)**and**Parihar and Pandey (2019)**.

Mortality percentage

The data~~Mortality~~ mortality percentage of Bael as growth of seedlings of different ~~bael~~ Bael varieties in the Prayagraj ~~agro~~ agro-climatic region~~are~~ issummarized in ~~table~~ Table 1.

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

This variation in mortality percentage might be governed by the genomic character associated with the genotypes and also by favorablefavourable climatic conditions. Similarly,results are also found infindings with **Uddin*et al.*, (2016).**

Bud breaks

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

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

This variation in length and width might be due to the genotypic and phenotypic characteristicscharacter associated with the genotypes and also due to existing environmental conditions. The result was in agreement with previous authors**Parihar and Pandey (2019).**

Leaf area (cm^2)

The dataon Leaf leaf area units of Bael as well as the growthas growth of seedlings of different bael Bael varieties in the Prayagraj agro agro-climatic region are summarized in table Table 1.

The data reveals that the Leaf leaf area unit of Bael increased significantly by the application of different bael Bael varieties essence under experiment over the control. The maximum Leaf leaf area unit of Bael(85) was recorded with treatments V6 (Banarashi) recorded, while the minimum (67) was recorded with treatment V5. Further, the interaction effect of *varieties* significantly influenced theLeaf 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 trees. This study is also in accordance with the results of **Parihar and Pandey (2019).**

Leaf area index

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

The data reveals that the ~~Leaf~~ leaf area index of Bael increased significantly by the application of different ~~bael~~ Bael varieties essence under experiment over the control. The maximum ~~Leaf~~ leaf area index of Bael(106.20) was recorded with treatment~~s~~ V6 (Banarashi) ~~recorded~~, while the minimum (76.52) was recorded with treatment V2. Further, the interaction effect of *varieties* significantly influenced the~~Leaf~~ 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 (2011).**

Chlorophyll content (SPAD value)

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

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

An increase~~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~~inherit~~ genetic makeup of the genotypes. The findings are in agreement with the findings of**Nagar *et al*.~~,~~ (2018).**

Plant spread area (cm^2)

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

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

The difference~~Difference~~ in plant spread area may be due to the plant's~~it's~~ inherit genetic character and also might be due to physiological and metabolic changes like chlorophyll and

photosynthetic activity involved in the colorin colour variation of the leaf. The observations were in agreement with the results of **Abhilash *et al*., (2018).**

Number of branches

The dataNnumbers of branches of Bael aswell as thegrowth of seedlings of different bael Bael varieties in the Prayagraj agro agro-climatic region are summarized in Table 2.

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

A greater variation in the numbers of branches among the genotypes might be due to the abundance ofthe presence of abundant genetic variability associated with their genotypes. These observations were in conformity with the results of **Parihar and Pandey (2019).**

Numbers of leaves

The dataNnumbers of leaves of Bael as well as thegrowth of seedlings of different bael Bael varieties in the Prayagraj agro agro-climatic region are summarized in Table 2.

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

Such variation in the numbers of leaves may be due to theirit's better photosynthetic activity and their utilization for building up of 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*., (2014).**

Plant height after transplanting

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

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

This variation in plant height might be due to the plant's~~it's~~ inherit genetic character and existing climatic conditions. Similar findings are in agreement with the results of**Singh *et al*.~~,~~ (2018).**

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~~/~~perplant, number of branches~~/~~perplant, plant spread (e-w), plant spread (n-s), leaf area, leaf area index, and chlorophyll content (SPAD value).

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

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

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