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Effect of Different Treatments on Seed Germination and Seedling Growth of Burmese Grape (*Baccaurea sapida* Muell. Arg.)

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Abstract

The experiment was carried out during the months of July, 2017 to September, 2019 at instructional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal to evaluate the role of different chemicals on seed germination and seedling growth behaviour. Among the minor fruit crops, Burmese grape (*Baccaurea sapida* Muell. Arg.) was one of the most popular and potential minor fruit. The plants were propagated through seeds and seeds were recalcitrant in nature. The maximum germination percentage (%), germination value and mean germination time (days) were recorded. The data recorded from the experiment revealed that the seeds treated with thiourea 100 ppm for 12 hrs (T_8) showed highest germination percentage(68.17%) followed by T_4 (63.94%). The germination value was recorded highest in T_8 (6.49) followed by T_9 (5.44) and mean germination time (26.99 days) respectively. Seed treated with KNO_3 at 100 ppm for 12 hrs also thrived good result on seed germination and germination value. The highest root length (9.94) was obtained from T_9 followed by T_4 (9.62) whereas highest shoot length (7.80) was recorded in T_7 followed by both T_8 and T_5 (7.58). Highest total seedling length was obtained from T_4 (16.96) followed by T_9 (16.86). Seedling vigour index was found highest in (T_8) treatment (1396.24) followed by T_9 (1363.03). Total fresh weight was obtained from T_9 (1.42) followed by T_8 (1.34) whereas total biomass was obtained from whereas hot water treatment was recorded minimum results for all the characters over control.

Keywords: Burmese grape, germination, KNO_3, seed, thiourea

1. Introduction

Burmese grape (*Baccaurea sapida* Muell.Arg.) is an important underutilized fruit crop grown mainly in the tropical forests of south East Asia. The fruits are mostly found in Bangladesh, Nepal, India, Bhutan, Thailand, Myanmar, China and Andaman and Nicobar Island. In West Bengal it is grown mainly in the hilly areas of Darjeeling (Chhetri et al., 2023), and northern parts (Terai regions), Coochbehar, Jalpaiguri, Dakshin Dinajpur and Uttar Dinajpur to a very limited scale (Pradhan et al., 2013). It is also grown in the Eastern sub-Himalayan region including high hills of Arunachal Pradesh and low hills of North Eastern states (Rymbai et al., 2016). The genus 'Baccaurea' derived from the latin word meaning golden yellow fruit colour (Chakrabarty and Gangopadhyay, 1997) and belongs to the family Euphorbiaceae (Rahman et al., 2014). The fruits are known by different names such as Kusum in Nepali, Latka in Bengali, Sohramdieng in Khasi, Khattaphal in Hindi, Amda in Odia and Burmese grape in English.

The tree is dioecious, evergreen in nature, slow growth habit, medium to tall height, and prefer shade (Dey et al., 2022). Burmese grape usually flowers during summer months and fruits are matured during monsoon period (May–June). The edible part of fruit is berry and the shape of a fruits are roundish spheroid to oval and pale yellow to light yellow in colour when matured (Bhowmick et al., 2016). The fruit bearing is cauliflorous in nature (Bhowmick, 2011), produces flowers directly from its main stem or older branches. The tree shows mild bienniality in cropping pattern (Pal et al., 2008). The fruits appear in bunches (10–12 fruits $bunch^{1}$) and edible portion is aril having 3 to 4 aril are present $fruit^{-1}$, which is covered by leathery rind which turns from green to yellow during ripening. The whole parts of the plant including roots, seeds, leaves and fruits have ethno medicinal value and health advantages. The fruit is rich in many nutritional properties such as vitamin C, iron and protein (Peter, 2007;

Hoque et al., 2021). The fruits can also be used as an anti-inflammatory and pain killer, used for the treatment of many injuries, rheumatoid arthritis, cellulitis, abscesses etc. (Lin et al., 2003). The bark is also reported to be used for curing skin diseases in Manipur and Meghalaya (Singh et al., 2014; Momin et al., 2016). The seed of Burmese grape is recalcitrant in nature, but propagated through seeds or by grafting. There is a great threat of becoming extinction of minor fruit crops whose seeds are recalcitrant and advanced propagation techniques are needed urgently (Chhetri et al., 2022). The tree also plays an important role in the agroforestry system (Alam et al., 2020). To enhance the seed germination and to break the dormancy various seed treatment methods can be applied such as stratification, scarification, soaking in cold water and application of chemicals and growth regulators which can be beneficial. As the crop is mainly propagated through seeds thus variability is found among different genotypes.

Keeping in view towards mass reproduction and genetic improvement of underutilized fruit having high potentialities; there is a necessity to develop quick and economical methods of producing planting material for large scale cultivation. Considering the foregoing points, the present study was carried out with the following objectives i.e., to standardize the effect of pre-treatments on the seed germination and to study the seedling growth of Burmese grape (*Baccaurea sapida* Muell. Arg.).

2. Materials and Methods

The experiment was carried out during the months of July, 2017 to September, 2018 at instructional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, plains of Terai zone of West Bengal with an elevation of 43 m above mean sea level. It was located at 15 km south west direction of Coochbehar town with 26° 23′ 86′′ North latitude and 89° 25′ 53′′ East longitude. The fresh ripened mature fruits of Burmese Grape were collected from the University farms and adjoining villages of UBKV of Cooch Behar, West Bengal and stored in a laboratory for 2–3 days. The fruits were de-pulped and the seeds were removed from the fruit by rubbing with hands gently and rubbing in sands. After removing the seeds from the fruits, it was washed thoroughly in running tap water several times. There were 9 treatments comprising with 3 replications was arranged in Completely Randomized Design (CRD). The following treatments were used for experiment: T_1-Control (without any pre-treatment) T_2- Soaking of seeds in cold water cold water for 12 hrs , T_3- Soaking of seeds in hot water at 40 ˚C followed by cold water for 12 hrs , T_4- Soaking of seeds in potassium nitrate at 50 ppm, T_5-Soaking of seeds in potassium nitrate at 100 ppm, T_6-Soaking of seeds in potassium nitrate at 500 ppm, T_7-Soaking of seeds in thiourea at 50 ppm, T_8-Soaking of seeds in thiourea at 100 ppm, T_9-Soaking of seeds in thiourea at 500 ppm.

2.1. Germination percentage (GP %)

Germination percent would be calculated as the number of seeds sown and the no. of seeds germinated expressed in percentage.

GP=Total number of seed germinated/Total number of seed sown×100

2.2. Germination value (GV)

The germination value, a composite that combined both germination speed and total germination which provided an objective means of evaluating the results of germination values calculated using the formula of Djavanshir and Pourbeik, 1976.

GV=(ΣDGS/N)×GP/10

2.3. Mean Germination Time (MGT)

The time taken to complete germination was determined as MGT in days according to Bonner (1983) and Phartyal et al., (2001) as given in below:

MGT=Σ(Daily germination×DAYS)/Total number of seeds sown)

2.4. Seedling vigour index (SVI)

It reflected the health of seedling. It would be calculated on the basis of the following formula (Abdul-baki and Anderson, 1973). After 45 days of seed sowing 5 random seedlings from each replication would be selected. Then the root portion would be dipped in water for cleaning the attached soil particles. Later the seedling would be kept on blotting paper to extract the extra water and their root shoot length would be measured with the help of measuring scale.

SVI= Germination percent (%) × seedling length (cm).

2.5. Total biomass

After 45 days of the growth of seedling, the root, shoot and leaves are cut into separately and weighed. Then they are dried in oven at 70°C to constant weight and added to calculate total biomass of seedling.

3. Results and Discussion

3.1. Germination percentage (%)

Significant variation was exhibited among all the treatments on germination percentage of *Baccaurea sapida*. The germination percentage was ranged from 56.00 to 87.33% (Table 1). Germination percentage was found to be highest in T_8 (Figure 1) when seeds treated with 100 ppm thiourea for 12 hrs (87.33%), followed by treatment T_4 (seeds treated with 50 ppm potassium nitrate for 12 hrs) with the value of (80.00%) and the minimum germination percentage was observed in T_3 when the seeds were treated with hot water for 12 hrs (56.00%). Similar result was obtained by Airi et al., 2009 in *Hippophe salicifolia* and Gurung et al. (2014) in Passion fruit. The results in the increment in germination percentage probably due to inhibit the activity of inhibiting chemicals present in seeds, thus resulting in the higher germination percentage.

3.2. Germination value

The germination value was varied from 2.67 to 6.49 (Table

Table 1: Effect of different treatments on germination percentage (%), germination value and mean germination time of Burmese Grape (*Baccaurea sapida*) seeds

Treatments	Germination percentage (%)	Germination value	Mean germination time
T_1	70.67 (57.24)	4.27^{cd}	29.42^{cd}
T_2	77.33 (61.61)	5.05^{bc}	27.99^{b}
T_3	56.00 (48.45)	2.67^{e}	29.97^{d}
T_4	80.00 (63.94)	5.37^{b}	28.05^{b}
T_5	75.00 (60.03)	4.80^{bcd}	28.16^{b}
T_6	69.00 (56.693)	3.99^{d}	28.85^{bc}
T_7	76.00 (62.03)	4.88^{bc}	28.51^{bc}
T_8	87.33 (68.17)	6.49^{a}	26.99^{a}
T_9	80.67 (61.83)	5.44^{b}	28.07^{b}
SEm±	4.18	0.82	1.01
CD (p=0.05)	1.34	0.27	0.34

Figure 1: Highest germination percentage

1), whereas the maximum germination value was obtained from the seeds treated with thiourea 100 ppm for 12 hrs T_8 (6.49) followed by T_9 (seeds treated with 500 ppm thiourea for 12 hrs) (5.44), and the minimum germination value was observed in T_3 (hot water for 12 hrs) followed by T_6 (potassium nitrate 500 ppm) (2.67 and 3.99 respectively). Thiourea and potassium nitrate might break the dormancy of the seed; therefore, it enhanced the germination percentage and increased daily germination speed resulting higher value as compared to other treatments.

3.3. Mean germination time (days)

The data in the Table 1 on mean germination time indicated that the mean time of seedlings *Baccaurea sapida* ranged between 26.99 (days) to 29.97 (days). The least germination time (26.99 days) was taken by the seeds in treatment T_8 (100 ppm thiourea for 12 hours). The maximum mean germination time was recorded on the seeds treated with hot water for 12 hrs (T_3) with the days of about 29.97 followed by control (T_1) with a small difference of about 29.42 (days). The reduction in mean germination time with the use of potassium nitrate might be due to acidification and loosening of the cell wall which eroded the seed coat and improved the permeability, resulting less mean germination time (Khan and Ungar, 2001 and Stidham et al., 1980).

3.4. Root length

The data revealed that the root length of the seedlings ranged from 6.93 cm to 9.94 cm and significant variation was exhibited among the treatments (Table 2). The maximum root length (9.94 cm) of *Baccaurea sapida* was found in T_9 (Figure 2) (500 ppm thiourea for 12 hrs) followed by T_4 (9.62 cm). Rajamanickam et al. (2004) recorded that the maximum length of the root was observed when aonla seed treated with KNO_3. Similar findings were also reported by Wagh et al., (1998). Thiourea also might help in cell elongation resulted better root length. Exogenous application of KNO_3 induced the activity of gluconeogenic enzymes during early stages of seed germination and this could be the reason for improved germination and vigour characteristics that was reflected in terms of increase in root length.

Figure 2: Highest root length

Table2: Effect of different treatments on root length, shoot length, total seedling length and seedling vigour index, total fresh weight and total biomass of Burmese grape (*Baccaurea sapida*) seeds

Treatments	Root length (cm)	Shoot length (cm)	Total seedling length (cm)	Seedling vigour index	Total fresh weight (cm)	Total biomass
T_1	6.93^{b}	6.79^{abc}	13.72^{c}	970.73^{de}	1.28^{ab}	0.19^{ab}
T_2	7.94^{ab}	6.77^{bc}	14.72^{abc}	1140.12^{bcd}	1.28^{ab}	0.19^{ab}
T_3	7.48^{ab}	6.37^{c}	13.84^{bc}	772.64^{e}	1.21^{b}	0.13^{ab}
T_4	9.62^{a}	7.34^{abc}	16.96^{a}	1360.00^{ab}	1.32^{ab}	0.18^{ab}
T_5	8.50^{ab}	7.58^{ab}	16.09^{ab}	1207.62^{abc}	1.27^{ab}	0.20^{ab}
T_6	8.00^{ab}	6.74^{bc}	14.74^{abc}	1017.65^{cd}	1.28^{ab}	0.20^{ab}
T_7	7.58^{ab}	7.80^{a}	15.39^{abc}	1171.39^{abcd}	1.28^{ab}	0.19^{ab}
T_8	8.43^{ab}	7.58^{ab}	16.01^{abc}	1396.24^{a}	1.34^{ab}	0.18^{ab}
T_9	9.94^{a}	6.92^{abc}	16.86^{a}	1363.03^{ab}	1.42^{a}	0.22^{a}
SEm±	0.73	0.3	0.7	69.82	0.09	0.02
CD (p=0.05)	1.57	0.91	2.1	209.64	0.81	0.18

3.5. Shoot length

The shoot length of seedling *Baccaurea sapida* ranged from 6.37 cm to 7.80 cm and varied significantly among all the treatments (Table 2). The highest shoot length was obtained from T_7 (Figure 3) Where the seeds were treated with thiourea 50 ppm for 12 hrs (7.80 cm) followed by the T_5 and T_8 having the common value as 7.58 cm (potassium nitrate 100 ppm and thiourea 100 ppm respectively).

3.6. Total seedling length

Significant variation was observed among all the treatments of total seedling length (Table 2). The data ranged between 13.72 cm to 16.96 cm whereas the highest seedling length of *Baccaurea sapida* was observed in T_4 (50 ppm potassium nitrate for 12 hrs) with the value 16.96 cm (Figure 4) whereas the lowest value was observed in T_1 (control) with the value of 13.72 cm. The data pertaining on total seedling length were statically significant under all the treatments. As potassium nitrate was crucial elementary constituent of numerous organic compounds like amino acid, proteins and nucleic acids played role in formation of protoplasm and new cells, as well as encouraged plant elongation. Besides, potassium acted as a major essential element required for physiological mechanism of plant growth and increased the availability

Figure 3: Highest shoot length

Figure 4: Total seedling length

of potassium and nitrogen that resulted in more height of seedling (Ramzan et al., 2016).

3.7. Seedling vigour index

The potential degree of activity and performance of seeds during the germination and growth stages of the seedlings was determined by the seedling vigour index. The seedling vigour index of (*Baccaurea sapida*) ranged between 772.64 to 1396.24 (Table 2). Maximum SVI was recorded in T_8 after the seeds treated with thiourea 100 ppm for 12 hrs 1396.24 followed by the T_9 (500 ppm thiourea for 12 hrs) 1363.03 and the minimum SVI was recorded for the T_3 treatment with the value of 772.64. Thiourea also might help in cell elongation resulted better seedling length. As a result, higher vigour index was recorded. Similar findings were also reported by Shanmugavalli et al. (2007) in case of the effect of nitrogenous salt such as KNO_3 and thiourea in different concentrations.

3.8. Total fresh weight

The total fresh weight of burmese grape ranged from 1.21 g to 1.42 g (Table 2). The maximum total fresh weight 1.42 g was obtained in T_9 (soaking of seeds in thiourea 500 ppm for 12 hrs) followed by T_8 (100 ppm thiourea). Lowest total fresh weight observed on the T_3 treatment (1.21 g). Highest fresh weight was recorded in seeds treated with thiourea might be due to that this treatment showed better germination by breaking the seed dormancy and subsequent seedling growth and weight.

3.9. Total Biomass

The total biomass of seedlings of *Baccaurea sapida* ranged from 0.13 g to 0.22 g and significantly varied among the treatments (Table 2). The maximum total biomass was observed in T_9 0.22 g (thiourea 500 ppm 12 hrs) followed by T_5 and T_6 having the same value of 0.20 g (potassium nitrate 100 ppm and 500 ppm respectively). Lowest total biomass 0.13 g was obtained in T_3 treatment. Higher biomass in seeds treated with thiourea and potassium nitrate might be due to better germination percentage by breaking the seed dormancy and subsequent seedling growth and weight. These findings were quite similar with the result recorded by Shanmugavalli et al. (2007) and Bhan and Sharma (2011) with thiourea and potassium nitrate at different concentrations.

4. Conclusion

Among the different seed treatments of *Baccaurea sapida*, seeds treated with 100 ppm thiourea for 12 hrs (T_8) recorded maximum germination percentage, germination value and take minimum days for germination whereas T_9 (seeds treated with 500 ppm of thiourea for 12 hrs) showing the highest biomass of the seedling. Thus, thiourea could be widely used by the village and forest nurseries in the North Bengal Himalayan region for large scale seedling production of burmese Grape.

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