Environmental Sciences Proceedings

Proceedings

Seed Parameters Study in *Commiphora wightii* (Arnott)–An Important Medicinal Tree of Arid and Semi-Arid Regions of India

Meena Choudhary†and U. K. Tomar*

Genetics and Tree Improvement Division
Arid Forest Research Institute, Jodhpur-342005, Rajasthan, India
*To whom all correspondence should be addressed:uktomar60@gmail.com, Tel.: +91-9166-729-698
†Presented at the1st International Electronic Conference on Forests, 15–30 November 2020;
Available online: https://sciforum.net/conference/IECF2020

Published: 25 October 2020

Abstract: *Commiphora wightii* (Arnott) is a critically endangered, dioecious plant and commonly known as Guggal. It has tremendous pharmaceutical and medicinal importance. The sex ratio is extremely skewed towards female plants and male plants are extremely rare. Slow growth, poor seed germination and extremely poor regeneration are some of the contributing factors causing decline in its population. The objective of the present work was to study the seed characters in different genotypes to establish the relationship amongst seed germination, seed colour and seed weight. Guggal plants produce seeds throughout the year but seed yield and viability are higher for seeds produced in winter. Total 1643 mature seeds were collected from nine genotypes (C1, C2, C3, P1, P2, P3, P4, P6 and P9) from Deesa (Gujarat, India) in November-December, 2017. The pooled seed weight data showed that average seed weight of black seeds (0.042 kg) was higher than that of brown (0.031 kg) and white seeds (0.023 kg). Seed germination was also higher in black seeds (17.2%) than in brown seeds (5.5%) whereas white seeds failed to germinate. A significant positive correlation was also observed between seed germination and seed weight. The study on percentage of different seed lobes for each genotype revealed that four lobed seeds were found only in C2 (8.9%) and C3 (3.2%), whereas three lobed seeds were produced by C2 (1.1%), C3 (2.3%) and P9 (1.2%). Other six genotypes produced 100% two lobed seeds. The above results indicated that the seed colour and seed weight influence the seed viability as well as germination. Superior genotypes can be selected on the basis of the seed quality for establishing seed orchard and plantations as conservation strategy.

Keywords: seed viability; dioecious plant; guggal; genotypes

1. Introduction

Commiphora wightii is a medium sized important medicinal tree, commonly known as Guggal in Hindi and Indian bdellium tree in English. In India, it is mainly distributed in Rajasthan, Gujarat, Madhya Pradesh and Karnataka states [1]. It yields valuable oleo-gum-resin, commonly known as Guggul. Guggul is complex mixture of diterpenoids, triterpenoids, steroids, long-chain aliphatic tetrols, aliphatic esters, ferulates, lignans, carbohydrates and a variety of inorganic ions [2]. The active components of oleo gum resin are E and Z guggalsterones. It is used to treat obesity, osteoarthritis, cancer, arthritis, constipation, liver disorders, inflammation, anemia, diabetes, malaria, ulcer etc. [3,4]. The plant is dioecious in nature with male, female and hermaphrodite plants. Male plants are extremely rare. It is non- pseudogamous apomictic plant [5]. Flowering and fruiting are asynchronous i.e. both mature and immature fruits can be seen together. However, summer (April-May) and winter (November) are two peaks for flowering and fruiting intensity [6]. Flowers are small and red in colour. Fruits are drupe, green when immature and turned red at maturity. Seeds are covered inside fruits and are of Black, White and spotted brown in colour. Seeds are generally having two lobes but sometimes may have more than two lobes. The unscientific gum harvesting practices, grazing pressure, slow growing nature, low seed setting, low seed germination, poor regeneration and lack of enough replenishing methods are pushing this plant species towards being endangered and listed under critically endangered category in IUCN Red data book [7,8].

The restricted population and limited raw material of guggal in India is insufficient to fulfill the demand of indigenous medicine [9] and thus creates urgent need of conservation through large scale plantation. Apomictic nature [5,10,11], low black seed and extremely low white seeds viability [1] of this plant are main problems in raising nursery. Therefore, the present study was done with the aim to study the seed characters in different genotypes to establish the relationship amongst seed germination and other seed parameters. Moreover, selection of superior genotypes on the basis of seed quality will be helpful in large scale guggal plantation for conservation and to meet the demand of this medicinal plant species.

2. Materials and methods

Ranpur forest nursery, Datiwara, Deesa (Gujarat, India) site was selected for Guggal seed collection being well protected and known age plantations. Mature fruits and dry seeds were collected from nine genotypes (C1, C2, C3, P1, P2, P3, P4, P6 and P9) in November-December, 2017 and were kept in brown paper bags along with their identity. These fruits were depulped by hand rubbing and washed in water then dried in shade. Total 1643 Seeds were collected for seed parameters study and were separated on the basis of their colour (black, brown and white seeds) and number of lobes. Each seed was tagged with **its** identity and weighed.

These seeds were sown in root trainer for germination in the March, 2018. The root trainers were filled with fine sand, coarse sand and compost in 3:2:1 ratio and kept in AFRI polyhouse conditions (309.03±10.15 K temperature and 53.8±21.4% humidity) to record germination. Emergence of plumule above germination medium was considered as seed germination. Seed germination data was recorded after 4 weeks.

3. Results and Discussion

3.1. Seed Lobes

Seed collected from nine genotypes revealed that major portion of seeds were two lobed. However, Genotype C2 and C3 produced 8.9% and 3.2% four lobed seeds, respectively whereas three lobed seed were also produced by C2 (1.1%), C3 (2.3%) and P9 (1.2%). Remaining genotypes (C1, P1, P2, P3, P4 and P6) produced 100% two lobed seeds. One lobe seed were absent in all genotypes studied (Figure 1).

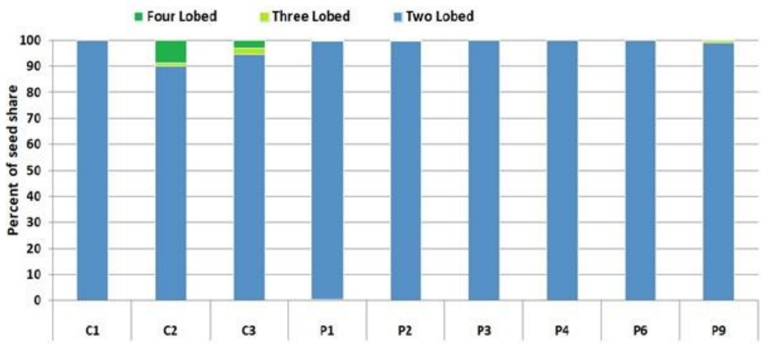

Figure 1. Percent of seeds with different number of lobes in nine genotypes.

Genotype of mother tree is one of the important factor that can affect the seed trait [12]. We also found that most of *C. wightii* genotypes produced two lobed seeds while some genotypes produced more than two lobed seeds i.e. three and four lobed seeds. Thus, three or four lobed seed is appearing to be a genetic characteristic in this species.

3.2. Seed colour, weight and germination

The seed studies of 1643 seeds revealed that apart from black and white seeds, brown seeds (shades ranging between black and white) were also present. In this sample share of Black seeds were 37.6% with 0.042 kg average seed weight (1000 seeds), brown seed 42.9% with 0.031 kg and white seed proportion was 19.5% with 0.023 kg lowest seed weight (Figure 2)

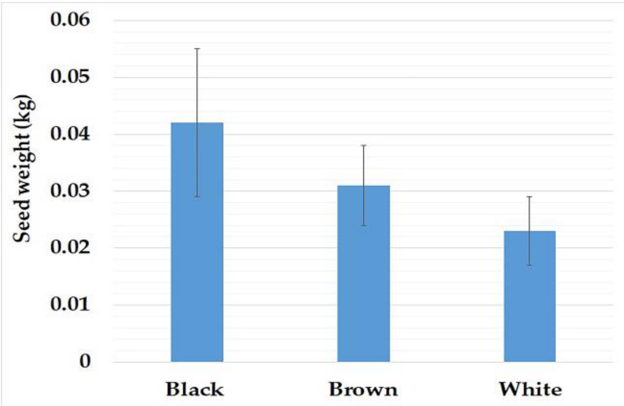

Figure 2. Seed weight of different seed types (black, brown and white).

Seed germination data of black, brown and white after 4 weeks revealed that seed germination was highest in black seeds (17.2%) followed by brown seeds (5.5%), whereas, no germination was recorded in white seeds. When seeds were categorized in different classes on the basis of their seed weight it was observed that seed weight is strongly correlated with seed germination. It means with increase in seed weight seed germination also increased.

Earlier literature on *C. wightii* already described the production of two types of seeds viz. black seed with higher viability and white seed with no or very poor viability [1,13,14], and higher germination in black seeds [1,15]. Present studies revealed that seed weight is directly correlated with seed germination. Higher the seed weight higher seed germination. Black seeds have higher seed weight, followed by brown seeds and white seeds have lowest seed germination. Similarly, higher seed germination percentage in heavy weight seeds than light weight seeds reported in *Quercus* species [16] and *Artocarpus heterophyllus* [17]. The difference in seed weight may be attributed to seed development and food reserve. Black colour of the seeds is good morphological marker of seed weight and germination as the seed colour gradient increases from white to black along with seed weight and the seeds viability. It means strength of certain vital biochemicals within the seed, are accountable for seed weight and viability also for seed colour. Therefore, this hypothesis is a subject of future investigations. The applied aspect of present investigation is to encourage the agropractices that improve black seed yield with higher seed weight because quality seeds are important in large scale plantation by development of seed production areas or seed orchards with superior genotypes for quality seeds.

Author Contributions: M.C.; original draft preparation, U.K.T.; Project investigator, conceptualization, funding acquisition, review and editing of manuscript, M.C. and U.K.T.; data analysis.

Funding: This research was funded by NATIONAL MEDICINAL PLANT BOARD (NMPB), NEW DELHI, INDIA.

Acknowledgments: Authors would like to acknowledge Purva Paliwal, Mr. Lovelesh Singh Saini, Miss Shabnam Bano, Priya and Mr. Thana Ram Rathore for the help extended in this study. We would especially like to acknowledge Gujarat Forest Department for allowing us to collect the study material.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lal, H.; Kasera, P.K. Status and Distribution Range of Guggal: A Critically Endangered Medicinal Plant from the Indian Thar Desert. *Science and Culture* 2010, *76*, 531–533.
2. Sarup, P.; Bala, S.; Kamboj, S. Pharmacology and Phytochemistry of Oleo-Gum Resin of *Commiphora wightii* (Guggulu). *Scientifica* 2015, 14 pages. http://dx.doi.org/10.1155/2015/138039.
3. Shen, T.; Wan, W.; Yuan, H.; Kong, F.; Guo, H.; Fan, P.; Lou, H. Secondary metabolites from *Commiphora opobalsamum* and their anti-proliferative effect on human prostate cancer cells. *Phytochemistry* 2007, *68*, 1331–1337.
4. Kumar, V.; Singh, S.; Singh R. Phytochemical Constituents of Guggul and their Biological Qualities. *Mini-reviews in organic chemistry* 2020,*17*, 277-288. doi. https://doi.org/10.2174/1570193X16666190129161757
5. Gupta, P.; Shivanna, K.R.; Ram, H.Y.M. Apomixis and Polyembryony in the Guggul Plant, *Commiphora wightii*. *Annals of Botany* 1996, *78*, 67-72.
6. Singhal, H.; Gaur, A.; Tomar, U.K. Observation on flowering and fruiting in *Commiphora wightii* (Arnott) Bhandari. *European Journal of Medicinal Plants* 2014, *4*, 1087-1097.doi.org/10.9734/EJMP/2014/10258
7. Ved, D.; Saha, D.; Ravikumar, K.; Haridasan, K. *Commiphora wightii*. The IUCN Red List of Threatened Species 2015: e.T31231A50131117.http://dx.doi.org/10.2305/IUCN.UK. 2015-2.RLTS.T31231A50131117.en. Downloaded on 22 August 2019.
8. Reddy, C.S.; Meena, S.L.; Krishna, P.H.; Charan, P.D.; Sharma, K.C. Conservation threat assessment of *Commiphora wightii* (Arn.) Bhandari—an economically important species. *Taiwania* 2012, *57*, 288–293
9. Yadava, B.B.L. *Commiphora wightii* (Gum-Guggul) Present Status in India: An Overview, *Herbal Tech Industry*, 2011, *8*, 24-28.
10. Geetha, K.A.; Kawane, A.; Bishoyi, A.K. Characterization of mode of reproduction in *Commiphora wightii* [(Arnot) Bhandari] reveals novel pollen–pistil interaction and occurrence of obligate sexual female plants. *Trees* 2013, *27*, 567–581. doi.org/10.1007/s00468-012-0810-8
11. Mohan, C.; Naresh, B.; Kumar, K.B.; Reddy, V.; Manjula; Keerthi, B.; Sreekanth, D.; Manzelat, S.F.; Cherku, P.D. Micropropagation studies and phytochemical analysis of the endangered tree *Commiphora wightii*. Journal of Applied Research on Medicinal and Aromatic Plants 2017, *6*, 70-79.doi.org/10.1016/j.jarmap.2017.02.004
12. Salazer R.; Quesada M. Provenance variation in *Guazuma ulmifolia*L. in costa rica. *The commonwealth Forestry review*1987, *66*, 317-324.
13. Prakash, J.; Kasera, P.K.; Chawan, D.D.A Report on Polyembryony in *Commiphora wightii* from Thar Desert, India, *Current Science* 2000, *78*, 1185- 1187.
14. Kumar, D.; Mishra, D.K.; Sharma, S.K. Standardization of agronomic practices for *Commiphora wightii* (Arnott) Bhandari: an important medicinal plant of indian desert. *ENVIS Forestry Bulletin* 2012, *12*, 69-72.
15. Kulloli, R.; Kumar, S.; Jindal, S. Ex-situ Conservation of an Arid Threatened Species *Commiphora wightii* (Arnt.) Bhand. Through Seeds. *Journal of Tropical Forestry* 2013, *29*, 15-22
16. Tripathi, R.S.; Khan, M.L. Effects of Seed Weight and Microsite Characteristics on Germination and Seedling Fitness in Two Species of *Quercus* in a Subtropical Wet Hill Forest, *Oikos* 1990, *57*, 289-296. doi: 10.2307/3565956
17. Khan, M.L. Effects of seed mass on seedling success in Artocarpus heterophyllus L., a tropical tree species of north-east India, *Acta Oecologica* 2004, *25*, 103-110. doi.org/10.1016/j.actao.2003.11.007