VARIATION IN SEED MATURATION IN *MYRICA ESCULENTA* OF WEST HIMALAYA, UTTARAKHAND

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ABSTRACT

Myrica esculenta is highly valuable wild edible fruit species of the Indian Himalayan Region (IHR). In the study, *M. esculenta* was recorded dominated species with (500 Indi/ha) tree density, (126.62 cm^2) mean basal area, (6.33 m^2/ha) total basal area and (120.24) important value index, however, *Q. leocotrichophora* and *R. arboreum* was found lowest. Similarly, variation was found in leaf area, fruit color, fruit size and seed maturation in the studied site. Present studies concluded that phenology of seeds and a fruit varies in maturation periods. The present studies recommend that *M. esculenta* can be promoted by mass plantation in different altitudinal range for the conservation of the biodiversity and also fruits can be utilized by the native communities for preparation of value-added products such as juice, jam, squash etc., which can contribute for the income generation.

Keywords: *Myrica esculenta,* Indian Himalayan Region (IHR), Seed maturation, Fruit color, Uttarakhand, West Himalaya.

INTRODUCTION

Myrica esculenta Buch. Ham. ex D. Don (Family-Myricaceae), commonly known as "Kaphal" is highly valuable wild edible fruit species (Rawat *et al.,* 2011) and distributed between 900-2100 m asl in the Indian Himalayan Region (IHR) from Ravi eastwards to Assam, Khasi, Jaintia, Naga and Lushi Hills, and extending to Singapore, China and Japan (Bhatt *et al.,* 2004). The wild fruit species are gaining high attention as a food supplement and they are also the cheaper alternative to commercial fruits across the world (Gusain *et al.,* 2016; Bhatt *et al.,* 2017). The species is a medium sized, evergreen, dioecious wild tree occurred mainly in *Pinus roxburghii, Q. leucotrichophora* (Dhyani *et al.,* 1994). During the season, the demand of fruit either in the form of processed or fresh form is very high which contribute in the income generation of local populace of hilly regions (Pandey *et al.,* 1993; Bhatt *et al.,* 2000). Fruits are an important source of natural antioxidants, vitamins, minerals etc which can play a vital role in reducing the oxidative stress and preventing from certain degenerative diseases (Rawat *et al.,* 2011; Bhatt *et al.,* 2017). The species also recognized for their nitrogen fixing capacity and invading nature, known for its unique medicinal and industrial uses and considered as a source of good fuel, fodder, medicine and oil (Singh *et al.,* 1986; Rastogi *et al.,* 1991; Jeeva *et al.,* 2011). However, anthropogenic pressure like grazing, browsing, looping of trees for fuel wood and fodder, fire, deforestation etc., affecting the regeneration of a species. The rapid rise in human population depletion of forest cover is increasing day by day. Therefore, conservation of biodiversity is becoming more important. Since seeds are the major component of such conservation programs, as the seed is a reproductive unit which develops from an ovule, usually after fertilization and plays an essential role in regeneration and maintains genetic diversity (Justice 1972; Newton *et al.,* 2002). The quality of seed comprises on physiological viability, the vigour of seed and their ability to produce healthy offspring (Copeland *et al.,* 1999; Milosevic *et al.,* 2010) and more mature seed is, the greater is its vigour and potential to become an established as a seedling (Pollock *et al.,* 1972). In the above context, this study focused to investigate vegetation parameters and to assess seed maturation time in *Myrica esculenta* from Kumuan, west Himalaya.

METHODOLOGY

Bhowali is located between 29.38°N and 79.52°E having an altitude variation from 1600-1800 masl is selected for the present study. The average rainfall and temperature of the study area are 1487 mm and 34°C respectively. In the study site, random vegetation sampling was conducted where 5 quadrats (10X10) for trees were laid. Circumference at Breast Height (cbh at1.37cm height from ground) measured for tree species. The quadrat data were pooled for calculation of various quantitative measures such as density, frequency, total basal area and Important Value Index (IVI) were made following (Misra 1968; Saxena et al., 1982). Furthermore, the fresh fruits were randomly harvested from the lower, middle and higher altitude of the studied site at the intervals of seven days and brought into the laboratory for further analysis of seed maturation (Fig. 1). Another physiological parameter (i.e., color, size weight and moisture content) of fruits and seeds were also taken.

RESULTS AND DISCUSSION

In the study, five random (10mX10m) quadrates was performed and reported *M. esculenta* was dominated species with (500 Indi/ha) tree density, (126.62 cm^2) mean basal area, (6.33 m^2/ha) total basal area and (120.24) important value index, however, *Q. leocotrichophora* and *R. arboreum* was found lowest. The varied range of leaf area (15.8-34.2 cm^2), weight (0.14-0.33 mg), mean tree height (2.98-4.81 m) and mean circumference of the tree (22.30-67.62 cm) was found in *M. esculenta* (Table 1).

Myrica esculenta is an important wild edible tree species which provides nutritious fruits (Rawat *et al.*, 2011) and used for fodder and fuel-wood (Dhyani *et al.*, 1994). The multipurpose nature of the plant has led to over harvesting, hard seed coat, unavailability of mature seed, poor seedling establishment and negligence of sustainable utilization has adversely affected regeneration in natural condition (Chen *et al.*, 2008; Shah *et al.*, 2010; Jeeva *et al.*, 2011). Previous studies indicated that the species generally propagated via seeds but physical dormancy caused by impermeable seed coat results in unreliable germination pattern and vegetative propagation with cutting also difficult (Bhatt *et al.*, 2000). Few attempts such as pretreatments by prolonged warm plus cold stratification or by exogenous application of GA_3 or by removal of endocarp and seed coat tissues was reported increased seed germination significantly in *Myrica rubra* (Chen *et al.*, 2008) and controlled micropropagation process for *Myrica esculenta* also helpful for producing large number of plants (Bhatt *et al.*, 2004). In addition, researchers reported that pre-sowing seed hydration technique is one of the effective approaches to improve germination and seedling establishment (Purohit *et al.*, 2009; Rehman *et al.*, 2011). Also, strong positive correlation was reported between

Table 1. Change in leaf area over the study period

Date	Area	Weight
30 October 2013	15.8	0.14
8 November 2013	23.3	0.24
20 November 2013	24.8	0.26
1 December 2013	31.3	0.33
13 December 2013	34.2	0.33
20 December 2013	34.2	0.33

Table 2. Variation in morphological parameters in fruits and seeds of *Myrica esculenta*

Site	Fruit Characteristics				Seed Characteristics		
	Color of fruit	Size (L*W) mm^2	Weight of 30 fruits (g)	Moisture content (%)	Size (L*W) mm^2	Weight of 30 fruits (g)	Moisture content (%)
S1 (Lower elevation)	Green	1.64±1.6	0.464	47.14	0.20±0.1	0.201	20.25
	Reddish-Green	3.49±1.8	1.137	56.16	1.15±0.5	0.568	22.16
	Red	3.89±1.9	1.906	56.75	1.45±0.7	0.953	23.89
	Dark-Red	4.05±0.7	2.201	60.72	2.15±0.9	1.105	52.15
S2 (Mid elevation)	Green	2.29±0.4	0.686	49.15	1.14±0.5	0.343	23.70
	Reddish-Green	4.45±0.9	1.349	58.14	2.23±0.8	0.674	24.48
	Red	4.57±1.5	1.869	61.13	2.49±2.1	0.934	26.15
	Dark-Red	5.23±1.4	3.152	63.85	3.11±1.9	1.576	57.15
S3 (Higher elevation)	Green	2.95±1.5	0.987	49.75	1.62±0.8	0.493	23.99
	Reddish-Green	4.50±1.7	1.792	58.90	2.52±0.9	0.896	26.39
	Red	4.85±1.3	1.909	61.25	2.89±0.7	0.953	44.25
	Dark-Red	6.85±1.9	4.242	66.77	3.92±0.5	2.121	57.85

seed weight and germination in *Quercus* species (Tripathi *et al.,* 1990) which influenced that heavy seeds germinated earlier and showed better germination than light seeds.

Similarly, fruit color was changed from green to dark red during the month of March to the mid April. Also, fruits showed variation in size S1 (1.64-4.05 mm^2), S2 (2.29-5.23 mm^2) and S3 (2.95-6.85 mm^2), where weight varies from S1 (0.46-2.20g), S2 (0.68-3.15g) and S3 (0.98-4.24g) and moisture content varies from S1 (47.14-60.72%), S2 (49.15-63.85%) and S3 (49.75-66.77%). The seed of *Myrica esculenta* varied in size from S1 (0.20-2.15 mm^2), S2 (1.14-3.11g) and S3 (1.62-3.92g) where as weight varies from S1 (0.20-1.10 g), S2 (0.34-1.57g) and S3 (0.49-72.12g) and moisture content varies from S1 (20.25-52.15%), S2 (23.70-57.15%) and S3 (23.99-57.85%) and seed maturation was complete in the last week of April

The results revealed that male-female ratio of tree varied from (5:3 North to 3:2 South) in low altitude, (7:4 North to 8:3 South) in mid-altitude and (7:3 North to 6:4 South) in the high altitude of the studied site. It is observed that the initiation of flowering started from mid November and fruiting started from March to April in *Myrica esculenta.* This study found that there is a delay in the timing of fruiting and flowering which may result in sterile production

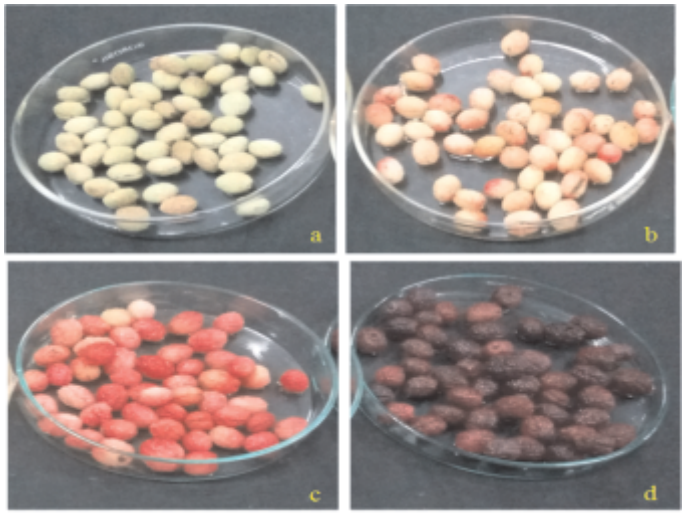

Fig.1. Description of selected maturity stage (a) Green (b) Reddish- Green (c) Red and (d) Dark Red in *Myrica esculenta*, West Himalaya

In the study, maturation period is one of the important factors for variation in phenology(seeds and fruits). Previous reports also support the present investigation and indicated that maturation date varies from tree to tree in the same stand (Allen 1960) from stand to stand in the same year and varies from one year to next year (Fowells 1949; Singh *et al.*, 2015). Also, few environmental factors such as elevation, temperature, rainfall, aspects and habitats might be responsible for variation in fruiting of tree and growth periods (Van Schaik *et al.,* 1993; Hamann 2004; Heydel *et al.*, 2017).

Myrica esculenta is growing naturally in the forest edge at higher elevation. The development of appropriate strategy, action plan and monitoring system are required for conservation of the economically important forest communities (Samant *et al.,* 2007). The necessary steps should also be taken for cultivation of this important potential multipurpose tree species in agro forestry systems (Jeeva *et al.,* 2011). In view of the high socio-economic and conservation values of the species required sustainable utilization, protection of natural regeneration and standardized suitable advanced technique for mass multiplication would be required.

RECOMMENDATIONS AND CONCLUSIONS

Present studies concluded that phenology of seeds and a fruit varies in maturation periods. Fruit colour changes from green to dark red towards maturity. Therefore, present studies recommend that *Myrica esculenta* can be promoted by mass plantation in different altitudinal range for conservation of the biodiversity, also utilized by the native communities in various forms as edible/food, fodder, fuel, timber & prepared value-added products such as juice, jam, squash etc., which increased economic value of the communities and increases intake of fresh fruits and their products which reduces diseases in human.

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