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Growth responses of *Hippophae rhamnoides* L. subsp. *sinensis* towards different agro-climatic conditions

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Abstract

Seabuckthorn is an important medicinal plant. Present study investigates growth responses of *Hippophae rhamnoides* L. *subsp. sinensis* cuttings towards different agro-climatic conditions. Experiment was designed according to the Randomized Complete Block Design with three replications. Cuttings were treated with 50 ppm NAN solution for 24 hours and growth pattern was monitored closely for 12 months regularly. Results showed significant effect of different climatic conditions and planting periods on sprouting (70.74%-93.16%), plant height (21.10 cm-27.75 cm), number of branches (4.40 - 7.12 per plant), number of roots (2.00 – 3.12 per plant), roots length (7.22 – 10.90 cm), root weight (1.00 – 1.96 g), survival percentage (68.78% - 90.59%) and overall health indicator (25.22 – 33.39). Selection of appropriate species with best suited planting period and established treatment will benefit Seabuckthorn growers for better yield, increased productivity and reasonable cash returns.

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Introduction

Hippophae rhamnoides L. subsp. *turkestanica* Rousi. is commonly grown in Northern parts of Pakistan is a less productive species to benefit local farmers and growers. However, *Hippophae rhamnoides* L. subsp. *sinensis* is an exotic species with higher yield, productivity and economic returns. Seabuckthorn is a winter hardy, deciduous, drought resistant, dioeciously multi-branched, thorny shrub, reaching 2 to 4 m in height can withstand temperatures from –43° to 40°C (Bailey and Bailey 1978, Lu 1992, Heinze and Fiedler 1981). However, irrigation is needed in regions receiving <400 mm of rainfall per year (Li and Schroeder 1996).

Berries are sub-globose, 6 to 10 mm long and 4 to 6 mm in diameter, turning yellow to orange when mature in mid-September. (Akkermans *et al.*. 1983, Rousi 1971). Vitamin C concentration in fruit ranges from 100–300 mg/100 g fruit, which is higher than strawberry, kiwi, orange, tomato, carrot, and hawthorn (Bernath and Foldesi 1992, Lu 1992). Vitamin E content is (202.9 mg/100 g fruit) which is higher than wheat embryo, safflower, maize, and soybean.

Medicinal uses of sea buckthorn are well documented in Asia and Europe. Oil is: anti-inflammatory, antimicrobial, pain relief, and promoting regeneration of tissues. Sea buckthorn oil is also touted as a treatment for oral mucositis, rectum mucositis, vaginal mucositis, cervical erosion, radiation damage, burns, scalds, duodenal ulcers, gastric ulcers, chilblains, skin ulcers caused by malnutrition, and other skin damage (Li and Wang 1998).

In Europe and Asia, there are numerous products made from sea buckthorn, such as tea from leaves, beverages and jam from fruits, fermented products from pulp, and animal feeds from leaves, pulp, and seed residues. The purpose of the present study was to test growth responses (acclimatization) of new exotic species in local agro-climatic conditions.

Materials and methods

Chemical treatment

During February 2011 to February 2012 study was conducted at PCSIR Laboratory Skardu, Gilgit-Baltistan. Selected 22-25cm length and 1-1.5cm diameter wood cutting of 2 to 3 years old shoot (Baloch A. 1994). After making top out slightly, above a node and lower cut slightly below the node, cuttings were immersed in 50 ppm NAN solution for 24 hours (Hue shuhua *et al.* 1989). Treated cuttings were planted on February 5, 25, March 16, 22 and April 20, 2003. A mixed medium of salt, sand and farmyard manure (4:1:1) on open field was used.

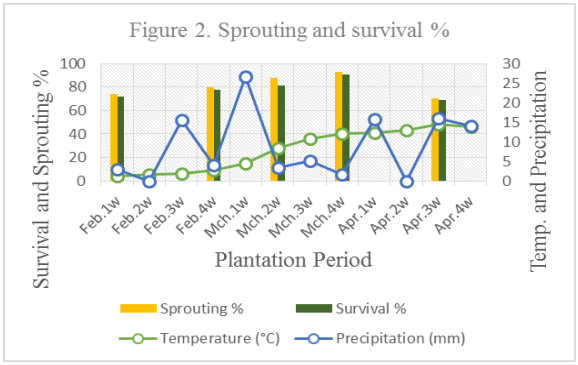

Fig. 2. Sprouting and survival %.

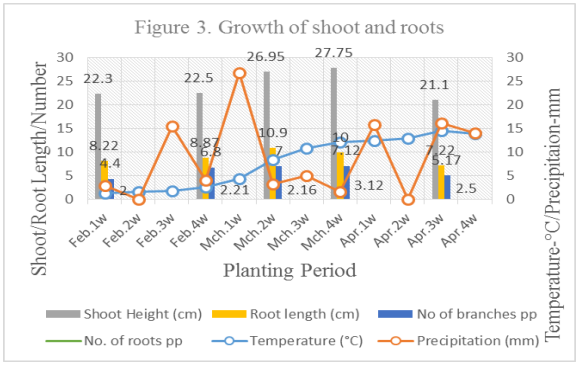

Fig. 3. Growth of shoot and roots.

Experimental Design

Experiment was designed according to the Randomized Complete Block Design (RCBD) with three replications. Each treatment consists of 20 cutting. Seven growth and biomass related parameters against local mean surface temperature (°C) and mean precipitation (mm) were monitored throughout the year, data was recorded and analyzed. An overall average of all parameters refered as 'Overall Average Health Indicator (AHI)' was

calculated. Temperature and precipitation recordings were collected from the Government Meteorological Station, Skardu. For all other growth and biomass parameters, common scale and analytical balance was used. Parameters evaluated were sprouting (Spr), plant height (PtH), number of branches (nBr), number of roots (nRt), roots length (RtL), root weight (RtW) and survival percentage (SvP).

AHI = ∑ (Spr + PtH + nBr + nRt + RtL + RtW + SvP) /7

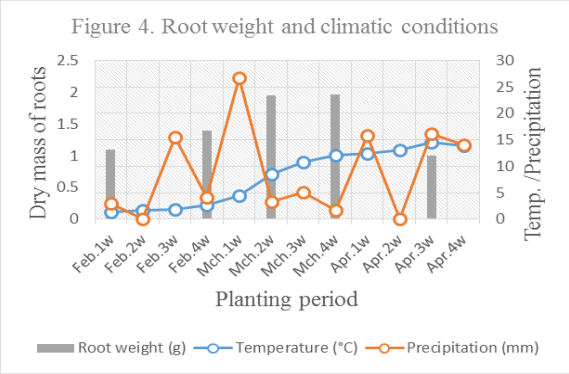

Fig. 4. Root weight and climatic conditions.

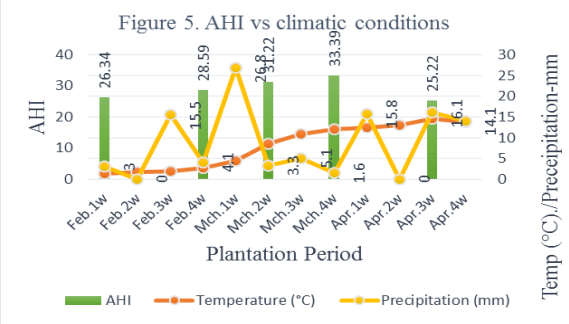

Fig. 5. AHI vs climatic conditions.

Therefore, AHI is an average sum of all parameters monitored indicating overall average health and suitability of planting cut under the agro-climatic conditions. Besides the above mentioned morphological parameters, daily mean surface temperature and moisture was recorded. Earth ball was used to uproot plants.

Results

Sprouting and survival percentage

Planting timing has significant effect on sprouting and survival (see figure 2 & table). Maximum sprouting (93.16%) and survival (90.59%) were recorded in plants planted in 23rd March contrary to minimum sprouting (70.74%) and 68.78% survival in plants planted on April 20. From the results we deduce that the propagating cuttings of exotic species (*Hippophae rhamnoides* L. subsp. *sinensis*) show sensitivity towards surface temperature and humidity at the time of planting. Except planting time frame, all other agro-climatic conditions remained the same for all other cuttings.

Root and shoot length

Plant height and root length were measured from the point of plant sprouting to the apex and from the root origination respectively. Likewise sprouting and survival percentages, root and shoot growth are significantly influenced by the average mean surface temperature and humidity. Maximum shoot height was recorded 27.75cm in the plants planted on March 23. Whereas maximum root length was calculated in the plants planted on March 6. We conclude that root and shoot growth are differentially responsive towards mean surface temperature and precipitation. Minimum shoot and root was recorded in the plants planted on April 20 with 21.1cm and 7.22cm respectively (Fig. 3).

Branches and roots

Mean data (see figure 3) showed that plant planted 23rd March produced maximum branches and roots per plant are 7.12 and 3.12 respectively. We infer from the results that number of root and shoot growth was maximum in the moderate temperature and precipitation ranging from 1°C to 14°C and 21mm to 26mm respectively. Whereas below and above temperature and precipitation ratios have adverse effect on the number of branches and roots per plant. Minimum numbers of branch (4.4) and roots (2) per plant were recorded in the plants planted on February 5. Plants planted on April 20 also showed minimum number except with slight difference.

Root weight

To measure dry biomass of roots per plant, all the roots were cut off from the stem, washed thoroughly and dried. Using analytical balance average weight (g) was calculated. Table and figure 5 show that

maximum root weight (1.96 g) was recorded in plants planted on 23rd March. While minimum (1.00 g) was calculated from the plants planted on April 20. We conclude that mean surface temperature above 11°C and below 2°C is unfavorable for healthy mass gain.

Overall Average Health Indicator

Overall Average Health Indicator (AHI) was calculated from the average mean of all growth and biomass parameters. AHI shows overall health of the plant and growth suitability in the agro-climatic conditions of Skardu and associated areas of Gilgit-Baltistan. Maximum AHI (33.39) was recorded for the plants planted between March 1 and first week of April having temperature ranges from 6°C and 13°C and precipitation from 23.0mm to 25.0mm. Plants planted beyond these ranges showed adverse effect on AHI.

Recommendations

Hippophae rhamnoides L. subsp. *sinensis* is an important exotic medicinal plant species with greater productivity. Larger berries with more quantity and less thorns enable farmers to collect larger quantities of berries with ease. Larger leaf lamina has an added value for livestock.

This Chinese variety was tested for the first time in Gilgit-Baltistan under the local agro-climatic conditions showed its high yield and return if planted under an average mean surface temperature ranging from 6°C and 13°C and precipitation from 23.0 mm to 25.0 mm.

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