Growth pattern of *Prinsepia. utilis* (Bhenkal) at different girth classes growing naturally at inner Himalayan region

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Abstract: Present study was undertaken to evaluate the growth pattern of *Prinsepia.utilis* growing at Western Himalayan region at four study sites i.e. S1 (Jhala), S2 (Dharali), S3 (Jaspur) and S4 (Sukki) at Uttarkashi district at Garhwal Himalaya in the year 2008-09 The data recorded for different parameters related to growth of *Prinsepia.utilis* at different sites showed variation. Growth parameters viz. lengths of plants, branch number, length of seed, seed output etc. were examined during the present study. Maximum shoot length at 25.1-30 cm girth class (220.5±23.13 cm), maximum leaf area at girth class 5.1 – 10 cm (1.98) and the maximum fruit productivity at girth class 25.1 – 30 cm (1800.63g) were observed where as minimum production was recorded at girth class 10.1 – 15 cm (756.9g).

Keywords: Girth class, Leaf area index, *Prinsepia utilis*, Seed output, Shoot length

INTRODUCTION

Himalayas are the largest mountain system in India shielding the north-western part of the country like a massive barrier. Its western part supports sub-tropical, temperate and alpine vegetation in response to the increasing altitude. Three zones are noticed viz. the sub-montane zone, found at elevation up to 1520 m temperate zone occupying the elevation ranging from 1520 to 3050 m and the alpine zone situated at elevation above 3050 m (Puri, 1960). The Garhwal Himalaya of Uttarakhand region lies in the central part of the western Himalayas that represents a great variation in topography and slope aspect. The main ranges are aligned in NW-SE direction. The asymmetrical slopes i.e. steeper along the southern sides and gentler along the northern one, form the characteristic features of the region. Uttarkashi is one of the border districts of Garhwal Himalaya that comprises of the temperate to alpine zone.

Prinsepia utilis (Rosaceae) locally known as "Bhenkal" is one of such promising but under exploited wild edible oil yielding shrub and was a chief source of oil before 1960s or 70s particularly in remotest villages located between 1800-2500m in higher Himalayan zone of Garhwal. Present paper deals with the Growth attributes of *P.utilis* at inner Himalayan region. The biodiversity essentially refers to the variability among the different life forms or the number of species or races with in the species or 'gene pools'. India has a very wide range of climate and habitat resulting in rich diversity of plants and animals (Ambasht and Ambasht, 1996).

Populations of non-timber species growing in landscapes subject to different kinds and levels of anthropogenic pressure may respond to harvest in very different ways. Several non-timber forest products (NTFP) are able to withstand higher harvest levels and have greater capacities for regeneration in secondary forests than in primary forests, due to availability of their more light (Siebert, 2000; Svenning, 2002; Ticktin *et al*.,2003). Despite the fact that non-timber species are often harvested in conjunction with logging operations, there exists little ecological data on how these types of extraction interact (Salick *et al*., 1995). Rates of growth and reproduction of NTFP growing in agro forestry systems, enhancement forest plantings and home gardens may also differ significantly from those in unmanaged forest environments, due to differences in availability of light (Velasquez-Runk, 1998) in intraspecific competition (Ticktin *et al.,* 2003), or in a combination of factors (Martinez-Ballestéet *et al*., 2002).

The aim of present study was to evaluate the various growth attributes of *Prinsepia utilis* growing at four study sites differing in different ecological parameters of Garhwal Himalaya.

MATERIALS AND METHODS

Study area: The study area for the present work is located near Gangotri at the fringes of Gangotri National Park near Gangotri shrine. Four locations dominated with the plants of different girth classes of *P.utilis* (Bhenkal), having different ecological characteristics i.e. sandy soil, sun facing slope and shady slope were selected and designated as S1(Jhala), S2(Dharali), S3(Jaspur) and S4(Sukki). Geographically these sites are located at 30^0

44' to 30^0 56' N latitude and 79^0 02' to 78^0 42' E longitude and at an altitudinal range of 2300 m to 2700 m asl. The exact geographical locations of four studied sites.The main associates of *P.utilis* were *Hippophae rhamnoides* L. *Cedrus deodara, Betula utilis, Rosa webbiana, Juniperus macropoda, Cotoneaster spp.,* etc.

Methodology: The data of rainfall, atmospheric temperature, relative humidity and solar radiation were recorded by placing automatic rain gauge, automatic thermo hygrograph and solar meter respectively at all the four study sites and presented the average values in Table 2. The meteorological data were recorded at the study sites, revealed that maximum average temperature of the hottest month i.e., June was 21.2^0C and minimum average temperature of the coldest month i.e., January was -3.4^0C and relative humidity ranges from 23-100 percent. Annual precipitation received by the area during the study period was 910 mm. being a dry temperate zone, this area receive very little rainfall. Maximum rainfall was found in the month of July. Hailstones were very common in this area. During the winters, from November to March, whole study area remains covered by thick blanket of snow.

Physico- chemical characteristics of soil samples: Soil samples of all the four sites were collected and analyzed for soil texture, pH, nitrogen, and phosphorus following the standard methods (Wilde *et al.*, 1972). Calcium, potassium and sodium content of the soil were determined by flame photometer method (Peach and Tracey, 1956). Sand (50-58 %) silt (06 to 09 %) clay (33- 39 %) and pH value ranges from (5.5 to 6.1) varied among all four study sites. The ranges of % water holding capacity WHC (26-32) porosity (38 to 42) organic carbon (0.42 to 0.49 %) total N (0.13 to 0.15%) Phosphorous (1.6 to 2.1 ppm) potassium (38 ppm to 45ppm), Calcium (207 to 223 ppm) and Sodium (142 ppm to 173 ppm).

Growth behaviour of *P. utilis:* For the growth attributes analysis, the area was surveyed several times at one month interval to locate the densely populated area with *P.utilis* with different girth classes. The associated plants were collected, identified and a list of associated species was prepared.

Shoot length was measured by measuring tape. It was calculated from ground level to apex. The data of number of leaves was recorded by counting all the leaves, irrespective of their size, present on the marked plants and than calculating the average number of leaves per plant (Shukla and Bist, 1994; Chamoli, 2003), For the observation of number of branch per plant, the number of branch was counted which were more than 5 cm in length (Shukla and Bist, 1994; Chamoli, 2002). Leaf area of the leaves was determined by the method proposed by Misra and Misra (1981).

The total leaf area was observed from the plants which

were marked for number of leaves and leaf area. The total leaf area was observed by multiplying the total number of leaves of a plant with leaf area and expressed as cm^2per plant. Leaf area index was calculated by the formula proposed by Ambasht and Ambasht (1999), the data of number of flowers per branch was observed by counting the total number of flowers in a branch. Five branches were taken for counting the average number of flowers per branch .Number of flowering twigs was observed by counting the total number of twigs which were in flowering phase. For the calculation of average number of flowering twigs total five plants were observed and their flowering twigs were calculated. Number of Fruit per plant: was calculated by counting the total number of fruits in a branch and then multiplying the total number of fruiting branches (Chamoli, 2003).

Fruit ripening period was noticed by observing the period of fruit ripening. The size and shape of fruit by taking**:** five different fruits were selected from different plants for determining the fruit size. Size of fruit was determined by measuring the length and diameter (breadth) of the fruits with the help of vernier caliper Size of seeds was calculated by covering the thread over the seed and then length of thread was measured by inch tape. The weight of 100 fruits was calculated by weighing the fruits in electronic balance (Chandok, 2006).The average seed output is the number of seeds obtained by a plant. As the object plant's fruit contain one seed inside it, the average seed output is equal to number of fruits produced by the plant. *i.e.*

Average seed output = No. of seeds per fruit × No. of fruits per plant.

RESULTS

The result of various growth parameters viz shoot length, number of leaves, number of branches, leaf area index, number of flowers per branch, number of flowering twigs, fruit productivity per plant, fruit length, fruit diameter, length of seed, seed diameter, seed output of *Prinsepia utilis*. a different girth classes of different sites are given in (Table 1).

The length of shoot of *Prinsepia utilis* at site 3 was reported to be minimum (70.4±6.13) cm for girth class 0.1-5cm, and maximum (220.5±23.13cm) for girth class 25.1-30cm, at site 1 respectively (Table 1). The numbers of leaves per branch were minimum 20±4.68 at site 3 for girth class 0.1-5cm, and maximum 80.5±41.21 for girth class 25.1-30cm, at site 4.

The numbers of branches per plant at site 2 were found minimum 3.6±0.46 for girth class 0.1-5cm, and maximum 6.8±0.73 for girth class 25.1-30cm at site 1. Leaf area index of *Prinsepia utilis* studied are given in Table 1. Maximum Leaf area index was found 1.98 for girth class 5.1-10cm, at site 1 and minimum 0.70 for girth class 25.1-30cm at site 4.

Table 1. Growth parameters of *P.utilis* at different girth class intervals at different sites at Uttarkashi district of Garhwal Himalaya.

Growth parameters	Girth class (cm.)					
	(0.1-5)	(5.1-10)	(10.1-15)	(15.1-20)	(20.1-25)	(25.1-30)
Shoot length (cm)						
Site 1	80.5±12.03	96.8±15.45	150.9±13.6	165.5±12.64	185.8±11.67	220.5±23.13
Site 2	75.3±12.31	90.3±8.11	143.2±11.67	160±17.83	180±36.05	201±22.78
Site 3	70.4±6.13	91.3±6.7	153.5±14.45	170.2±7.33	184±30.51	192±23.81
Site 4	74.4±6.12	90.8±9.5	140±14.55	163±5.32	173±22.51	193±2.84
No. of leaves per branch						
Site 1	23.5±8.4	34.9±6.66	48.3±7.86	58.0±9.27	64.3±6.8	70.5±7.61
Site 2	22.6±8.88	30.8±6.32	50.9±6.58	60.6±4.78	70.8±12.69	75.6±11.87
Site 3	20±4.68	28±22	38.6±11.17	45.2±4.02	59.6±12.84	72.8±30.77
Site 4	27±5.88	38.7±10	50±11.17	61.4±7.05	72±14.58	80±41.21
No. of branches						
Site 1	4.60±0.44	6.0±0.79	5.6±0.39	5.8±0.6	6.6±0.38	6.8±0.73
Site 2	3.6±0.46	4.6±0.44	4.8±0.44	5.7±0.47	5.3±0.45	6.2±0.6
Site 3	5.2±0.38	5.4±0.45	4.8±0.58	5.3±0.46	5.8±0.45	6.1±0.44
Site 4	4.9±0.35	5.2±0.44	4±0.41	5.2±0.38	5.3±0.41	5.9±0.44
Leaf area index						
Site 1	1.80	1.98	1.60	1.21	1.09	0.80
Site 2	1.90	1.78	1.55	1.40	1.05	0.75
Site 3	1.80	1.53	1.49	1.031	0.91	0.80
Site 4	1.70	1.48	1.40	0.97	0.80	0.70
No. of flowers per branch						
Site 1	---------	---------	40±22.41	51.7±7.15	68.6±6.30	81±7.50
Site 2	---------	55.5±12.86	68.2±13.82	70.6±6.56	65±7.38	70.9±6.68
Site 3	---------	60.4±10.75	65.4±11.48	77.7±12.67	88.4±5.77	90±9.66
Site 4	---------	---------	54±10.73	60.7±7.11	65.7±11.56	89.6±5.77
No. of flowering twigs						
Site 1	---------	---------	5.7±1.5	9±3.08	10±2.7	11.4±3.32
Site 2	---------	4.2±1.04	6.2±2.02	7.4±1.49	9.6±4.08	10.4±3.34
Site 3	---------	4.7±3.05	4.6±1.03	5.0±2.28	7.2±4.11	8.6±1.62
Site 4	---------	---------	4.4±3.04	5.0±1.03	6.6±1.27	7.2±3.13
Fruit length (cm)						
Site 1	-------	--------	0.840±0.036	0.905±0.08	0.915±0.028	0.935±0.08
Site 2	-------	0.75±0.07	0.69±0.08	0.78±0.07	0.86±0.05	0.88±0.09
Site 3	-------	0.77±0.04	0.78±0.09	0.76±0.08	0.73±0.07	0.79±0.09
Site 4	-------	--------	0.73±0.04	0.74±0.08	0.79±0.07	0.88±0.08
Fruit diameter (cm)						
Site 1	--------	---------	0.999±0.081	0.889±0.030	0.795±0.04	0.289±0.08
Site 2	--------	0.84±0.03	0.80±0.02	0.93±0.04	0.91±0.08	0.98±0.07
Site 3	-------	0.80±0.06	0.75±0.07	0.80±0.09	0.85±0.09	0.90±0.01
Site 4	-------	--------	0.70±0.03	0.81±0.02	0.84±0.06	0.88±0.05
Length of seed (cm)						
Site 1	-------	--------	0.56±0.04	0.58±0.4	0.62±0.06	0.65±0.06
Site 2	--------	0.50±0.05	0.61±0.02	0.66±0.07	0.67±0.05	0.70±0.03
Site 3	--------	0.49±0.06	0.51±0.02	0.58±0.4	0.61±0.2	0.65±0.5
Site 4	--------	---------	0.48±0.07	0.50±0.03	0.52±0.05	0.54±0.03
Diameter of seed (cm)						
Site 1	-------	---------	0.44±0.04	0.46±0.28	0.44±0.30	0.47±0.03
Site 2	-------	0.46±0.36	0.52±0.21	0.58±0.38	0.60±0.26	0.59±0.26
Site 3	--------	0.48±0.04	0.60±0.05	0.52±0.08	0.61±0.07	0.61±0.03
Site 4	--------	--------	0.50±0.04	0.52±0.04	0.51±0.08	0.43±0.03

Contd.

Table 1. Contd.

Seed out put						
Site 1	-	**-**	1049.6±376.4	1306.8±661.2	1698±894.4	2209±510.97
Site 2	-	908.2±313.72	1134.4±672.72	1650.8±852.12	1880.8±789.67	1690.2±637.6
Site 3	-	1167.6±127.16	1091.1±126.75	1218.2±117.36	1398.5±105.62	2010.4±467.26
Site 4	-	**-**	898±322.57	1230±654.35	1458.7±866	1886±398.61

The number of flowers per branch for site 1 and 4 are given in Table 1. In girth class 10.1-15cm, number of flowers per branch was found minimum 40±22.41 at site 1 and maximum 89.6±5.77 flowers per branch for girth class 25.1-30 cm at site 4. The data of number of flowering twigs per plant of *Prinsepia utilis* in different girth classes are given in table 1. Minimum numbers of flowering twigs were 4.2±1.04 in girth class 5.1-10 cm, at site 2.and maximum 11.4±3.32 in girth class 25.1-30 cm at site 1 respectively.

Fruit production by female plant of *Prinsepia utilis* was measured annual basis. It was found that site 2; maximum fruits productivity was found 1800.63g for girth class 25.1-30cm and minimum 756.9g for girth class 10.1-15cm, at site 4. Minimum fruit length was found 0.69±0.08 cm for girth class 10.1-15cm, at site 2 and maximum 0.935±0.08 cm for girth class 25.1-30 cm at site 1. The data of fruit diameter are shown in Table 1. The minimum fruit diameter was found to be 0.70±0.03 cm for girth class 10.1-15 cm, at site 4 and maximum 0.88±0.05cm for girth class 25.1-30cm, at site 4, respectively. The length of seed is given in Table 1. It was minimum found 0.48±0.07cm for girth class 10.1-15cm, at site 4 and maximum 0.70±0.03 cm for girth class 25.1-30 cm at site 2, respectively. The minimum Seed diameter was found 0.43±0.03cm for girth class 25.1-30cm at site 4 and maximum 0.61±0.07cm for girth class 20.1-25 cm at site 3. Seed output is the average number of seeds obtained by one plant. The minimum Seed output was 898±322.77 for girth class 10.1-15cm, at site 4 and maximum 2209±510.97 for girth class 25.1-30 cm, at site 1.

DISCUSSION

The results of various growth parameters indicate that plant shoot length varies among all four sites for different girth class. Maximum plant shoot length was found for site 1 and amounting to 220.5±23.13cm for maximum studied girth class 25.1-30cm, while minimum plant shoot length 70.4 ±6.13cm was found for site 2. Singh and Singh, (2004). Studied the morphological growth variations in Bhenkal populations growing in Lahul valley, at dry temperate Himalayas. They found that plant height decreased in *Prinsepia. utilis* with an increase in altitude, which varied from a maximum of 271 cm at Jhala (2900 m) to a minimum of 101 cm at Shuling (3200 m). (Number of leaves per branches ranges from 20 (site 3) to 80 (site 4). Almost similar results were found by Yadav *et al,* (2006). The variation in shoot length, and number of leaves

indicate that microclimate of an area may be one of the determining factor of growth behaviour of a species (Agrawal, 1989).

Maximum leaf area index was 1.98 for girth class 5.1-10cm at site 1 and minimum 0.70 for girth class 25.1-30cm at site 4. Fruit productivity was found maximum at site 2. It was 1800.63 grams/plant. Fruit length was found minimum 0.69±0.08 cm at site 2 for girth class 10.1-15 and maximum 0.88±0.09 cm at site 2 among all sites. Yadav *et al,* (2006) were also recorded similar results. All these variations are due to altitudinal and climatic difference according to Yadav *et al,* (2006) average fruit length varied from 8.0 to 17 mm. and fruit width range from 6.2-9.8. Dwivedi *et al.,* 2004 and Thapliyal (2006) reported the weight of 100 seeds within the range of 200-250 gm. The observation recorded by Yadav *et al.* (2006), Dwivedi *et al.* (2004), and Thapliyal (2006). Fruit diameter was found to vary between 0.70 to 0.98 cm among all four study sites. Dwivedi *et al.* (2004) reported that fruit diameter was found to be varies from 6. 2 to 9.8 mm. Seed length varies between 17mm, long and contains a single large seed. Seed diameter ranged between 0.67 to 0.99 cm among all girth class in all four sites. Singh and Singh (2004) also found the similar results with *Hippophe rhamnoides* at lahul valley. Fruit productivity per plant per annum was also recorded in the present study and found within the range of 759.9.g per plant to 1800.09g per plant. Kawecki *et al.,* (2004) Studied in Belarus that yields ranged widely from 2.2 to 20.1 kg/bush, with an average of 7.4 kg/bush. The maximum yields recorded were for 'Otrodnaya' (20.1 kg/bush) and 'Podarok Sadu' (17.0 kg/bush), both in 2003. In 2001 and 2002, none of the varieties had yields over 10 kg/bush (Kawecki *et al.,* 2004).

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