



FORM-F

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Human Resource Development Group

(Extra Mural Research Division)

CSIR Complex, Library Avenue, Pusa, New Delhi – 110012

PROFORMA FOR PREPARING FINAL TECHNICAL REPORT

(Five copies of the report must be submitted immediately after completion of the research scheme)

1. Title of the scheme

“Morpho-cytological analysis in seabuckthorn (<i>Hippophae rhamnoides</i> L.) with emphasis on the identification of sex chromosomes”	Scheme No.: 38(1426)/16/EMR-II Dated: 17/05/2016 Date of Commencement: 01/07/2016 Date of termination: 31/12/2019
--	--

2. Name and address of Principal Investigator

Dr. Veenu Kaul Professor Department of Botany University of Jammu, Jammu-180006, Jammu and Kashmir

3. Name of Sponsoring laboratory of CSIR (If applicable)

Not applicable

4. Total grant sanctioned and expenditure during the entire tenure

	Amount Sanctioned	Expenditure
Staff	Rs. 9,42,434/-	Rs. 7,74,790/-
Contingency	Rs. 2,75,000/-	Rs. 2,63,587/-
Equipment	Rs. 5,40,000/-	-Nil- Refunded to CSIR vide DD No 576284 dated: 28-01-2019
Total	Rs. 17,57,434/-	Rs. 10,38,377/-

5. Equipment(s) purchased out of CSIR grant

Name	Cost
Could not be purchased within stipulated time	
Due to certain unavoidable hurdles at various steps of the purchase process, the sanctioned amount under head Equipment could not be utilized on time. The problems faced for the same have been brought to the notice of concerned authorities through e-mail or telephone and by the SRF employed in the project on his visit to your section on July 26, 2017. Therefore, the	

cytological work which is the prime objective of the project could be started only in 2017.

6. Research fellows associated with scheme

Name& Designation	Date of Joining	Date of leaving
DR. SONAM TAMCHOS (SRF)	15/09/2016	10/10/2019

7. Name(s) of the fellow(s) who received Ph.D. by working in the scheme, along with the Title(s) of thesis: MR. SONAM TAMCHOS

“Studies on Morpho-Taxonomic Evaluation of Seabuckthorn (*Hippophae* L.) Growing in Leh and Nubra Valleys of Ladakh (J&K)”

8. List of research papers published/communicated/ under pipeline based on the research work done under the scheme (Name(s) of author(s), Title, Journal, Volume number, Year and Pages should be given for each paper published and a copy of each of them should be enclosed; reprints/copies of papers appearing after submission of FTR should also be sent to CSIR):

Six abstracts published and presented in different National and International Conferences and two best poster presentations awarded.

List of Abstracts published

1. “Some Interesting Nuances in the Reproduction of *Hippophae* L. (Veenu Kaul, Amjad Ali and Sonam Tamchos) in “86th Annual Session of National Academy of Sciences, India” organised by The National Academy of Sciences, India held at Dehradun, **December 2-4, 2016.**
2. “Morphological analysis of Male and Female plants of Seabuckthorn from Zaskar, Ladakh” (Nawang Tundup, Sonam Tamchos and Veenu Kaul) in 12th JK Science Congress. Organized by University of Jammu in collaboration with J&K State Science Technology and Innovation Council, Govt. of J&K held at Department of Botany, University of Jammu, Jammu J&K. **March 2-4, 2017 (BEST POSTER PRESENTATION).**
3. Variability at the morphological level and its scope in the improvement of Seabuckthorn (Sonam Tamchos) in 106th Indian Science Congress. Organized by Lovely Professional University, Jalandhar, Punjab in collaboration with Indian Science Congress Association, **Jan. 3-7, 2019.**
4. Seabuckthorn- a non-leguminous nitrogen fixer and ecosystem restorer (Sonam

Tamchos and Veenu Kaul) in International Conference on Recent Advances in Interdisciplinary Sciences. Organized by Department of Electronics, University of Jammu, Jammu J&K. **Jan 11-12, 2019.**

5. Intra-specific diversity in Seabuckthorn growing in Ladakh- analysis and conclusion (Sonam Tamchos, Veenu Kaul, Amjad Ali, Randeep Sen and Nawang Tundup) in UGC-SAP sponsored two day National Seminar on Plant and Fungal Diversity: Status and Challenges and Symposium on Plant Ecology. Organized by Department of Botany University of Jammu, Jammu J&K. **March 18-19, 2019. (BEST POSTER PRESENTATION).**
6. Investigation of floral variability and fruiting density in Seabuckthorn (*Hippophae* L.) growing in Ladakh (Sonam Tamchos, Amjad Ali and Veenu Kaul) In UGC-SAP (DRS-II) sponsored two day National Seminar on Diversity and Reproduction in Plants and Microbes: Present Scenario. Organized by Department of botany University of Jammu, Jammu J&K. **February 7-8, 2020.**

I. One paper published and two under preparation.

List of papers: Published

1. Sonam Tamchos and Veenu Kaul (2019). Seabuckthorn: opportunities and challenges in Ladakh. National Academy of Science Letters 42(2):175–178

Under preparation

2. Phenotypic variability in Seabuckthorn (*Hippophae* L.) growing in cold desert of India.
3. Assessment of morpho-cytological variability in plants of *Hippophae rhamnoides* growing in Ladakh.

9. Details of new apparatus or equipment designed or constructed during the investigation: **Nil**

10. The likely impact of the completed work on the scientific/technological potential in the country (this may be attached as Enclosure-I):

- I. A complete and comprehensive directory of the variability at the morphological and cytological levels is available.**
- II. Database generated can be utilized whenever and wherever required in the country.**

11. Is the research work done of some industrial or agricultural importance and whether patent(s) should be taken? **Yes**

12. How has the research work complemented the work of CSIR Laboratory that sponsored your scheme? **NA**

13. Detailed account of the work carried out in terms of the objective(s) of the project and how far they have been achieved; results and discussion should be presented in the manner of a scientific paper/project report in about 5000 words; and this should be submitted as **Enclosure-II** to this report.


14. An abstract of research achievements in about 200-500 words, suitable for publication.

Seabuckthorn is widely distributed across Ladakh region of Jammu and Kashmir. It grows naturally along the rivers and their tributaries, roads, agricultural fields and waste lands. Detailed survey has been carried out in four different valleys (Leh, Nubra, Kargil and Zaskar) which are geographically different and isolated from each other. The distance between Leh and Kargil is around 225km and that of Zaskar from Kargil is 245 km while Leh is around 125 km from Nubra. Five populations from each valley located at different altitudes and habitats were selected for the present study. Field surveys along with their GPS details have been completed in all these four regions. Research materials from each of these sites have been collected and subjected to various investigations. Cuttings collected from populations raised in Leh are maintained; root formation occurred successfully in almost all. All the morphological parameters have been worked out in detail. Mitotic and meiotic data for majority of plants from selected sites have been put on record. Specimens have been deposited in the herbarium of Department of Botany, University of Jammu, Jammu.

15. Mention here whether or not the unspent grant has been refunded to CSIR:

The unspent balance has been refunded to CSIR vide DD No. **097860** dated **02/07/2020**

Date:07-07-2020


Signature of PI

Note: Final Technical Report is expected to be self-contained complete report of the work done. Please do not leave any column unanswered.

Enclosure-II

Areas surveyed

Four valleys of Ladakh i.e., Leh, Nubra, Kargil and Zaskar have been explored extensively and plants belonging to five populations of each of these areas were selected and labeled (Table 1; Fig 1). Located between 33° 23' to 34° 40' N and 76° 03' to 77° 48' E at altitudes ranging from 2712 to 3718 masl (Table 1), these are detailed below.

Valley	Population	Altitude masl	No. of plants collected from each populations
Leh	1. Choglamsar	3229	10
	2. Sakti	3718	10
	3. Matho	3480	11
	4. Basgo	3302	6
	5. Skurbuchan	2884	4
Nubra	1. Partapur	3116	10
	2. Hunder	3101	10
	3. Yakfarm	3113	10
	4. Sumur	3129	10
	5. Panamik	3161	10
Kargil	1. Barootsogs	2712	10
	2. Andoo	2722	10
	3. Kanoor	2828	10
	4. Minjee	2809	10
	5. Akchamal	2840	10
Zaskar	1. Gyapak	3548	10
	2. Salapi	3544	10
	3. Bardan	3650	10
	4. Ufti	3530	10
	5. Raru	3553	10

All populations consisted of male and female plants. However, some were female dominated, some male dominated while many exhibited 1:1 sex ratio. Skurbuchan is an exception; its population size is very small and all the plants are female. Yet fruit formation occurs on account of facultative apomixis (Ali and Kaul, 2017).

Plants grow in various habitats like road sides, river beds, sandy lands, meadows and plains etc (Figs. 2a-1) in varied forms. Most of the populations consist of either shrubs or treelets while some have a mixture of shrubs and tree-lets. Only few have small trees (Figs.2 a-1). All the plants were critically scrutinized and data on different morphological traits “both qualitative and

quantitative” recorded in the field during different periods of the year (see below) and from herbarium in the lab as per the descriptor given by Hyvonen (1996) and Mathew *et al.* (2007).

Floral morphometry: Mid April – First week of May

Fruit characteristics: October – November

Herbarium specimen: September – October

The compilations are consolidated in Tables 2, 3 and 4.

Herbarium specimens and descriptors of all the plants of all the populations mentioned above are ready. Consolidated average data of the ecological and morphological traits of these are represented in Tables 2-3.

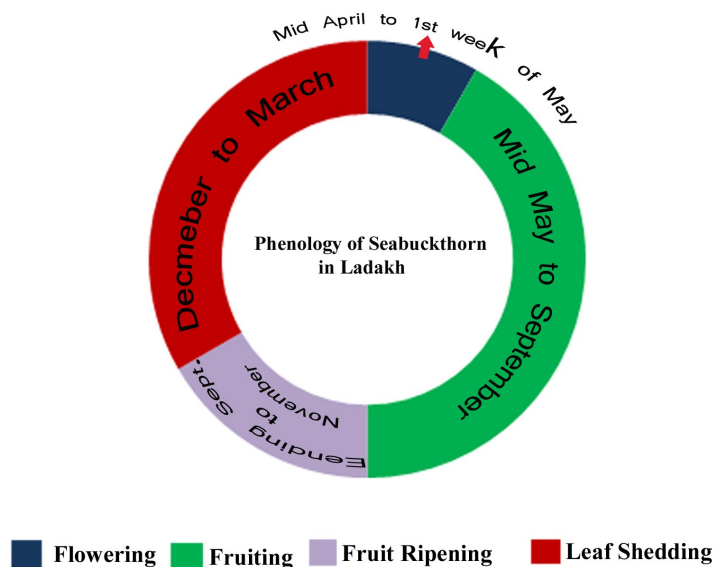
Results and Discussion

The plants show wide variation in almost every morphological trait within and between populations and between the sexes as well. *Hippophae* L. is a thorny species. The thorns are distributed sparsely or abundantly and are either branched or unbranched (Table 2). The plants of Kargil bear less thorn as compared to those of Leh and Nubra. However, the size is longer. Similarly the number of leaves borne per unit length of branch (6 Inch branch) in both the sexes is highest in plants of Zaskar followed by those of Leh and Nubra and least in the plants of Kargil. Those of Nubra bear smallest leaves across Ladakh (Table 3; Fig. 4.1).

Plants of Seabuckthorn are largely dioecious and expectedly obligate out-crossers. Individual flowers are very small. Male flowers are borne in tight racemes and vary between 4 and 18 per inflorescence (Fig. 3). These inflorescences bear a striking resemblance with the cones of gymnosperms both in dehiscent and un-dehiscent states. Female flowers are whorled or arranged in close spirals of 3 to 12 (Fig. 3). Irrespective of the sex, flowers are inconspicuous, each having two tepals and a bract that encloses the flower from outside. All the accessory organs are clothed densely in scales and stellate hairs. Flowers of both the sexes are colorless, nectar less, and odorless each consisting of either androecium or gynoecium and very rarely both enclosed by two tepals. However, some plants of Matho and Basgo deviate from this sex expression (Figs 5a-l). Flowers borne by these plants are of three types; male, female and hermaphrodite occurring on a single inflorescence of a single branch or different branches of the same plant (Table 4;

Figs. 5a-l). Sex expression of this type has been documented for the first time in this species. Data on the morphology and reproductive biology of these flowers have been generated.

Formation of floral buds starts in November but these remain dormant till April. In second week of April, the buds develop further, undergo expansion and mature into flowers. Blooming of flowers is initiated in mid April before the new leaves emerge. In first week of May new leaves start appearing. Male flowers are the first to open in a population with the apical ones in the raceme opening first. The female flowers follow after a gap of around 8 – 12 hours.



Semi hardwood cuttings of 15-20 cm collected from different populations were raised and are being maintained at Leh. Root formation (Fig. 4) was recorded in majority of the cases. Karyotypes have been worked out from these cuttings of male and female plants.

The flowering season is followed by long fruiting period and fruits completely ripen in October – November. Fruits show huge variation in color ranging from deep yellow to red with different shades in between (Fig. 6A), whereas the seeds are varied in colour, size and texture (Fig. 6B). The berries and seeds of Seabuckthorn are highly nutritious and rich source of many different essential compounds like vitamin C, omega fatty acids, flavonoids, organic acids etc. And the variation documented here is bound to differ in these essential constituents. Biochemical profiling, therefore, need to be followed subsequently.

Seed germination

Seed germination tried both in vivo and in vitro is quite high ranging from 92- 98% (Figs. 4c-d). However recruitment in the field is extremely low probably on account of reduced seedling survival. Only 1-2% seedlings survive. As a consequence seedling recruitment gets adversely affected. This is because majority of the seeds fall nearby, germinate into seedlings which are unable to compete with the already established mother plant. Additionally, those dispersed by birds are likely to fall into viable niches already occupied by the other plants.

Cytological studies

Root tip mitosis was worked out from seedlings as well as cuttings maintained at Leh. However good results were obtained in squashes from root tips of seedlings only. All the root tip cells have $2n=24$ chromosomes across populations; very few with $2n=48$ have also been put on record (Figs. 7-11, 12f, g). Size of chromosomes is very small; submetacentrics outnumber metacentric chromosomes; frequency of subtelocentric is least found in 11.35% cells (Figs. 7-11). On an average, the Total Chromatin Length (TCL) varies between 57.71 and 65.2 μm , and Mean Chromatin Length (MCL) from 2.38 to 2.71 μm (Tables 5 and 6).

Area wise, plants of Kargil have most variable somatic complements followed by those of Nubra and Leh in that order. Somatic complements could be categorized in two types: Type I and Type II on the basis of the overall size, pairing potential and placement of centromere. In Type I, all pairs are homomorphic; last pair has mean $\text{TCL}=1.71$, relative length=5.67 and index number =0.73. In Type II, all pairs except one are homomorphic. The heteromorphic ones have mean $\text{TCL}=1.79/2.91$, relative length=5.65/9.19 and index number=0.76/0.62. This established XX/XY system (Figs. 12 a-e) of sex determination in the species.

Reduction division in male track was extensively studied in second year from 10 accessions each of 17 populations and, 11, 6 and 4 from the remaining three. Majority (89.73 to 96.31%) of pollen mother cells (pmcs) have regular 12 bivalents at Prophase-I and Metaphase-I; 83.21 – 90.86% of these segregate normally at Anaphase-I (Figs. 13, 14). Average chiasmata frequency calculated is small i.e., 20.3 (19.13 – 21.1) and Recombination Index works to a range of 31.13 – 33.2.

Anomalies in the form of univalents, multivalents and cytomixis are most prevalent in 3.69 to 20.63% pmcs (Figs. 13 d-f, 14 d-g). Variation in bivalent number in some was also noticed. Few pmcs with heteromorphic bivalents were also observed indicating the presence of XX/XY type of sex determining mechanism in the species (Figs. 15a-d).

Significant Achievements

1. The plants of Seabuckthorn growing at Ladakh region of J & K exhibit a welter of variations in almost all features of morphological, cytological and reproductive nature. Plants can be raised to adulthood within 4-5 years from the seed and 2½ to 3 years from cuttings.

2. The plants are predominantly dioecious and out crossing in nature. However occasional sexual polymorphism coupled with asexual means of reproduction makes this species a complex. Many hermaphrodite, monoecious and poly gamo monoecious plants have been isolated from two populations. Apomixis also operates in few female dominated or exclusively female populations.

3. Complete morphological characterization of male and female plants belonging to 20 populations of Leh, Nubra, Kargil and Zaskar areas of Ladakh has been accomplished. Nevertheless, some promising populations have been identified. These are, plants with:

- less thorn density per unit length
- small sized thorns
- larger leaves
- higher leaf number per unit length
- greater fruit number and/or weight
- greater seed weight

4. Cytological analysis

- a) Meiotic studies of almost all the populations have been carried out.
- b) Mitotic studies accomplished for some populations of each of the regions of Kargil, Leh and Nubra.
- c) Majority of the plants are diploid with $2n = 2x = 24$. Some with variable numbers $2n = 4x = 48$ have also been isolated; some with $2n=20$ are also there.

A complete and comprehensive directory of the variability at the morphological and cytological levels is available and database generated can be utilized whenever and wherever required in the country.

One of the most important achievements is the cytological evidence favouring XX/XY type of sex determining mechanism in *Hippophae rhamnoides*.

Table 1. Physical parameters of plants of seabuckthorn belonging to different populations of four valleys of Ladakh

Valley	Population	Altitude masl	Latitude (E)	Longitude (N)	Soil aspect	Habitat
Leh	Choglamsar	3229	77° 36.455'	34° 05.295'	Sandy	Govt.Forest park
	Sakti	3718	77° 48.249'	33° 58.560'	Mixed*	River side
	Matho	3480	77° 38.322'	34° 00.056'	Mixed*	Street side
	Skurbuchan	2884	76° 45.667'	34° 27.233'	Stony	River side
	Basgo	3302	77° 16.233'	34° 13.192'	Fertile moist	Agricultural field
Nubra	Partapur	3116	77° 26.887'	34° 36.643'	Sand & clay	Along irrigation canal
	Hundar	3101	77° 29.491'	34° 34.551'	Clay	Waste land
	Yakfarm	3113	77° 32.443'	34° 33.743'	Sandy	Govt. Yak breeding farm
	Sumur	3129	77° 36.622'	34° 36.785'	Sand & clay	River side
	Panamik	3161	77° 32.331'	34° 46.579'	Sand & clay	River side
Kargil	Barootsog	2712	76° 08.603'	34° 32.522'	Sand & clay	River side
	Andoo	2722	76° 08.701'	34° 32.791'	Sandy	River side
	Kanoor	2828	76° 03.268'	34° 25.542'	Clay	Agricultural field
	Minjee	2809	76° 05.373'	34° 28.782'	Sand & clay	Waste land
	Akchamal	2840	76° 09.474'	34° 33.265'	Clay	Road side
Zaskar	Gyapak	3548	76° 51.429'	33° 29.826'	Mixed*	Marshy
	Salapi	3544	76° 50.992'	33° 29.781'	Mixed*	Meadow
	Bardan	3650	76° 55.101'	33° 23.862'	Sandy	Local protected area
	Ufti	3530	76° 53.724'	33° 29.148'	Sandy	Marshy
	Ruru	3553	76° 52.939'	33° 29.686'	Sand & clay	Cultivated land

*clay, sand and pebbles

Table 2. Qualitative traits of different populations of Seabuckthorn growing in four valleys of Ladakh

Region	Population	Growth habit	Thorniness/ branching	Stem colour	Fruit colour	Fruit shape	Seed colour and shape
Leh	Choglamsar	Erect shrub	Sparse & abundant/ branched & unbranched	Variable	Reddish orange & red	Oval & elongated	Dark brown, blakish and oval and flate oval
	Sakti	Erect shrub & treelet	Sparse & abundant/branched	Variable	Yellow – orange	Round	Brown and oval
	Matho	Erect shrub	Sparse & abundant/branched	Variable	Yellow – orange	Oval & elongated	Brown and oval
	Skurbuchan	Treelet	Less thorn and unbranched	Variable	Yellow – yellowish orange	Elliptical	Chocolate and elliptical
	Basgo	Erect shrub	Sparse & abundant/branched and unbranched	Variable	Yellowish orange - reddish orange	Oval & round	Brown and oval
Nubra	Partapur	Erect shrub	Sparse & abundant/branched	Variable	Orange – reddish	Oval	Brown, dark brown and oval
	Hundar	Erect shrub & treelet	Abundant/branched	Variable	Reddish orange	Round	Dark brown and spherical
	Yakfarm	Treelet	Sparse /branched and unbranched	Brown	Yellowish orange - reddish orange	Oval	Brown, chocolate; oval and spherical
	Sumur	Erect shrub	Abundant/branched	Brown & Ashy	Reddish yellow – Reddish orange	Oval/elliptical	Chocolate and oval and spherical
	Panamik	Erect shrub & treelet	Sparse /branched	Brown	Yellow - Reddish orange	Oval/elliptical	Brown and oval
Kargil	Barootsog	Bushy shrub	Abundant/branched	Variable	Orange-yellow	Round	Light brown, choc; oval
	Andoo	Erect bushy shrub	Abundant/branched	Variable	Yellow - reddish	Round	Brown and oval
	Kanoor	Erect shrub	Sparse/unbranched	Brown	Orange	Round/elongated	Brown; oval, elongated
	Minjee	Erect shrub	Sparse & abundant/ branched & unbranched	Variable	Yellowish orange	Round/elongated	Chocolate; elliptical, oval
	Akchamal	Erect shrub	Sparse & abundant/ branched	Variable	Yellowish orange – reddish	Round	Brown; oval, elongated
Zaskar	Gypak	Erect shrub	Sparse & abundant/ branched & unbranched	Reddish brown	Yellow & red	Oval	Chocolate, oval
	Salapi	Erect shrub	Sparse/ branched	Light brown	Orange	Oval	Chocolate; oval
	Bardan	Erect treelet	Sparse & abundant/ branched	Dark brown & reddish brown	Yellow – Red	Oval, round and elliptical	Brown, oval
	Ufti	Erect shrub	Sparse/ branched	Light brown-brown	Orange	Round	Brown; elliptical
	Ruru	Erect shrub	Sparse/ branched	Variable	Reddish	Round	Chocolate; oval

Table 3. Gender-wise quantitative traits of different populations of seabuckthorn growing in Leh
Nubra, Kargil and Zaskar valleys of Ladakh
[A] Both the sexes

Region	Population		No. of thorn/6 inch	Thorn length (cm)	No. of leaf/6 inch	Leaf length (cm)	Leaf width (cm)
Leh	Choglamsar	♂	23.1±9.21	1.006±0.39	150±70.7	2.46±0.44	0.34±0.05
		♀	29.9±20.08	0.87±0.145	192±84.9	2.36±0.44	0.29±0.03
	Sakti	♂	25.75±10.45	1.18±0.27	157.5±18.9	2.05±0.3	0.27±0.03
		♀	38.87±36.76	1.22±0.26	167.3±41.9	2.87±1.54	0.31±0.03
	Matho	♂	21±5.77	1.44±0.61	109.3±40.19	2.6±0.32	0.3±0.04
		♀	32±16.37	1.26±0.11	114.8±50.5	1.99±0.52	0.32±0.52
	Skurbuchan	♀	8.5±3.48	0.5±0.11	258±26.1	2.8±0.23	0.4±0.02
		♂	22.7±6.7	0.89±0.1	282.7±16.2	2±0.22	0.27±0.02
Nubra	Partapur	♂	13.4±5.64	0.76±0.21	125.6±23.8	1.5±0.08	0.29±0.34
		♀	13.3±4.3	0.82±0.15	116.4±43.9	1.93±0.56	0.3±0.01
	Hundar	♂	24.6±14.4	1.81±0.57	175.2±53.6	1.65±0.37	0.2±0.39
		♀	15.1±3.4	1.23±0.7	185.4±54.18	1.57±0.09	0.28±0.02
	Yakfarm	♂	27.16±19.6	0.87±0.17	98.5±22.2	1.77±0.29	0.28±0.14
		♀	12±3.8	0.86±0.02	127.6±30.4	1.43±0.24	0.28±0.02
	Sumur	♂	36.15±22.5	1.08±0.47	202.2±80.3	1.42±0.37	0.24±0.04
		♀	11.75±3.83	0.83±0.15	100.5±27.2	1.6±0.02	0.29±0.02
Kargil	Panamik	♂	21.3±18.14	0.97±0.21	132.5±36.37	1.75±0.29	0.3±0.006
		♀	13±4.66	1.47±0.6	123±28.84	1.69±0.37	0.28±0.02
	Barootsog	♂	10.5±2.5	1.04±0.19	75.1±7.1	2.31±0.5	0.3±0.02
		♀	6.6±2.05	1.04±0.37	67.3±33.6	3.47±0.08	0.33±0.06
	Andoo	♂	11±5.2	1.16±0.71	53.8±18.4	3.2±1.19	0.34±0.07
		♀	16±6.4	1.35±0.9	75.4±30.3	2.7±0.6	0.35±0.04
	Kanoor	♂	7.9±1.75	1.9±1.8	72.3±26.3	3.1±0.5	0.39±0.11
		♀	9.3±3.66	0.93±3.7	76.6±30	3.6±1.05	0.43±0.08
Zaskar	Minjee	♂	11±6.03	0.83±0.23	70.8±15.9	3.4±0.67	0.45±0.04
		♀	7±2.36	1.35±0.67	82.1±25.3	3.2±0.7	0.33±0.05
	Akchamal	♂	6.8±2.3	1.82±0.8	60.8±19	3.1±1.1	0.33±0.05
		♀	9.9±4.98	1.59±1.09	89.6±24.8	2.7±0.39	0.29±0.07
	Gypak	♂	7.2±1.36	1.86±0.42	213±10.28	3.82±0.93	0.44±0.047
		♀	6.6±0.51	1.9±0.4	195±3.79	2.98±0.84	0.4±0.048
	Salapi	♂	7.8±1.16	1.18±0.19	248±11.76	2.96±0.68	0.42±0.041
		♀	7.6±0.81	1.42±0.19	213±15	2.9±0.67	0.44±0.036
Zaskar	Bardan	♂	25.4±3.82	4.76±0.37	236.4±16.5	3.26±0.3	0.39±0.03
		♀	25.2±3.05	3.34±0.32	299.6±8.4	3.42±0.3	0.38±0.03
	Ufti	♂	6.2±0.8	1.88±0.18	231±11.93	3.07±0.24	0.37±0.013
		♀	6.2±0.66	1.56±0.13	220±15.31	2.98±0.76	0.35±0.09
	Ruru	♂	9.8±1.16	1.62±0.23	202±12.61	3.87±0.25	0.64±0.132
		♀	8.4±0.51	1.94±0.05	218±13.36	3.05±0.68	0.43±0.04

[B] Female plants

Region	Population	Fruit size (cm)	Seed size (cm)	Fruit weight g/100	Seed weight g/100
Leh	Choglamsar	0.62±0.05	0.35±0.02	13.9±1.79	0.84±0.07
	Sakti	0.5±0.09	0.42±0.02	8.72±0.11	1.11±0.02
	Matho	0.73±0.18	0.38±1.01	17.8±3.24	0.7±0.16
	Skurbuchan	0.61±0.04	0.35±0.02	11.31±0.42	0.98±0.07
	Basgo	0.69±0.04	0.34±0.03	16.67±2.54	1±0.14
Nubra	Partapur	0.66±	0.36±0.44	12.5±1.09	1.09±0.09
	Hundar	0.6±0	0.34±0.18	11.38±0.52	0.89±0.07
	Yakfarm	0.7±0.03	0.32±0.24	14.9±1.45	1.03±0.11
	Sumur	0.7±0.04	0.33±0.48	13.3±0.2	0.96±0.04
	Panamik	0.69±0.05	0.39±0.06	14.24±0.24	1±0.02
Kargil	Barootsog	0.85±0.43	0.42±0.02	10.29±0.29	0.89±0.01
	Andoo	0.61±0.05	0.32±0.02	8.71±0.28	1.08±0.02
	Kanoor	0.68±0.05	0.4±0	10.7±0.24	0.91±0.006
	Minjee	0.59±0.09	0.34±0.02	9.52±9.13	0.86±0.008
	Akchamal	0.69±0.06	0.34±0.024	10.69±0.009	0.74±0.0088
Zaskar	Gypak	0.57±0.02	0.29±0.017	8.9±0.02	0.2±0.04
	Salapi	0.54±0.04	0.24±0.024	9.03±1.71	0.3±0.01
	Bardan	0.55±0.06	0.28±0.03	9.7±1.57	0.4±0.01
	Ufti	0.48±0.03	0.28±0.022	7.5±0.26	0.3±0.02
	Ruru	0.58±0.02	0.3±0.21	12.7±1.12	0.33±0.21

Table 4: Qualitative and quantitative data of hermaphrodite plants of Seabuckthorn

A. Qualitative

Plant form	Thorniness / branching	Stem colour	Fruit colour	Fruit shape	Seed shape	Seed colour
Intermediate and erect	Sparse & abundant; branched	Brown and dark brown	Reddish orange	Round and oval	Irregular and elongated	Brown

B. Quantitative

No. of thorn/unit length (cm)	Thorn size (cm)	No. of leaves/ unit length (cm)	Leaf length (cm)	Leaf width (cm)	Fruit size (cm)	Seed size (cm)	Fruit weight g/100	Seed weight g/100
51.3±11.72	1.12±0.17	177.3±69.59	3.05±0.86	0.33±0.05	0.6±0.05	0.45±0.023	22.7±0.93	1.18±0.04

Table 5 A,B. Data on chromosome morphology of A. Type I (Fig. 11) and B. Type II(Fig. 12) somatic complements of plants of Minjee

(A) Type I

S. No	Length in μm			Index number (S/L)
	Long arm (L)	Short arm (S)	Total (L+S)	
1	2.02	1.48	3.51	0.73
2	2.02	1.48	3.51	0.73
3	1.48	1.48	2.97	1
4	1.48	1.48	2.97	1
5	1.55	1.35	2.90	0.86
6	1.55	1.28	2.83	0.82
7	1.35	1.35	2.70	1
8	1.41	1.28	2.70	0.90
9	1.95	0.67	2.63	0.34
10	1.95	0.60	2.56	0.31
11	1.28	1.28	2.56	1
12	1.28	1.14	2.43	0.89
13	1.35	0.81	2.16	0.6
14	1.35	0.74	2.09	0.55
15	1.28	0.81	2.09	0.63
16	1.28	0.74	2.02	0.57
17	1.01	1.01	2.02	1
18	1.01	1.01	2.02	1
19	1.14	0.81	1.95	0.70
20	1.21	0.74	1.95	0.61
21	1.01	0.87	1.89	0.86
22	1.14	0.74	1.89	0.64
23	1.08	0.81	1.89	0.75
24	1.01	0.67	1.68	0.66
Karyotypic formula: 7M,15SM, 2ST TCL = 58.04 MCL= 2.41 LC/SC= 2.08				

(B)Type II

S. No	Length in μm			Index number (S/L)
	Long arm (L)	Short arm (S)	Total (L+S)	
1	2.09	1.35	3.44	0.64
2	2.02	1.35	3.37	0.66
3	1.75	1.48	3.24	0.84
4	1.75	1.48	3.24	0.84
5	1.48	1.48	2.97	1
6	1.48	1.48	2.97	1
7	1.35	1.01	2.36	0.75
8	1.35	0.94	2.29	0.7
9	1.28	1.01	2.29	0.78
10	1.28	1.01	2.29	0.78
11	1.48	0.67	2.16	0.45
12	1.41	0.67	2.09	0.47
13	1.28	0.81	2.09	0.63
14	1.28	0.81	2.09	0.63
15	1.21	0.81	2.02	0.66
16	1.21	0.81	2.02	0.66
17	1.01	1.01	2.02	1
18	1.01	1.01	2.02	1
19	1.28	0.67	1.95	0.52
20	1.28	0.67	1.95	0.52
21	1.01	0.74	1.75	0.73
22	1.01	0.67	1.68	0.66
23	0.81	0.60	1.41	0.7
24	2.02	0.67	2.70	0.33
Karyotypic formula: 4M,19SM,1ST TCL = 56.5 MCL= 2.35 LC/SC=2.39				

Table 6 A,B. Data on chromosome morphology of A. Type I (Fig. 15) and B. Type II(Fig. 16) somatic complements of plants of Panamik

(A) Type I

S. No	Length in μm			Index number (S/L)
	Long arm (L)	Short arm (S)	Total (L+S)	
1	2.2	1.95	4.18	0.87
2	2.2	1.95	4.18	0.87
3	2.36	1.82	4.18	0.77
4	2.36	1.75	4.12	0.74
5	1.68	1.68	3.37	1
6	1.68	1.68	3.37	1
7	2.02	0.87	2.90	0.43
8	2.02	0.87	2.90	0.43
9	1.62	1.01	2.63	0.62
10	1.55	1.01	2.56	0.65
11	1.28	1.28	2.56	1
12	1.28	1.28	2.5	1
13	1.21	1.21	2.4	1
14	1.21	1.21	2.43	1
15	1.48	0.87	2.36	0.59
16	1.35	1.01	2.36	0.75
17	1.28	0.87	2.16	0.68
18	1.28	0.81	2.09	0.63
19	1.35	0.67	2.02	0.5
20	1.28	0.74	2.02	0.57
21	1.28	0.67	1.95	0.52
22	1.28	0.67	1.95	0.52
23	0.87	0.67	1.55	0.76
24	0.87	0.67	1.55	0.76
Karyotypic formula: 6M,18SM TCL = 64.52 MCL= 2.68 LC/SC=2.69				

(B) Type II

S. No	Length in μm			Index number (S/L)
	Long arm (L)	Short arm (S)	Total (L+S)	
1	2.15	1.68	3.83	0.78
2	2.09	1.68	3.77	0.80
3	2.02	1.68	3.7	0.83
4	2.02	1.56	3.58	0.77
5	2.02	1.55	3.57	0.76
6	1.88	1.55	3.43	0.82
7	1.48	1.35	2.83	0.91
8	1.48	1.21	2.69	0.81
9	1.35	1.14	2.49	0.84
10	1.21	1.14	2.35	0.94
11	1.21	1.14	2.35	0.94
12	1.55	0.8	2.35	0.51
13	1.34	1.01	2.35	0.75
14	1.31	1.01	2.32	0.77
15	1.27	1.01	2.28	0.79
16	1.27	1.01	2.28	0.79
17	1.27	1.01	2.28	0.79
18	1.27	1	2.28	0.78
19	1.28	1.14	2.28	1
20	1.14	0.92	2.06	0.80
21	1.14	0.67	2.05	0.48
22	1.38	0.67	2.02	0.49
23	1.35	0.67	2.02	0.49
24	1.35	0.67	2.02	0.53
Karyotypic formula: 4M,20SM TCL = 64.45 MCL= 2.65 LC/SC=1.89				



DEPARTMENT OF BOTANY

UNIVERSITY OF JAMMU

Baba Saheb Ambedkar Road, Jammu-180 006 (J&K) INDIA

No: JU/Bot/ CSIR/20/136

CSIR Sponsored Research Project on Sea buckthorn

Dated: 07-07-2020

The Head (EMR-II)
CSIR HRDG
CSIR Complex
New Delhi

Subject: 1. Utilization Certificate and Statement of Accounts
2. DD of unspent amount
3. Final Technical Report in FORM-F

Reference: 38(1426)/16/EMR-II dated: 17-05-2016

Sir,

This bears reference to the project entitled "**Morpho-cytological analysis in seabuckthorn (*Hippophae rhamnoides* L.) with emphasis on the identification and characterization of sex chromosomes**" sanctioned to me vide above mentioned letter number and date.

Please find herewith the following:

1. **Three copies of Utilization Certificate and Statement of Accounts** till December 31, 2019.
2. The **Demand Draft (in original) of unspent amount Rs. 1, 79, 057-00 (Rupees One lakh seventy nine thousand fifty seven only) bearing No. 097860 dated 02-07-2020.**
3. **Five copies of the Final Technical Report** in the prescribed form (**FORM-F**) of the above mentioned project.

Thanking you in anticipation

Yours sincerely

Veenu Kaul
07/07/2020
Veenu Kaul

PI, CSIR Sponsored research project
Department of Botany
University of Jammu
Jammu

Encls: As above including DD in original

ANNEXURE-II

Consolidated Statement of Accounts (01st April 2019 to 31st December 2019)

Scheme Number : 38(1426)/16/EMR-II, dated 17/05/2016
Title of the Research Scheme : Morpho-cytological analysis in Seabuckthorn (*Hippophae rhamnoides* L.) with emphasis on the identification and characterization of sex chromosome
Name of the Principal Investigator : Dr. Veenu Kaul
Date of Commencement : 1st July 2016
Date of Termination : 31/12/2019

Receipts [Particulars of grants received from CSIR and carry forward from previous financial year (2018-19)]					Payments (Particulars of grants spent)				
Period	Cheque No., date & Amount	Stipend	Contingency	Scientist Allowance (for Emeritus Scientist Scheme only)	Equipment Grant	HRA + MA	Total	Balance	
01/04/2019 to 31/12/2019	(P1910011840 265 dated 01/10/2019) Rs. 4,18,722/- & (P19110206631832 dated 2/11/2019) Rs. 2,88,712/-	Rs. 5,85,364/-	Rs. 1,25,678/-	Nil	Nil	Permissible as per host Institute	Rs. 7,11,042/-	Rs. 3,57,000/-	Rs. 1,14,265/-
						HRA @ Rs. 57,120/- MA @ Rs. 3,600/-	Rs. 5,31,985/-	Rs. 1,79,057/-	

Registrar
 Signature of Registrar
 with Stamp

Joint Registrar (Finance)
 Signature of Finance Officer
 with Stamp

Venu
 Signature of PI
 with Stamp
 Principal Investigator
 CSIR Project



10/02/2020



**FORM-L
UTILISATION CERTIFICATE**



COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Human Resource Development Group
CSIR Complex, Library Avenue, Pusa, New Delhi – 110012

CSIR-HRDG Scheme No. 38(1426)/16/EMR-II dated: 17/05/2016

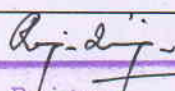
S.No.	Particulars	Letter No. /Bank Transaction ID Nos. & Date	Amount
1	Grants received from CSIR during the year (2018-19)	P19100118401265 dated 01/10/2019 and P19110206631832 dated 02/11/2019	Rs. 7,07,434/-
2	Unspent balance of previous year		Rs. 3608/-
3	Interest earned/accrued on CSIR grant		-Nil-
Total			Rs. 7,11,042/-

Certified that out of **Rs. 7,07,434** of grant-in-aid released by Extramural Research (EMR) Division of HRDG (CSIR) as given in the margin during the year **2019- 20** and **Rs. NIL** earned/accrued as interest from bank on grants released by CSIR and **Rs. 3608 /-** on account of unspent balance of the previous year, a sum of **Rs. 5,31,985/-** has been utilized for the purpose for which it was sanctioned and unspent balance of **Rs. 1,79,057/-** has been refunded via DD No **09 7860** dated **27-02-2020** to the funding agency.

1. Certified that I have satisfied myself that the conditions on which the grants-in-aid was sanctioned have been duly fulfilled/are being fulfilled and that I have exercised the following checks to see that the money was actually utilized for the purpose for which it was sanctioned. The detail expenditure incurred during the year is shown in the enclosed "Statement of Accounts (Receipt & Payment)".


Joint Registrar (Finance)
University of Jammu

10/02/2020

Signature of Authorized Officer
with Date & Seal


Registrar
University of Jammu

Countersigned by Registrar/Dean/Director
of the institute with Date & Seal

The Utilization certificate and statement should be signed by Head of the Finance & Accounts and countersigned by Registrar/Dean/Director of the University/Institute.



"PAYABLE AT PAR AT CBS BUSINESS UNITS"

J&K Bank

Demand Draft

Issuing Branch

CANAL

S. S. No.

97860

D D M M Y Y Y Y

27-03-2020

Or Order

On Demand Pay DY, SECY, EMR CSIR HRDG NEW DELHI

Rupees (in words) One Lakh Seventy Nine Thousand

₹ #####1,79,057.00

Fifty Seven only

OT TT OL TL ATL

Name of Purchaser (Mr./Ms./M/S) : REGISTRAR For The Jammu & Kashmir Bank Limited

***** Not Over INR. 1,79,057.00 *****

OLD/TMV/M/18

Alpha Prefix CIRCLE

Drawee Branch DELHI

AUTHORISED SIGNATORY
Code No.

Please sign above

[Signature]

AUTHORISED SIGNATORY
Code No.

⑈097860⑈ 000051000⑈

16

Valid for three months only from the date of issue
KL HI-TECH SECURE PRINT LTD. HYD./CTS/2017