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Comparative study of Morphological Growth of both the Rheum species viz. R. emodi and R. moorcroftianum found in different population from Garhwal Himalaya .

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ABSTRACT:-

In *Rheum emodi* the shoot length was recorded (116.4cm $\pm$ 38.37 to 154.5cm $\pm$ 4.10) and was 2-3 times more than that of *Rheum moorcroftianum*. The number of leaves varied from 4 to 6 in both the species of *Rheum*. Leaf length was noticed more in *R. moorcroftianum* than *R. emodi*. However, length decreased with increasing altitude. Lower leaves were longer than the upper leaves. In *Rheum emodi* root fresh weight was higher than shoot fresh weight. Root fresh weight increased with increasing altitude while shoot fresh weight decreased with increasing altitude. In most of the populations of *Rheum emodi*. The number of seeds per plant was recorded minimum (75-871) at Tungnath (3300m) and maximum (363-1526) at KN (3600m). In addition the colour of seeds also varied in both the species of *Rheum*.

Key Words – Ecophysiology, KN –Kedarnath, TN Tungnath, HK – Hemkund, VF – Valley Of Flowers, MD – Madhymashwar, HKD- Harkeedun.

Introduction :-

Two species of *Rheum* viz. *Rheum emodi* Indian Rhubarb ver. Archa and *Rheum moorcroftianum* ver. Dolu are herbaceous plant species growing in alpine and subalpine zone of Himalaya. Indian Rhubarb is well known for its medicinal value in Indian systems of medicine, modern pharmaceutical industries and in local systems of medicine leading to over and illegal exploitation and habitat destruction. Both the species are now restricted to few pockets and are facing threats to their existence. Keeping this in view, there is need to study the different populations of *Rheum* species and plan their conservation strategies.

Ten species of *Rheum* have been reported from Indian high altitude areas and these are commonly known as Indian Rhubarb. Most of them occurs naturally in the whole Himalayan range at an elevation of 3000 to 5200m including Garhwal Himalaya, Kashmir, Nepal and Sikkim. In the Garhwal Himalaya mainly two species of *Rheum* have been documented namely *R. emodi* and *R. moorcroftianum*. *Rheum emodi* (Archa) and *R. moorcroftianum* (Dolu) are two important medicinal plant species growing in the high altitude regions of Garhwal Himalaya. *R. emodi* Wall ex Meissn vern Archa grows on humus rich open slopes in alpine and subalpine zone of Himalaya.

This perennial herb is used as a pharmaceutical for its laxative, purgative, and cathartic properties which are attributed to the anthraquinones and their derivatives present in its rhizome (Ghouse and Katti, 1933; Chopra, 1958; Anonymous, 1972). In addition to anthraquinones this species also

contains oxalic acid tannins (Anonymous, 1972) and essential oils (Ghouse, 1935). Roots are used in wounds, ulcers, and several others diseases (Nadkarni, 1954).

The roots of another species *R. moorcroftianum* Royle possess purgative properties more or less similar to those of *R. emodi*. Roots of this species are also used for dyeing woolens yellow. The long and stout petioles of both these and some other species of *Rheum* are eaten either raw or cooked as vegetable (Kirtikar and Basu, 1935).

The phenotype of an organism is controlled by a multitude of genes, which act both individually and in converts upon the various stages of development and are influenced to varying degrees by the environment.

Review Of Literature :-

Alpine region represents the vegetation beyond timberline (Troll, 1956). Timberline is a reliable guide in the north hemisphere but it is much less distinguished in the southern part of the world. In the alpine regions of the Newzealand the timberline is at lower elevations to indicate the real boundaries between alpine and subalpine conditions. This situation is carried out to extreme, in such places as the western slopes of the Andes in Central Chile where there is no mountain forest, thus no timberline, and the lower edge of the alpine zone is left solely to ecologists judgement.

Hedberg (1957) concluded that climate vicissitudes of a different dimension is obtained at high levels on tropical mountains. Under natural conditions the vegetation of tropical mountains display a regular zonation. It is noteworthy that in spite of the richness of the flora, at lower levels the number of vascular plant species occurring in the alpine belt of East African mountains only amounts to between 70 to 150, and that most of these belongs to alpine flora elements (Hedberg, 1961,1965). A number of morphological features in alpine region that are unknown or rare at lower levels on the mountains and in their surroundings are giant leaf rosettes, dense grass tussocks, acaulescent growth, dense cushion growth and sclerophylly etc (Hedberg, 1973).

Morphological modification in the plants occurring at the high altitudes are considered of adaptive significance (Gate, 1975). Leaf morphology varies significantly from plant to plant but variations are often found in the individual plants with change of climate. The leaf structure affects (1) leaf temperature and transpiration (2) respiration and photosynthesis (3) heat tolerance or cold hardiness and (4) mechanical or structural stability (Taylor, 1971). A strong correlation exists between leaf structure and climate, but the correlation is not sufficient to describe and analyse the interactions of the leaf with the environment. Nautiyal (1982) concluded that the leaf length and width invariably increased with increasing altitude and effect become prominent within two months of the acclimatization of seedlings at these altitudes. Environmental modification of phenotype is the common

Character of high altitude plants. Adaptational changes in the plant phenotype are considered of adaptive significance and these adaptive changes are called phenotypic plasticity (Bradshaw, 1965). Plants may respond their surroundings by positive or adaptive, neutral or the fitness significant changes (Kuiper, 1985). The existing environment may also results in the genetic correlation among traits (Schlichling, 1989).

The ecological studies concerned with the floristic survey, bio- geographical features, composition and distribution pattern of vegetation of alpine regions in Garhwal were made by several workers

(Osmaston, 1922; Mani, 1974; Semwal and Gaur, 1981; Ram and Singh, 1988; Rawat et al., 1994 and Nautiyal et al., 1997).

Result And Discussion: -

The variations in plant morphology viz. leaf size, shape, number and biomass of different populations of *Rheum emodi* and *Rheum moorcroftianum* were recorded. The average number of leaves observed in different populations of *Rheum emodi* were 6 (± 1.58) at TN, 5 at HK, VF and KN and 4 (± 0.83) at HKD. The maximum length of leaf i.e. 20.2cm (± 3.56) was recorded at HKD, followed by 19.4cm (± 4.82) at HK, 15.85cm (± 4.03) at VF, 13.6cm (± 3.36) at TN and minimum 12.3 (± 0.14) at KN. The average length of floral spikes was 36.2 (± 4.33) at TN, 65.2 (± 9.52) at HKD, 64.6 (± 2.46) at HK, 54.4 (± 0.22) at VF and 59.3 (± 6.08) at KN. In case of *Rheum emodi* maximum shoot length was noticed 154.5cm in KN followed by 151.8cm in HK, and 149.4cm in VF, whereas minimum shoot length of 116.4cm was recorded in TN population. Maximum shoot fresh weight of 150.6gm was observed in TN population of *Rheum emodi* followed by 131gm in VF, 130.6gm in HK, 115gm in HKD and lowest 27.8gm of KN. Similarly highest root fresh weight (558.2gm) of *Rheum emodi* was observed in KN population followed by 344gm of HK, 338gm of TN, 286gm of VF and lowest (200gm) in HKD (Table 1).

While in case of *Rheum moorcroftianum* the number of leaves in all the three populations viz. TN, HK, and MD was observed 06 (± 0.70), leaf length of *Rheum moorcroftianum* was recorded 42.9 cm (± 2.12) at TN, 31.5 cm (± 0.07) at HK and 22.8 cm (± 2.58) at MD. Maximum length of floral spikes was observed at TN (60 ± 8.76 cm) followed by MD (53.99 ± 3.12 cm) and lowest in HK (41.89 ± 1.18 cm). Root fresh weight of *Rheum moorcroftianum* was recorded 155gm in TN and 251gm in HK and the dry weight of root was 33.1gm in TN and 64.8gm in HK (Table 2).

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Table 1-

Speeies / Populat ion	SN	N0 Of leaf	Leaf lengt h	Leaf widt h	Petio le Leng th	Shoo t Leng th	Root Leng th	Root Fr. Wt.	Sho ot Fr.t.	Root Dry wt	Sho ot dry wt	Steam Diame ter	Length Of Influen ces	No See ds
R. emodi Tunghn ath 3320 m	1	07	10	12	15	97	36	235	82	60	22	1.0	17	297
	2	4	16	18	8	90	22	355	81	86	12	1.5	42	159
	3	08	10	14	02	125	32	710	195	210	30	2.5	50	871
	4	06	17	18	2.5	180	12	160	185	43	25	2.0	28	75
	5	05	15	16	7.0	90	30	232	210	55	38	2.5	44	112
Mean		06	13.6	15.6	6.9	116.4	26.4	338.4	150.6	90.8	254	1.9	35.0	302
R. emodi Herkee dun 3260m	1	03	19	22	16	132	37	53	140	14	18	2.5	53	380
	2	04	20	21	4	130	26	140	92	35	15	2.0	60	670
	3	04	15	13	5	145	21	267	85	84	14	1.5	70	520
	4	05	23	25	16	175	60	328	115	124	18	2.0	78	1415
	5	05	24	35	35	150	19	212	143	60	26	2.0	65	495
Mean		04	20.2	23.2	15.2	150.4	32.6	200	115	63.4	18.2	2.0	65.2	696
R. emodi Valley Of Flower 3200 m	1	06	12	16	2	148	35	216	173	76	34	1.5	77	1135
	2	05	12	11	1.0	128	18	242	97	74	16	1.0	52	308
	3	05	15	20	70.	143	29	184	126	57.0	15.0	1.5	70	875
	4	05	18	17	1.0	164	12	95	67	31	16	1.0	60	493
	5	04	8.0	11.0	1.5	115	32	107	45	35	10	1.0	35	410
Mean		05	13	15	2.5	139.6	25.2	168	101.6	54	18	1.2	58.8	644
R.	1	5	26	35	1.5	143	-	-	-	-	-	2.0	55	840

emodi Hamku nd 3240 m	2	5	15	20	2.0	171	-	-	-	-	-	2.5	100	363
	3	5	16	15	2.5	152	32	-	-	-	-	1.5	80	775
	4	04	17	16	3.0	125	32	-	-	-	-	2.0	53	121 5
	5	05	23	25	5.0	168	28.6	-	-	-	-	2.0	35	152 6
Mean		05	19.4	22.2	2.8	151. 8	31.6	344	131	112	21.4	2.0	64.6	943

Table -2

Speeies/ Population	S N	N O Of lea f	Leaf leng th	Lea f wid th	Peti ole Len gth	Sho ot Len gth	Root Len gth	Root Fr. Wt.	Sho ot Fr.t.	Root Dry wt	Sho ot dry wt	Steam Diamete r	Length Of Influen ces	No See ds
R. moorcroftian um Madhymash war 3980 m	1	05	33	28	09	-	-	438	-	112	-	-	55	102
	2	04	12	27	10	-	-	163	-	67	-	-	44	161
	3	02	13	16	09	-	-	187	-	45	-	-	42	45
	4	02	10	11	08	-	-	160	-	37	-	-	37	102
	5	03	11	10	08	-	-	307	-	63	-	-	35	94
Mean		3. 0	15.8	18. 4	8.8	-	-	251	-	64.8	-	-	42.73	100
R. moorcroftian um Herkeedun 3980 m	1	06	36	42	15	-	-	-	-	-	-	-	54.8	486
	2	04	32	16	43	-	-	-	-	-	-	-	38.5	80
	3	08	28	14	30	-	-	-	-	-	-	-	34.5	69
	4	05	30	14	35	-	-	-	-	-	-	-	38.5	135
	5	06	32	16	30	-	-	-	-	-	-	-	39	60
Mean		06	31.6	15	36	-	-	-	-	-	-	-	41.06	166
R. moorcroftian um Tungnath 3800 m	1	6	36	42	17	-	-	-	-	-	-	-	6	62
	2	5	38	35	31	-	-	-	-	-	-	-	3	34
	3	7	65	67	22	-	-	-	-	-	-	-	5	42
	4	7	36	39	29	-	-	-	-	-	-	-	5	51
	5	6	47	54	25	-	-	-	-	-	-	-	7	52
Mean		6	44.4	47. 4	24.8	-	-	-	-	-	-	-	5	54



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