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Phytosociological analysis in brown oak dominated forest of Garhwal Himalaya, India

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ABSTRACT: The present study was carried out in eight forest sites dominated by *Quercus semecarpifolia* (brown oak) to asses variations in floral biodiversity and community with changes in microclimatic conditions between 2500-3500 m elevation in Chopta (Garhwal). Anthropogenic disturbances are changing the species richness and diversity, which influence the soil and environmental conditions. Thus, the conservation and management of these forests will be important for the sustainability of human and land in the region. A total of 14 species of trees, 8 species of shrubs and 20 species of herbs & grasses were encountered across the study area. [New York Science Journal. 2009; 2(4): 1-4]. (ISSN: 1554-0200).

Key words: Tree species, study sites, Garhwal Himalaya

INTRODUCTION

India is among the important mega-biodiversity centers of the world, with a lot of contribution from the Himalayan ecosystem. Biodiversity is used variously for fodder, fuel wood, timber, and leaf litter for manuring crop fields, construction, industrial raw material and several non-timber forest produce. Biodiversity is the totality of genes, species, and ecosystem in a region. Vegetation in a mountain area is affected by several factors of which altitude, aspect, slope, soil, canopy cover and microclimate are predominant at they modify regimes of moisture and exposure to sun. Forest diversity is the main source of livelihood of the people living in Uttarakhand, Central Himalaya. Species composition of major forest types of central Himalaya have been described by Ralhan et al (1982), Saxena and Singh (1984), Singh and Singh (1987), Singh and Singh (1992) have summarized the information on the structure and function of the Himalayan forest ecosystem. The present study was conducted in eight forest sites of *Quercus semecarpifolia* (brown oak) located between 2500-3500m elevations in Chopta forest of Garhwal to asses the phytosociological analysis of the vegetation. The impact of local people on vegetation, variation in floral biodiversity and community with changes in microclimatic conditions, and regeneration status were recorded during 2006.

MATERIALS AND METHODS

Chopta forest is located at 79º-79º30´E longitude and 30º30´-30º42´N latitude between 1500-4000m elevation in the Garhwal Himalaya. Altitudinally Chopta is located in temperate zone. For the detailed study of plant biodiversity and other vegetational parameters, the area was divided into eight forest sites. All the sites were located within the elevation range 2500-3500m.

The Chopta is characterized by its typical climate from temperate to alpine. About 60% of the area falls under alpine zone, which remains under snow during winter months. Broadly, three seasons can be recognized for the Chopta area, viz. summer (April-June), rainy (July-September) and winter (October-March). Winter experiences serve cold the main precipitations are received in the form of snow. Maximum snow depth occurs in the sub-alpine and alpine areas during February-March. With the rise the temperature in the month of April snow start malting in the lower altitudes by April it remains in scattered isolated patches below 2800m especially in shady localities. Snow melts only in April-May in the alpine zone. The main annual rainfall of the Central Himalaya is 2000mm (Singh and Singh, 1992). Rains are mostly confined to rainy season and heavy down pours in rainy season causes landslides and soil erosion.

A total of 15 (10mX10m) quadrats for trees, saplings and seedlings, 40 (2mX2m) for shrubs, and 40 (50X50cm) for herbs in each site were placed randomly and studied. Regeneration in the forests was sampled at four levels namely mature tree, sapling and seedling. Mature tree comprised of plants with >31.5 cm (gbh) over the bark at breast height (1.37m), sapling included all individuals >10.5 cm and <31.5cm gbh and seedling class composed individuals of <10.5cm gbh (Chaturvedi, et al 2005). The vegetational data was calculated for density (Curtis and Mc Intosh, 1950), and species richness was determined following Whittaker (1972) by tabulating the number of species in each site.

RESULTS

Quantitative analysis of trees, saplings, seedlings, shrubs and herbs at different study sites are given in Table 1-3. A total of 14 species of trees, 8 species of shrubs and 20 species of herbs & grasses were recorded from the study area. Except three sites (site 4th, 5th and 8th) broadly have similar major tree species. *Quercus semecarpifolia* and/or *Rhododendron arboreum* are the major tree species in all the eight sites. Only five sites are well canopied having 50-58% canopy cover.

Tree layer: *Tree layer:* Among the different sites, the maximum total tree density 2488 ind ha^{-1} recorded in the site 4th. However the minimum total tree density 323 ind ha^{-1} was recorded at site 3rd (Table 1).

Sapling layer: The total sapling density was recorded between 6-645 ind ha^{-1} at different sites. The *Quercus semecarpifolia* was found in sapling stages at only four sites except site 1st, 2nd, 5th, and 8th and its density ranged from 6-133 ind ha^{-1} (Table 1).

Seedling layer: The seedling density of *Quercus semecarpifolia* was recorded to maximum 692 ind ha^{-1} at site 7th and minimum (6 ind ha^{-1}) at site 2nd and site 8th respectively. Among the species maximum seedling density was recorded 692 ind ha^{-1} for site 7th and the minimum density also recorded 32 ind ha^{-1} at site 2nd (Table 1).

Shrub layer: The shrub density was recorded maximum 29675 ind ha^{-1} at site 1st and minimum 425 ind ha^{-1} at site 5th (Table 2).

Green layer: The herbaceous (ground vegetation) density was recorded to be maximum 526000 ind ha^{-1} at site 6th and minimum density was 425 ind ha^{-1} at site 5th.

Distribution pattern: There was no regular distribution pattern of the different strata observed in the study area as maximum species (88.01%) displayed their random distribution pattern at different sites and 11.98% species displayed contagious distribution pattern at different site of the study area (Kumar, 2008).

Table 1: *Density (ind ha $^{-1}$) for trees, saplings and seedlings*

Site	Species	Trees	Saplings	Seedlings
1	*Quercus semecarpifolia*	193	-	210
	Rhododendron arboreum	213	53	-
	Abies pindrow	106	-	-
	Taxus baccata	20	-	26
	Ilex dipyrena	40	-	-
	Acer sp	6	-	-
		578	**53**	**236**
2	*Quercus semecarpifolia*	372	-	6
	Rhododendron arboreum	80	-	13
	Ilex dipyrena	33	-	13
	Acer sp	13	-	-
	Abies pindrow	13	-	-
	Taxus baccata	6	-	-
		517	**0**	**32**
3	*Quercus semecarpifolia*	153	6	53
	Abies pindrow	25	-	-
	Ilex dipyrena	40	-	-
	Rhododendron arboreum	53	-	60
	Lyonia ovalifolia	6	-	26
	Machilus gamblei	33	-	-
	Quercus floribunda	13	-	-
		323	**6**	**139**
4	*Quercus semecarpifolia*	546	6	-
	Rhododendron arboreum	390	20	-
	Acer sp	220	20	-
	Aesculus indica	666	-	-
	Taxus baccata	666	-	-

		2488	**46**	**0**
5	*Quercus semecarpifolia*	293	-	73
	Rhododendron arboreum	380	73	16
	Abies pindrow	13	-	-
	Taxus baccata	13	6	6
	Acer sp	13	-	-
		712	**79**	**95**
6	*Quercus semecarpifolia*	220	10	40
	Rhododendron arboreum	120	40	40
	Acer sp	113	40	-
	Taxus baccata	26	-	6
	Sourbus cuspdata	6	-	-
	Syzgium cumini	13	-	-
	Abies pindrow	13	-	-
		511	**90**	**86**
7	*Quercus semecarpifolia*	293	133	406
	Rhododendron arboreum	220	46	-
	Rhododendron anthopogon	160	426	286
	Taxus baccata	80	40	-
	Abies pindrow	13	-	-
	Syzgium cumini	33	-	-
		799	**645**	**692**
8	*Quercus semecarpifolia*	146	-	6
	Rhododendron arboreum	20	-	60
	Acer sp	13	-	-
	Rhododendron anthopogon	20	-	-
	Picea simithiana	180	-	-
		379	**0**	**66**

Table 2: *Density (ind ha $^{-1}$) for shrubs*

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Daphne cannabina	29675	14000	5625	-	3425	-	-	-
Vibrunum cylindricum	1675	4675	800	2125	425	2875	675	6875
Berbaris petiolaris	1750	2000	925	3250	-	-	1550	
Daphne papyracea	-	600	-	-	-	-	-	-
Thamnoclamus jonsarensis (Ringal)	-	-	-	39100	-	-	-	-
Cotonneaster microphyllus	-	-	-	-	3425	-	-	1800
Skimmia anquetilia	-	-	-	-	-	-	22675	2425
Cotoneaster acuminatus	-	-	-	-	-	-	4050	-
Rosa sericea	-	-	-	-	-	-	1925	-

Table 3: *Density (ind ha $^{-1}$) for herbs*

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Lycopodium sp	42800	-	-	-	-	-	-	190400
Fragaria Sp	388800	418800	484000	366800	42800	-	118000	-
Heteropogon contortus	232800	-	232000	-	202000	-	40800	-

Impatins thomsonii	28000	-	-	-	-	-	-	-
Gentiana peldicellata	38000	340800	266000	-	84000	104000	-	238800
Ocimum americanum	184000	68000	-	10000	32000	52000	-	-
*Pusiyaghass**	104800	-	-	416000	-	526000	28800	230800
Dryopteris sp	40000	254000	-	112800	-	44000	46800	96000
Bistorata macrophylla	-	106000	252000	104800	30000	168000	122000	-
Daphniphyllum himalense	-	58000	-	160800	-	38800	-	-
Potentilla fulgens	-	92000	54000	-	425	-	-	114000
Sellaginella sp	-	-	172800	-	-	-	-	-
Lentanasp	-	-	100800	-	-	-	100800	18400
Saxifraga andersonii	-	-	-	16800	30800	-	-	-
Potentilla fulgens	-	-	-	32800	-	-	-	-
Valeriana jatamansi	-	-	-	100800	-	-	16000	44800
Impatins thomsonii	-	-	-	378000	-	68800	-	-
Pteris cretica	-	-	-	-	-	-	104000	60000
Gaultheria nummylariodes	-	-	-	-	-	-	-	290800
Nardostachys jatamansi	-	-	-	-	-	-	-	74800

** Locally identified*

DISCUSSION

The present study area is located in the altitudinal range of 2500-3500m and divisible of 8 different study sites on the basis of various disturbances such as grazing, browsing, litter removal and lopping. *Quercus semecarpifolia* and *Rhododendron arboreum* are the dominant tree species in all study sites. Giri, et al (2008) reported, the total tree density ranged from 320 to 1560 ind ha^{-1} in *Quercus leucotrichophora* forest and 320 to 1960 ind ha^{-1} in *Quercus floribunda* forest, but it was not recorded in *Quercus semecarpifolia* forest. The total tree density ranged from 323-2488 ind ha^{-1}, total sapling density from 0-645 ind ha^{-1} and seedling density from 0-692 ind ha^{-1} were recorded in present study sites. The tree density was comparatively high than the value of other oak reported by Giri, et al (2008). The anthropogenic pressure on *Quercus semecarpifolia* forest for firewood, fodder and timber, play an important role in declination of forest together with lichen moss collection.

In the present years the awareness regarding to conservation of flora and fauna among the local community and in people residing in the forest has helped in a large extend in protecting the forest in this area. The tendency of the people has changed as they are earning their livelihood regularly from forest by some alternative (selling milk, firewood by utilizing the forest foliage) instead of destroying trees.

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Species Richness in an Oak Forest of Indian Himalaya with reference to Canopy Gap.

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Abstract: The continuous anthropogenic disturbances are responsible for creating gaps of various sizes in forest canopies. The creation of gaps, both directly and indirectly, influence species richness and other vegetational parameters of a forest. In the present study, a total of 66 plant species were reported from all the three canopies of oak forest. The lowest species number (27) was recorded in closed canopied forest while medium canopied forest contained greatest richness (44). This indicates that the opening of canopy increase number of different plant species which belongs to the group of species present in closed as well as open canopied forest. The medium canopied forest maintained greater species richness compared to open and closed canopied forests. Tree species richness was present as open > medium > close, while highest shrub and herb richness were recorded in medium canopied forest. [New York Science Journal. 2009;2(4):5-16]. (ISSN: 1554-0200).

Keywords: Species Richness, Oak Forest, Canopy, Himalaya.

Introduction: Biodiversity is the "variation of life at all levels of biological organization" (Gaston and Spicer, 2004). The Summit defined "biodiversity" as "the variability among living organisms from all sources, including, *'inter-alia'*, terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems." Biodiversity is considered an important aspect of ecosystem energy because it allows building complex trophical networks and it functions as insurance for ecosystem stability and resilience (Gaston and Spicer, 2004).

Biodiversity is not distributed evenly on earth. It is consistently richer in the tropics and in other localized regions such as the California Floristic Province. As one approach Polar Regions, generally finds fewer species. Flora and fauna diversity depends on climate, altitude, soils and the presence of other species. In the year 2006, large numbers of the Earth's species are formally classified as rare or endangered or threatened species; moreover, most scientists estimate that there are millions more species actually endangered which have not yet been formally recognized.

Diversity at all organisation levels, ranging from genetic diversity with population to the diversity of ecosystems in landscapes, contributes to global diversity. In addition, effects of species richness on function of ecosystems and species diversity influence the resilience and resistance of ecosystems to environmental changes (Chapin *et al.*, 2000).

Species diversity is an important concept, and one of the major attributes of a natural community. Communities exhibit a property in which they vary enormously and this property is named diversity (Pielou 1975). According to Whittaker (1977) species diversity can be defined as on several scales from a point or microenvironment to a region, but the essential evolutionary questions treat number of species in communities, landscapes and regions. Diversity has often been related to various community attributes such as productivity (Margalef, 1968; Singh and Mishra, 1969; Auclair *et al.*, 1976), structure (Goff and Zedler, 1968; Auclair and Goff, 1971; Bazzaz, 1975), stability (Watt, 1965; Woodwell and Smith, 1969; Johnson *et al.*, 1975), niche structure (Johnson, 1977), and evolution (Pianka, 1966; Slobodkin and Sanders, 1969; Tramer, 1974; Auclair *et al.*, 1976).

Biodiversity at all hierarchical levels is impacted upon by disturbance of an ecosystem in terms of maintenance and restoration (McNaughton, 1989; Walker, 1989; Pickett and Parker, 1994). Changes, such as, of land use, in resource use, increased biotic invasions, reduction in species number and creation of stress, have a direct impact on biodiversity through habitat destruction and resource over exploitation and indirect impact through their effect on the composition of the atmosphere and the climate (Heywood 1995). In areas influenced by humans many species have been purged (Chapin III *et al.* 2000). Factors, such as, the available pool of species, the physical characteristics of the land, soil fertility, climate and disturbance regime characteristics, control the vegetation dynamics of forests system (Gauthier *et al.* 2000). Understanding and managing the disturbance regimes of a landscape under past natural or semi-natural conditions is one of the foundations of conservation of biodiversity in forest landscapes (Spies and Turner 1999). The chronic disturbances and fragmentation, both natural and manmade, are major threats to biodiversity in the Himalayan region (Singh, 1998).

Material and Methods: The study was conducted during years 2005 and 2006. The study area was Ayarpatta (Fig.1.), located on the west hill of Nainital town, India. Three canopy covers were selected for the vegetation analysis and the status of leguminous shrub was also observed in the forest. The canopy cover was determined with the help of Densitometer, an instrument for measuring forest cover with density level 12"-18" in front of body and at elbow height. So that firstly, we have selected Ayarpatta site and determined canopy cover. On each site four readings were taken with the help of Densitometer per location facing North, East, South and West, and averaged. Assumed four equal spaced dots in each square of gird and systematically count dots equivalent to quarter square canopy opening multiply the total count by 1.04 to obtain percent of overhead area which would not be occupied by canopy. After measuring the canopy cover, the area was divided into three canopies cover, *viz*. open canopy (<30%) medium canopy (<30-60%) closed canopy (>60%).

Fig 1. (A). Ayaarpatta Closed Canopied Oak (Quercus leucotrichophora) forest.

Fig. 1.(B). Ayarpatta Open Canopied Oak (Quercus leucotrichophora) forest.

After through reconnaissance, tree, shrub and herb species were identified with the help of plant taxonomist, floras (Polunin and Stainton, 2006) and listed from all the forest sites. All the three vegetation layer i.e. tree, shrubs and herbs were analysed for each canopy cover. Tree layer was analysed in ten, 10×10 m quadrats, shrubs were analysed by placing ten, 5×5 m quadrats and herbs by ten, 1×1 m quadrats, randomly. Species richness was determined as the number of species per unit area (Whitaker 1972, 1975). The herbs were analysed during peak growing season (August-September). Circumference at breast height (cbh 1.37 m) was taken to determine the tree basal area as, $c^2/4$.

Cover of leguminous shrubs was taken by taking five replicate plants in each canopy cover. The length (L) and width (W) of the canopy was measured and the product (L x W) is considered as the shrub cover (m^2/ plant). Tree basal area of a species was the multiple of mean tree basal area and density while total cover of a leguminous shrub species was the multiple of mean cover and density. Total basal area was sum of the basal area of all species. The vegetation data were quantitatively analyzed for Abundance, Density and Frequency (Curtis and McIntosh 1950). The distribution pattern of different species was studied using the ratio of abundance to frequency (Whitford 1949).

Results

Overall species richness of the study area was 66, out of which 6 were trees, 21 shrubs and 39 herbs (Table 1). In open canopied forest, total species richness was 31; in medium canopied 44; and in close-canopied forest were 27 (Fig. 2). *Cornus macrophylla* and *Quercus leucotrichophora* were common in all the canopy covers while *Berberis asiatica, Desmodium elegans* and *Indigofera heterantha* were the common species in shrub layer and *Anemone vitifolia, Arthraxon prionodes, Carex nubigena, Commelina benghalensis, Gallium rotundifolium* and *Valeriana wallichii* herbs were common in all the canopies (Table 1).

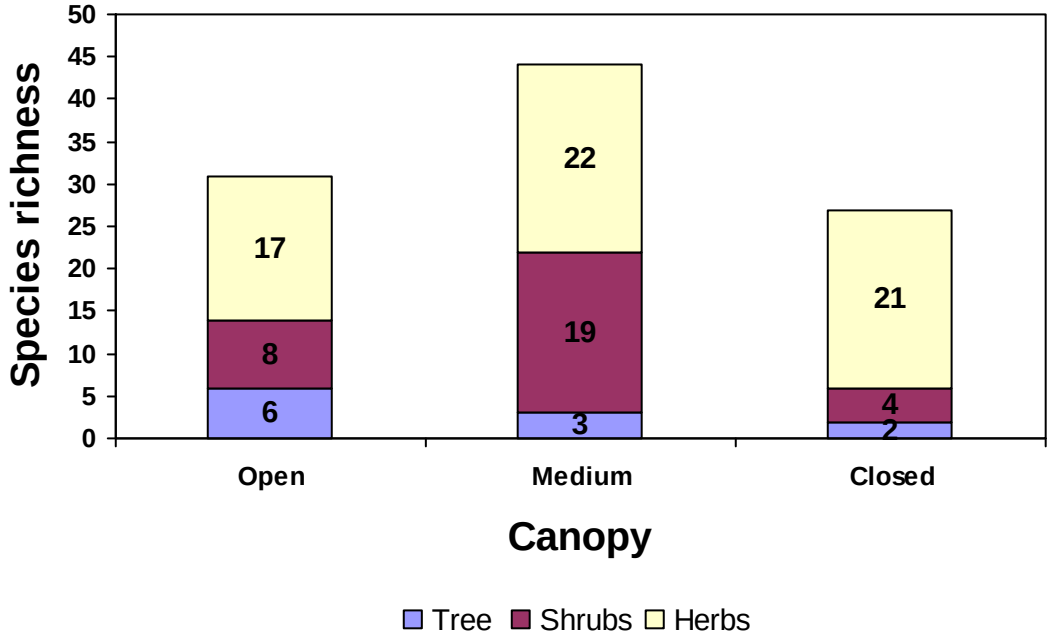

Fig. 2 Species richness for different canopy covers.

Tree richness varied from 2 to 6, it was maximum in open canopied forest and minimum in closed canopied forest. Shrubs richness varied from 4 to 19, it was maximum in medium canopied forest and minimum in closed canopied forest. Herbs richness varied from 17 to 22, which was the maximum in medium canopied and minimum in open canopied forest.

Discussion:

The continuous anthropogenic disturbances are responsible for creating gaps of various sizes in forest canopies. The creation of gaps, both directly and indirectly, influence species richness and other vegetational parameters of a forest. In the present study, a total of 66 plant species were reported from all the three canopies of oak forest. The lowest species number (27) was recorded in closed canopied forest while medium canopied forest contained greatest richness (44). This indicates that the opening of canopy increase number of different plant species which belongs to the group of species present in closed as well as open canopied forest. The medium canopied forest maintained greater species richness compared to open and closed canopied forests. Tree species richness was present as open > medium > close, while highest shrub and herb richness were in medium canopied forest. Nath *et al.* (2005) reported that tree and shrub richness decreased from low to high disturbance regimes while medium disturbance favouring high herb richness, but overall species richness was greater in low disturbances in a tropical wet evergreen forest and reverse was reported in subtropical and temperate forests of Uttaranchal (Table 2). Again, the shrub species declined from low disturbance to high disturbance in tropical wet evergreen forest while it was higher in medium disturbed sites in sub-tropical forest, except as reported by Kumar and Ram (2005), which showed almost similar trend as reported in the present study but slightly increased in tropical wet evergreen forest. Khera *et al.* (2001) reported that shrubs and herbs richness varied with disturbance level.

Table 1 Presence (+) and absence (-) of different species in banj oak (*Quercus leucotrichophora*) forest.

Tree	**Open canopy**	**Medium canopy**	**Closed canopy**
Aesculus indica, Calebr.	+	-	-
Cornus macrophylla, Wall	+	+	+
Picea smithiana, Boiss.	+	-	-
Pinus roxburghii, Sarg.	+	-	-
Quercus floribunda, Lindl.	+	+	-
Quercus leucotrichophora, A. Camus	+	+	+
Total	**6**	**3**	**2**

Shrubs	**Open canopy**	**Medium canopy**	**Closed canopy**
Artemisia Linn.	-	+	-
Berberis asiatica, Roxb	+	+	+
Colquhounia coccinea, wall.	-	+	-
Debregeasia longifolia, Wedd.	-	+	-
D. falcata	+	-	+
Desmodium elegans, DC	+	+	+
*Deutza staminine*a, R. Brown	+	+	-
Drapanostachyum falcatum	-	+	-
Gerardiana heterophylla (Vahe) Decne.	-	+	-
Indigofera heterantha wall. Ex Brandis	+	+	+
Inula cuspidate, Clarke	-	+	-
Asminum humile, Linn.	-	+	-
Myrsine africana, Linn.	-	+	-
Plectranthus japonicus (Burm. Fil) Koidz	-	+	-

Pyracantha crenulata, (D. Don) M. Roem.	+	-	-
Rosa brunanii, Lindley	+	+	-
Rubus ellipticus, Sm.	+	+	-
Rumex hastatus D.Don	-	+	-
Sarcococca hookeriana, Baill.		+	-
Smilax vaginata, Decsne.	-	+	-
Urtica dioica, L.	-	+	-
Total	**8**	**19**	**4**

Herbs	**Open canopy**	**Medium canopy**	**Closed canopy**
Achyranthes bidentata (Blume)	-	-	+
Anemone vitifolia Buch. Ham. Ex DC	+	+	+
Arisaema tortuosum (wall.) Schott	-	-	+
Arthraxon prionodes, (Steud.) Dany.	+	+	+
Arundinella setosa, Trin.	-	+	+
Aster asperculus. Nees.	+	+	-
Boennuinghaysenia albiflora (Hook) Reichb	-	+	-
Calamintha umbrosa, Banth.	-	-	+
Carex cruciata Wahlenb.	-	-	+
Carex nubigena Tiloch and Taylor	+	+	+
Cnicus falcuoneri Hook. F.	-	+	-
Commelina benghalensis L.	+	+	+
Cyperus niveus Retz	-	-	+
Dipsacus mites D. Don.	-	+	-
Erigeron karvinskianus DC	-	+	+
Gallium aparina L.	-	+	+
Gallium rotundifolium L.	+	+	+

Geranium nepalenense, sweet.	+	+	-
Gerbera gossypina (Royle) G. Beauv.	+	-	-
Goldfussia dalhousieana, Nees.	+	-	-
Hebernaria latilabris (Lindl.) Hook. Fit.		-	+
Hederra Linn.	-	-	+
Hedychium spicatum Buch. Ham. ex. 1.E. Smith	-	-	+
Impatiens balsamina, L.	-	+	+
Ophipogon intermedius, D.Don	-	+	-
Oplismenus compositus (L.) P. Beauv.	-	+	-
Parthenium histophorous, L.	-	-	+
Pilea scripta (Buch. Ham ex D.Don) wedd.	-	+	+
Plantago major Linn.	-	-	+
Salinum wallichianum (DC.) raizada and Saxena	+	-	-
Scutellaria angulosa Benth.	+	+	-
Swertia ciliata (G.Don) Burtt		-	-
Thalictrum foliolosum DC. Nees	+	-	-
Thalliictrum neurocarpum	-	+	-
Valeriana wallichii DC.	+	+	+
Vitis himalayana Brandis.	+	+	-
Unidentified sp. 1	-	+	-
Unidentified sp. 2	+	-	-
Unidentified sp. 3	+	-	-
Total	**17**	**22**	**21**

Table 2. Comparison of species richness in different disturbance levels in oak forest.

Vegetation layer	**Richness**			**Authors**
	L	**M**	**H**	
Tree	50	20	18	Nath *et al.*, (2005)
	5	6	10	Arvind and Ram (2005)
	6	7	9	Khera et al (2001)
	2	3	6	Present study
Shrubs	27	22	14	Nath *et al.*, (2005)
	12	19	21	Arvind and Ram (2005)
	15	19	16	Khera et al (2001)
	4	19	8	Present study
Herbs	23	31	29	Nath *et al.*, (2005)
	27	35	41	Arvind and Ram (2005)
	34	29	24	Khera et al (2001)
	21	22	17	Present study

Note: L=Low disturbances, M=Medium disturbances, H=High disturbances

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Model for Evaluating the Concentration of Iron Upgraded during Pyrobeneficiation of Iron Oxide Ore Pelletized with Powdered Potassium Chlorate

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Abstract: Model for predicting the concentration of iron upgraded during pyrobeneficiation of iron oxide ore (pelletized with powdered potassium chlorate) has been derived. The model-predicted %Fe upgrades were found to agree a direct relationship between %Fe values and weight-input of $KClO_3$ as exhibited by %Fe upgrades obtained from the experiment. The model; $\%Fe = 7.1367\gamma$ indicates that iron upgrade is dependent on the weight input of $KClO_3$. The validity of the model was rooted in the expression $(\%Fe/\gamma)^{\alpha} = (T/\beta)^{N}$ where both sides of the expression are correspondingly almost equal. The positive or negative deviation of each of the model-predicted values of %Fe from those of the corresponding experimental values was found to be less than 19% which is quite within the range of acceptable deviation limit of experimental results. [New York Science Journal. 2009;2(4):17-23]. (ISSN: 1554-0200).

Keywords: Model, Evaluation, Upgraded Iron, Pyrobeneficiation, Iron Oxide Ore.

1. Introduction

Agbaja iron ore deposit is the largest known Nigerian iron ore deposit estimated at 1250 metric tonnes of ore reserve. It consists of oolitic and pisolitic structures rich in iron oxides, in a matrix that is predominantly clay. The principal constituent mineral is goethite, with minor hematite, maghemite, siderite, quartz, kaolinite pyrite and an average of 0.09%S [1].

It was discovered that one of the most important factors influencing the desulphurization process during iron making is the state of oxidation of the bath [2].

Nwoye [3] carried out desulphurization of Agbaja iron oxide ore concentrate using solid potassium trioxochlorate (V) ($KCI0_3$) as oxidant. The concentrate was treated at a temperature range 500 – 800^0C. The results of the investigation revealed that simultaneous increase in both the percentage of the oxidant added (up to 15g per 50g of ore) and treatment temperature (maximum 800^0C) used give the ideal conditions for increased desulphurization efficiency. This translates into high desulphurization efficiency when both oxidant concentration (up to 15g per 50g of ore) and treatment temperature (maximum 800^0C) are high.

The mechanism and process analysis of desulphurization of Agbaja iron ore concentrate using powdered potassium trioxochlorate (v) ($KCI0_3$) as oxidant has been reported [4]. Concentrates were treated at a temperature range 500 – 800^0C. Results of the process analysis indicate that oxygen required for the desulphurization process was produced following decomposition of $KClO_3$ within a temperature range 375-502^{o}C. It was observed that this temperature range is the Gas Evolution Temperature Range (GETR) for sulphur present in Agbaja iron ore. Sulphur vapour and oxygen gas produced at this temperature range were believed to have reacted to form and liberate SO_2. The process analysis suggests that the mechanism of the desulphurization process involves gaseous state interaction between oxygen and sulphur through molecular combination. The results for the extent of desulphurization reveal that simultaneous increase in both the percentage of the oxidant added and treatment temperature used (up to 15g $KClO_3$ per 50g of ore and maximum of 800^0C respectively) are the ideal conditions for the best desulphurization efficiency.

Agbaja oolitic iron ore, which has not been responsive to so many upgrading processes, has been upgraded to 73.4% Fe assay (starting from as-received concentrate assaying 56.2%Fe) by pyrometallurgical-oxidation method [5]. Main parameters investigated were the effects of treatment temperature and oxidant ($KClO_3$) on the upgrading process. It was established that 800^0C is the optimum temperature for the upgrading step considering the range of temperature used (500-800^0C). It was observed from results of the investigation that both oxidant and temperature increase (up to 12g per 50g of iron ore and maximum of 800^0C respectively) during the process are vital conditions for improving on the grade of the ore concentrate.

An intensive and selective oil agglomeration of Agbaja iron ore has been carried out [6]. The researcher, starting from the crude ore Fe content (45.6%), concentrated the ore by oil agglomeration technique to 90% Fe recovery and 65% Fe assay. He stated that the ore require grinding to minus 5µm to effect adequate liberation. These results were obtained at optimum pH 9. Successful studies [7] on the effect of temperature on magnetizing reduction of Agbaja iron ore have been carried out. The results of the investigation showed that the fine-grained oolitic Agbaja iron ore, which is not responsive to conventional processing techniques, can be upgraded by the magnetizing reduction method with an Fe recovery of 87.3% and Fe assay of 60% at 600^0C.

Attempt has been made to enhance concentrate Fe recovery [8]. The researchers stated that concentrate Fe recovery decreases progressively below pH 8. In this pH region, oleate used is present as dispersion of oleic acid, and its adsorption on the surface of the iron oxides is similar to the process of hetero-coagulation involving positively charged iron oxide particles and negatively charged oleic acid droplet.

The aim of this work is to derive a model for evaluating the concentration of iron upgraded during pyrobeneficiation of Agbaja (Nigeria) iron oxide ore with powdered potassium chlorate as oxidant.

2. Model

The solid phase (ore) is assumed to be stationary, contains some unreduced iron remaining in the ore. It was found [9] that oxygen gas from the decomposition of $KClO_3$ attacked the ore in a gas-solid reaction, hence removing (through oxidation) the sulphur present in the ore in the form of SO_2 .Equations (1) and (2) show this.

$$2KClO_{3\,(s)} \longrightarrow 2KCl_{\,(s)} + 3O_{2\,(g)} \qquad (1)$$

$$S_{(s)} \xrightarrow{\text{Heat}} S_{(g)} + O_{2\,(g)} \longrightarrow SO_{2\,(g)} \qquad (2)$$

Nwoye (2008) posited that when sulphur inherent in the iron ore is removed in this stance, the concentration of iron present in the ore is upgraded since sulphur is an impurity element.

2.1 Model Formulation

Experimental data obtained from research work [10] carried out at SynchroWell Research Laboratory, Enugu were used for this work.

Results of the experiment as presented in report [10] and used for the model formulation are as shown in Table 1. Computational analysis of the experimental data [10] shown in Table 1, gave rise to Table 2 which indicate that;

$$(\%Fe/\gamma)^{\alpha} = (T/\beta)^{N} \quad \text{(approximately)} \qquad (3)$$

Taking logarithm of both sides of equation (3);

$$\text{Log}\,[(\%Fe/\gamma)^{\alpha}] = \text{Log}\,[(T/\beta)^{N}] \qquad (4)$$

$$\alpha\text{Log}(\%Fe/\gamma) = N\text{Log}(T/\beta) \qquad (5)$$

$$\alpha[\text{Log}(\%Fe/\gamma)] = N[\text{Log}T - \text{Log}\beta] \qquad (6)$$

$$\text{Log}(\%Fe/\gamma) = N/\alpha[\text{Log}T - \text{Log}\beta] \qquad (7)$$

Introducing the values of T, β, N and α into equation (7) reduces it to;

$$\text{Log}(\%Fe/\gamma) = 0.8535 \qquad (8)$$

$$(\%Fe/\gamma) = 10^{0.8535} \qquad (9)$$

$$(\%Fe/\gamma) = 7.1367 \qquad (10)$$

$$\%Fe/ = 7.1367\gamma \qquad (11)$$

Where

%Fe = Upgraded concentration of iron during the beneficiation process

N = 0.87 (Decomposition coefficient of $KClO_3$ during the beneficiation process) determined in the experiment [10].

(β) = Weight of iron oxide ore added during the beneficiation process (g)

(γ) = Weight of $KClO_3$ added during the beneficiation process (g).

T = Treatment temperature (^0C)

(α)= 1.10 (Oxidation coefficient of $KClO_3$ at the treatment temperature) determined in the experiment [10].

I_e =7.1367 (Assumed Iron Enhancement Factor)

Equation (11) is the derived model**.**

Table1:Variation of upgraded concentration of iron with weight-input of $KClO_3$.[10]

%Fe	(γ)	(β)
63.58	8	50
65.88	9	50
67.46	9.6	50
68.00	10	50
70.02	11	50
72.24	12	50

Table 2: Variation of $(\%Fe/\gamma)^{\alpha}$ with $(T/\beta)^{N}$

$(\%Fe/\gamma)^{\alpha}$	$(T/\beta)^{N}$
9.7781	8.6874
8.9323	8.6874
8.5399	8.6874
8.2368	8.6874
7.6597	8.6874
7.2037	8.6874

3. Boundary and Initial Condition

Consider iron ore (in a furnace) mixed with potassium chlorate (oxidant).The furnace atmosphere is not contaminated i.e (free of unwanted gases and dusts). Initially, atmospheric levels of oxygen are assumed just before the decomposition of $KClO_3$ (due to air in the furnace).Weight, M of iron oxide ore used; (50g), and treatment time; 360secs. were used. Treatment temperature; 600^{o}C, ore grain size; 150μm, and weight of $KClO_3$; (8- 12g) were also used. These and other process conditions are as stated in the experimental technique [10].

The boundary conditions are: furnace oxygen atmosphere due to decomposition of $KClO_3$ (since the furnace was air-tight closed) at the top and bottom of the ore particles interacting with the gas phase. At the bottom of the particles, a zero gradient for the gas scalar are assumed and also for the gas phase at the top of the particles. The reduced iron is stationary. The sides of the particles are taken to be symmetries.

4. Model Validation

The formulated model was validated by direct analysis and comparison of %Fe values predicted by the model and those obtained from the experiment for equality or near equality.

Analysis and comparison between these %Fe values reveal deviations of model-predicted %Fe values from those of the experiment. This is attributed to the fact that the surface properties of the ore and the

physiochemical interactions between the ore and the oxidant (under the influence of the treatment temperature) which were found to have played vital roles during the oxidation-beneficiation process [10] were not considered during the model formulation. This necessitated the introduction of correction factor, to bring the model-predicted %Fe values to those of the experimental %Fe values (Table 3).

Deviation (Dv) (%) of the model-predicted %Fe values from experimental %Fe values is given by

$$Dv = \frac{Dp - DE}{DE} \times 100 \quad (12)$$

Where Dp = Predicted %Fe values from model

DE = Experimental %Fe values

Correction factor (Cf) is the negative of the deviation i.e

$$Cf = -Dv \quad (13)$$

Therefore

$$Cf = -\left(\frac{Dp - DE}{DE}\right) \times 100 \quad (14)$$

Introduction of the corresponding values of Cf from equation (14) into the model gives exactly the corresponding experimental %Fe values [10].

5. Results and Discussion

The derived model is equation (11). A comparison of the values of %Fe from the experiment and those from the model shows minimum positive and negative deviations less than 19% which is quite within the acceptable deviation limit of experimental results hence depicting the reliability and validity of the model. This is shown in Table 3. Table 2 also agrees with equation (3) following the values $(\%Fe/\gamma)^{\alpha}$ and $(T/\beta)^{N}$ evaluated from Table 1 as a result of corresponding computational analysis. The validity of the model is rooted in equation (3) where both sides of the equation are correspondingly almost equal.

The model-predicted %Fe upgrades (as in equation (11)) were found to show a direct relationship with the weight-input of $KClO_3$ (agreeing with %Fe upgrades from the experiment as in Table 1) where 7.1367 acts as a multiplying constant of proportionality hence contributing to the iron upgrades mathematically. Based on the foregoing, the constant; 7.1367 is assumed to be the Iron Enhancement Factor I_e.

Table3: Comparison between %Fe upgrade as predicted by model and as obtained from experiment [10].

$\%Fe_{exp}$	$\%Fe_M$	Dv (%)	Cf (%)
63.58	57.0936	-10.20	+10.20
65.88	64.2303	-2.50	+2.50
67.46	68.5129	+1.57	-1.57
68.00	71.3670	+4.95	-4.95
70.02	78.5037	+12.12	-12.12
72.24	85.6404	+18.55	-18.55

Where

$\%Fe_{exp}$= %Fe upgrade from experiment [10]

$\%Fe_M$ = %Fe upgrade predicted by model

6. Conclusion

The model evaluates the upgraded iron concentration during pyrobeneficiation of Agbaja iron oxide ore pelletized with powdered potassium chlorate. The deviation of the model-predicted %Fe values from those of the experiment is less than 19% which is quite within the acceptable deviation limit of experimental results. The validity of the model is rooted in equation (3) where both sides of the equation are correspondingly almost equal.

Further works should incorporate more process parameters into the model with the aim of reducing the deviations of the model-predicted %Fe values from those of the experiment

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Lichen-moss harvesting practices and their marketing strategy In Uttarakhand, India

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ABSTRACT: The present article is based on the concept of socioeconomic status of lichens (Kumar, 2009) and a compiled report of Appropriate Technology India, Ukhimath (Garhwal). Out of three auction sites of the State Ramnagar auction/ mandi (market) is the biggest market of lichen & moss followed by Tanakpur and Rishikesh. Traders of the mandi level are getting maximum profit from lichen & moss sector. [New York Science Journal. 2009;2(4):24-30]. (ISSN: 1554-0200).

***Key Words*:** Lichen, Marketing, Uttarakhand State.

INTRODUCTION

Lichens are the unique group of plants that consists of two unrelated organism, a fungus and an alga, growing together in a close symbiotic association. The study of lichen remains quite neglected throughout the world, through they together with mosses from dominant organism in ecosystem covering 10% of the earth terrestrial habitats, particularly higher elevations (Nash & Egan, 1988). Kumar & Upreti (2008) and Kumar (2009) lichen exploitation is a common practice among the villagers and the rivals in moist temperate regions of the Western Himalaya to collect the lichens together with tree twigs as oak and other trees bears luxuriant growth of lichens. Upreti et al (2005) mentioned the members of the families Parmeliaceae and Physciaceae are the ones most exploited commercially and are recommended by inclusion in the CITES list. However, Kumar (2008) reported Parmelioid lichens are commercially trading lichens from Garhwal Himalaya i.e. *Everniastrum, Parmotrema, Cetrariopsis, Bulbothrix, Hypotrachyna and Rimelia* collected by rivals together with two fruticose genera, *Ramalina* and *Usne.* Within Uttarakhand State of India where the present study was carried out 75 species of Parmelioid lichens reported, of which 27% each are known in Mussooorie hills and Saryu river valley near Pindari Glacier area, 17.5% are in Chaubatia-Ranikhet followed by 12.1% and 10.8% in Nain Singh top en route to Milam Glacier and Chopta-Tunganath peak (Divakar & Upreti, 2005).

Approximately 750 metric tons of lichens are collected from Uttarakhand hills, 800 metric tons are imported from other regions of India, including Himachal Pradesh, Sikkim and Assam and out of which about 50-80 tons are exported (Shah, 1997).

Total three bigger markets of lichen-moss of the State viz. Ramnagar, Tanakpur and Rishikesh were visited during 2005. Accept Rishikesh, other two markets are approximately similar in trade and turnover system of lichen and moss. In subsistence and rural economies, the role of contribution of lichen-moss is as crucial as source of food, fodder and nesting material etc. it helps to generate additional employment and income. Since lichens and mosses grow in the hilly areas, it is important source of livelihood for the people living in the area. Local people extract lichen-moss and sell it to the middlemen (local contractors) as they do not have the resources to reach the market or the auction sites, where they can fetch remunerative prices for their produce. Lichens are sold at rates of approximately half a dollar/kg (Upreti et al 2005, Kumar, 2009) and mosses are 0.11 dollar/kg in the local markets. The price however becomes triple for lichens and double for mosses when these materials reach in the auction sites. A trained collector can easily collect 6-8 kg of lichens with twigs (Kumar, 2009).

Description of the government and semi government corporation involved in the marketing of lichen and moss in the State:

Zila Bhesajh Sangh Sahkari Samiti (ZBSSS): It is a registered public institution central society under corporative samiti Act 1965. ZBSSS is in operation since 1983 in almost all the district of the Uttarakhand state. President who is the head of the samiti is selected in every five years. There are many societies formed in the villages by ZBSSS. The directors among themselves elect the president. Secretary of the ZBSSS is supposed to be the government employee. The main objectives of the ZBSSS are to provide training on extraction of medicinal plants in the hilly area through scientific method, employment to the cooperative society members, and establishment of ZBSSS based small enterprises, improve the economic condition of the farmers by providing training on cultivation of those plant species which are becoming extinct. ZBSSS is also helps in preventing the exploitation of local village collectors from different middlemen and contractors and making them available remunerative price for their produce. The

percentage of profit of the ZBSSS earned through commission is sheared among its members. About 10% of the profit is sheared.

Van Vikas Nigam (VVN): VVN is semi Government Corporation with divisional sales manager (DSM) directly from corporation, regional manger equivalent to conservator of forest from forest department. Previously the forest department (FD) used to directly give tenders to the contractors for the extraction of timber as well as other forest produces, as a result of which was massive exploitation of forest produce by local contractors. In order to regulate the trade of minor forest produce, FD involved VVN. Initially this Nigam was established with their prime objective of storage, production and trade of timber. Since 2004 VVN diversified its activity and earned into the field of ecotourism and medicinal plants also from the time was declared as an herbal state, the government asked the FD to take active role in the production, sustainable harvesting, conservation and marketing of forest produce. The FD with the help of VVN has also started commercial activities regarding medicinal and aromatic plants. Apart from these two agencies, Kumaun Mandal Vikas Nigam (KMVN) and Garhwal Mandal Vikas Nigam (GMVN) are performing the similar role as of ZBSSS.

MATERIALS AND METHODS

Study area: Uttarakhand, the 27th State of the Republic of India, was formed on 9th Nov. 2000 and, carved in out of the hilly tracts of Uttara Pradesh. It lies between 28º53'24" East and 31º27'50" North latitude and between 77º34'27" and 81º02'22" longitude. It has international boundaries with Tibet in the North and Nepal in the East. Himanchal Pradesh and Hariyana lie to its west and Uttar Pradesh to its south. The state with predominance of mountains and hills is spread over 13 districts with an area of 51,082 sq. kms or about 5.5% of such terrain of India (NRIF, 2004). It has a forest cover of 64.80%. The major forest types found in the state are sub-tropical, temperate and alpine forests. The total agriculture land in the state is 14% of its geographical area. Vast topographical, climate and seasonal variation makes the state rich in floral as well as faunal diversity.

Climate changes from subtropical in the southern foothill with average temperatures of about 30ºC and winter temperature of about 18ºC. Warm temperate conditions in the middle Himalayan valleys, with average summer temperature of 25ºC and cool winters. A cold alpine climate is observed at higher elevation where summers are cool and winters are severe. At elevation about 4880m the climate is very cold with freezing temperatures and the area is permanently snow covered. There are rains in July-September due to south west monsoon and occasional snow fall in winter months (November-February), due to western disturbances at higher elevations.

A survey was conducted in different district of Uttarakhand during year 2005. Market surveys were conducted to identify the marketing channels, price spread, and prospective markets in the important places. A detailed study of lichen & moss conducted by rural population of necessary for establishing the trade and ensuring proper margin to the collectors. The major auction markets (called mandis) and traders in these areas were interviewed in order to know the quantum of trade of lichen & moss in Uttarakhand.

Sampling frame: Information was collected from collectors, contractors (middlemen), small and big traders, commission agents from three trading centers (Ramnagar, Tanakpur and Rishikesh).

Method of sampling:

Criteria for selection of forest division: Badrinath and Kedarnath forest divisions were selected for the study in Garhwal region where the lichen & moss takes place in large scale. In BFD blocks selected for the study were Narayanbagar, Tharali and Dewal. These three blocks were studied as the primary collectors from the adjoining villages sell their produce to the local contractors from this division. The major villages of BFD involved in the extraction of lichens are Vaan, Dungari, Man, Kolpuri, Kuling Ghes-Balan, Himni, Mundoli, Ratgawn, Bursol etc.

Selection of auction sites: Before October, 2004 there was no regulation in the trade of lichen & moss. Entire trade was done privately without involvement of any Government agencies. Only the local contractors had to be approach the ZBSSS, from there they used to get approval for the forest department for "Ravanna" and then they could sell there produce anywhere in India in the open market. But after October 2004 in order to provide remunerative price to the primary collectors, Govt. took steps involving semi government corporation, VVN in this trade. In Uttarakhand, three auction sites are involved in the auctioning of lichen and moss viz. Ramnagar, Tankpur and Rishikesh. These auction sites were studied in order to estimate the quantum of lichen and moss from Uttarakhand.

Selection of contractors at block level: about four contractors from Tharali, five from Narayanbagar and two from Dewal block of district Chamoli Garhwal were interviewed in order to estimate the quantum of lichen & moss collected and priced received by the primary collectors for their produce.

Technique for data collection: Both primary and secondary data was collected for the study. Secondary data was collected in order to obtain the information and gets the idea regarding the availability of lichen & moss quantity trade from each of the auction sites, information sources for getting the relevant information regarding the study were as follows: Forest department (KFD & BFD), VVN, Bhesajh Sangh etc. Similarly, the primary data was collected from the local contractors, traders and commission agents. These techniques involved in the collection of data were personal interviewed and discussion through semi-structure interview. To explore the exiting value addition process, interviews with the people at each level were conducted at primary collectors level, traders level and on site visit.

RESULTS

The lichen and moss collection season is of six months in a year and one trader collects the produce from about 15-20 primary collectors. Table 1 shows on an average quantity of lichen is about 301 qtl per trader per season and the total quantity of lichen loaded from three blocks comes out to be 4515 qtl per season. Tharali block has found maximum contribution about 1750 qtl followed by Narayanbagar 1715 qtl and Dewal 1050 qtl lichen per season.

Seasonal availability of lichen-moss (L & M): The extraction of L & M takes place mainly from October to March. After 31st of March extraction of produce is completely banned as fire season commence. From July to September the produce can not be extracted because of monsoon season. The availability of lichen depends on monsoon as it is supposed to be the most effective season for its growth.

Market information at primary collector level: Primary collectors of BFD extract the lichen and moss from the allotted range and sell them to the contractors at Tharali, Narayanbagar and Dewal. They sell the produce to the contractors at these places after drying. All produce collected are sold and they do not keep it for personal use. The primary collector collects about 4-5 kg of lichen material per day but Kumar (2009) reported 3.39 kg lichen/day/collector in its collection period during October to March. The laborer collects lichen material 15-20 kg per day. The lichen is collected directly from the trees as well as from the ground that is fallen lichen.

The laborer collect the maximum amount of lichens about 5 quintals per month as they are hired especially for this job, but the villagers (primary collectors) collect it as a part time job apart from their agricultural and other household activities.

Different mode of marketing of L & M: In order to study the marketing channel for L & M, it is important to know the past and the present mode of marketing of this produce as well as the role of different institutions and organizations involves in the promotion of the trade. Prior to the year 2005-06, the L & M and other medicinal plants were not regulated. It was on the basis of contractor system. The only registered society that helped in the promotion of trade was Zila Bhesagh Sangh Sahkari Samiti (ZBSSS), which was responsible for regulating the trade only at extraction level. It had nothing to do with marketing of the produce.

After October 2004, Forest Department (FD) took active role by involving two semi government corporations namely Van Vikas Nigam (VVN) and Kumaun Mandal Vikas Nigam (KMVN) for Kumaun and Garhwal Mandal Vikas Nigam (GMVN) for Garhwal region. VVN now plays important role in auction of L & M.

Marketing channels for L & M: Out of three prevailing marketing channels for L & M, first two are more in practice. The main purpose of involving the ZBSSS and VVN in this trade is to regulate the extraction of the produce so that it is not overexploited and to provide remunerative price to the primary collectors (villagers) prevent their exploitation from contractors and middlemen.

Channel first: In this channel the forest department gives contract to two agencies for collection of L & M namely ZBSSS and VVN. Forest department is also involving KMVN for Kumaun and GMVN for Garhwal. The local traders whosoever is interested in the extraction of lichen and moss approach the ZBSSS for their area for contract. These contractors deposit a sum of Rs. 10,000.00 as registration fee in the form of security. This fee is refundable

after 31st March when extraction of produce from the allotted ranges (areas) gets over. The FD opens only few ranges for the extraction of the produce. This goes on the rotational basis i.e. if range 1 was opened last year, the range 2 will be opened this year and range 3 the consequent year.

The local traders collect lichen and moss from two sources viz. primary collectors and laborers appointed by them. The permit is provided to the villagers for the collection of L & M. The villagers collect the produce on daily basis and after drying sell the produce to the local contractors. These contractors have retail shops in the village itself. When sufficient quantity of L & M is collected by the local traders, they tabulate the quantity of L & M in terms of sack bags, number of trucks in the sack bags are loaded and other information about quantity etc. in the form of 'Talika' (tabular form) to the ZBSSS. The ZBSSS cross checks the information and forwards it to the forest department. The DFO forwards it to the range office, where they charge their royalty (Rs. 210.00/qtl., which was previously Rs. 160.00/qtl), which includes sale tax and income tax. After all these formalities of the FD issues transit pass locally called as 'Ravanna' to local traders. Ravanna tells the route to be followed by the contractor to the auction places (mandi). This Ravanna is valid till seven days from date of issue. The produce then reaches the VVN depot. VVN is responsible for the auctioning of the produce. This is a public auction and any person involved in buying for the produce can participate in this. After auction, the produces is loaded in truck and transported to its destination places for example Kannauj (a town of Uttar Pradesh). The commission charged of different commission agents from the trades given in table 2 and estimated expenses & profit per truck is given in table 3.

Second channel: It is also know as Van Panchayat Channel. In this method, the villagers with the permission from the Panchayat can extract the L & M from the Van Panchayat/ (called community) forest. The VP has to seek permission from the ZBSSS but the FD does not charge royalty. This fee is issued by the Panchayat for village development works. ZBSSS only takes the commission of selling price of the lot. After this the ZBSSS transports the produce of VVN deport for auction. The process is similar as in channel first.

Third channel: This channel is known as 'Bandhak' in local language or pledge. This is rarely practiced. According to this method, 75% of the amount of the goods sale is given to the traders and rest 25% is retained by the ZBSSS after deduction of its commission of 10% returns the rest 15% to the traders after completion of sale of the entire produce.

Auction process at the VVN depots: In Uttarakhand, auction of L & M takes place at three places, namely Ramnagar, Tankpur and Rishikesh. The auction is conducted at the VVN depots at these places. The date of auction is fixed and is different for each of these places. This is a public auction and any person can participate in it and can buy the produce by calling the price. Table 4 shows the produce from different places comes to these depots for auction.

Fixing of price at auction: The rates of lichen and moss are fixed on per kilogram basis. The standard rate is fixed by local traders and is approved by VVN officials. This standard rate is fixed keeping in view the entire expenses on transportation, cost price and profit. After this standard price is fixed, the private traders participate in auction process and call their price. The highest bigger gets the produce and within seven days, the price is paid to the local contractors.

Quantity analysis of lichen and moss traded at different auction sites: Table 5 shows the quantity of the lichen and moss at VVN depots in an auction. It is depicted that majority of the produce traded is lichen. It is evident that, out of all the three auction depots Ramnagar is the biggest mandi (market) and the number of participants is very high (Table 5).

Two auctions are held in each month, and it can be estimated that if in Ramnagar, in the last auction 500qtl of lichen and 76 qtl of moss was traded so in the a month total trade in approximate terms was of 1000 qtl of the lichen and 150 qtl of moss. The number of months auction takes place in one season is 8 (i.e., total number of an auctions in a year are 16). Approximate trade in terms of quantity in one season from Ramnagar mandi is around 8000 qtl lichen and 1200qtl for moss. The auction system in Ramnagar mandi was initiated from October 2004.

In Tanakpur, auction system was initiated from January 2005. The sales in the auction were not regular, if in one auction three was sale the other one showed nil sales. Total quantity of lichen traded from January to April was about 600 quintals and moss traded from the time of initiation of auction is about 7 quintals.

In Rishikesh, auction began from December 2004, and the total trade in terms of quantity in lichen up to April was 939 quintals and moss was 18 quintals.

Price analysis at primary collector level: The villagers (primary collectors) sell the produce weekly or twice in a week at the retail shops of the local contractors in the villages. They get about Rs. 25-35 per kg for lichens and Rs. 5-6 per kg for moss being extracted. The price of the produce fluctuates depending upon its quality and as well as availability. About three different qualities or grades of lichens are about Rs. 35-40 per kg for primary collectors.

Grade 1st supposed to be the best quality and is known as Phoolmaal in local language (*Everniastrum* species of lichen). It does not have any bark or moss attached to it. Their price is about Rs. 35-40 per kg for the primary collectors.

Grade 2nd contains the mixed percentage of grade 1st, mosses and bark of trees. The price of this grade is about Rs. 20-35 per kg for the primary collectors.

Similarly, Grade 3rd is known as 'Patthar Chura' growing over the rock surface (saxicolous lichens). The price fetched by the primary collectors for this grade is about Rs. 25 per kg.

Table 1: Quantum of lichen material traded at contractor level from BFD in one season (October to March)

Local market of district Chamoli Garhwal	No. of traders	Qty./ Trader (in Qtls.) (Number of trucks X quantity per truck)	Total quantity (in Qtls.) (Number of traders X quantity per trader)
Narayanbagar	07	7X35= 245	07X245= 1715
Tharali	05	10X35=350	05X350=1750
Dewal	03	10X35=350	03X350=1050
		Total	**4517**

Table 2: Percentage of commission

Name of organization	Commission charges
Van Vikas Nigam (VVN)	1% of selling price
Bhesajh Sangh	10% of selling price

Table 3: Calculation of profit to the traders

Capacity of a truck	Price of one truck lichen (@ Rs 3500.00/Qtl	Expenses/ Royalty/ Commission	Selling Price @ Rs. 7500/Qtl	Net Profit (Selling cost- Total expenses) - purchase cost
1	2	3	4	5
40 Qtl	Rs. 140000.00	FD= Rs. 210X40Qtl=Rs. 8400.00 VVN= 1% of column 4= Rs. 3000.00 BS= 10% of column 4= Rs. 30000.00 Net commission= 41400.00 Transpotation cost= Rs. 4000.00 Total Expenses (Total commission + Transportation Cost) = Rs. 41400.00+4000.00 = Rs. 45400.00	Rs. 300000.00	300000.00-45400.00 = Rs. 254600.00-Rs. 140000.00= Rs. 114600.00

Table 4: The produce from different places comes to the depots for auction

VVN Depots	Sources of produce to the depots
Ramnagar	Nainital, Badrinath (Chamoli), Bageshwar and Almora
Tanakpur	Pithoragarh and Champawat
Rishikesh	Kedarnath forest division (Rudraprayag)

Table 5: Status of lichen & moss traded at different auction sites of the state on weekly basis

Auction sites	Number of participants	Forest produces	Quantity (Qtls.)	Price Rs/Kg	Average price Rs./Qtl.	Total cost of the produce (Rs.)
Ramnagar	35	Lichen	502.8	50-83	6650.00	3343620.00
		Moss	76.57	24.10-30	2705.00	207121.85
Tanakpur	18	Lichen	228.00	42-70.60	5630.00	1621440.00
		Moss	1.6	18-21.50	1975.00	3160.00
Rishikesh	15	Lichen	70.00	60	6000.00	420000.00
		Moss	No moss	-	-	-

DISCUSSION:

Atkinson (1982) mentioned that the lichens from the Uttar Pradesh (now Uttarakhand) hills are traded in the plains of the country for medicinal uses as tonics, febrifuges and antipyretics. The big trading centers are located in Ramnagar, Tanakpur and Rishikesh. The Badrinath Forest Division (BFD) of the Uttarakhand state is situated extensively as majority of the trade outflow to the mandis or auction sites. The primary occupation of the peoples is agriculture, but owing to the subsistence nature of hill agriculture, they are partially dependent on surrounding forest resources for their livelihood. The primary collectors are ignorant of the market price and due to less income, are not able to participate in the auction. In the last two months quantity of lichen traded from Rishikesh was decreasing and traders are more and more participating in Ramnagar and Tanakpur depots. At the traders level, the value addition is done by the grading of lichens. The process of grading involves separating the different qualities of lichens and marketing them by giving different graders. The traders with manufacturers are also involved in the production of end products.

In the two auctions moss was not traded from Tanakpur and Rishikesh depots. In Ramnagar auction the traders from Kannauj also participated but they were not allowed to purchase the produce to local traders bid very high price. It was done so that the manufactures from Kannauj or other places brought the produce from the local traders of Ramnagar so that they could get their own share profit. In Ramnagar auction, traders from Nainital, Bhimtal, Nandprayag, Chamoli participated in auction. The other produce like Tejpatta, Coriander, Baelgiri contributes very little from Tanakpur and Rishkesh mandi. The major role of the VVN was the collection of lichen & moss and conducting a public auction.

Conservation Strategy: Kumar (2009) suggested a collector for the major part of the year can earn a reasonable income by collecting the fallen lichens without being destructive with some knowledge of the lichen fall and seasonal pattern. In case of lichen and moss sector, the ZBSSS provides training to the collectors on scientific harvesting technique. The bark of the respective trees should not be pulled out while its extraction. Upreti (1995) mentioned the ethnobotanical, commercial utilization of lichens and decline of forest cover as the leading factors to loss of lichen diversity in India. Singh and Sinha (1997) mentioned agriculture, urbanization, construction of road, building on hills, mineral extraction, hydroelectrical projects, shifting cultivation are responsible for depletion of many lichen rich habitats.

In this article the author have to describe the status of harvesting, collection and marketing strategy of lichens in the state. The excessive field information has been collected from several lichen collectors of Chamoli district Garhwal. A perusal of available literature (see references) has indicated that a study on lichen harvesting and marketing is not available. Therefore present article will certainly help to asses the demand of lichen and moss at different levels, so that major bottle-necks faced by the villagers in trading of lichen and moss can be removed.

This information will be the first attempt to answer these basic queries and help in collection, grading, trading, conservation and management of lichens. Define the current and future option available for alternate livelihood from the lichens. It will be help to guide immediate and long term management, policy and decision making strategies

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A Case Study: Conservation Strategies Of Biodiversity In Konkan Region Of Coastal Maharashtra, India

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ABSTRACT: The present article is based on the training cum workshop organized by Applied Environmental Research Foundation (AERF), Pune, India, based on field survey in March 2008. In the workshop some strategies for conservation of biodiversity has been developed in Konkan region of coastal Maharashtra, India and were assessed. [New York Science Journal. 2009;2(4):31-32]. (ISSN: 1554-0200).

Keywords: Konkan valley, conservation, sacred groves, Maharashtra

INTRODUCTION

The word conservation strategy (IUCN, UNEP and WWF, 1980) defines conservation as "the management of human use of the biodiversity so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations".India is well known for its plants diversity and has the second largest tribal population in the world after Africa (Jagtap, et al 2009). In addition the Trans Himalayan, Indian Desert, Semi-arid, Western Ghats, Deccan peninsula including Eastern Ghats, Gangetic plains, Northeast India, Coasts and Islands are the different biogeographic zones. Kharkwal (2008) reported that the floristic spectrum of India comprises of over 30,000 species (excluding fungi) of which the flowering plants with about 17,500 species constitute the dominant group representing about 7% of the flowering plant species of the world. However, 140 genera and 5285 species are endemic to the county. The tribals have good traditional knowledge about the conservation of natural resources. This knowledge is transmitted exclusively through oral communication from one generation to next using a scriptless language. The valuable knowledge is therefore, in an unwritten form and requires urgent measures of conservation. The main aim of the present case study **was** to evaluate some less known conservation efforts of plants by the tribals and to encourage preservation of their culture, conservation and sustainable utilization of the plant wealth of Konkan valley, Sadawali district Ratnagiri of Maharashtra, India. The aim of the study was also to prepare efficient management for conservation and development of bio resources and also for capacity building.

Sacred groves are the forest patches traditionally protected by local communities in the name of a local deity. The fragments of forest now form important repositories of regional biodiversity and have been known to retain viable population of rare and endangered plants. The field survey brought out many different clues for the development of sacred groves to conserve biodiversity of the area.

MATERIALS AND METHODS

Maharashtra is a central western part of India, located in the south of Madhya Pradesh. More than 25 participants attended the training workshop, organized by Applied Environmental Research Foundation (AERF), Pune, at Sadawali village; district Ratnagiri of Maharashtra, India. During the workshop a field survey was conducted and a long discussion provided by the participants and local villagers on various conservation strategies of local biodiversity has been documented. Two sacred groves (Devvani and Ujgawn) of the western Ghat region were visited during the survey. Devvani sacred grove is situated at 185m altitude (a.m.s.l.), there is a village temple of local God called Devvani (meaning Dev= Devta/God and Vani = Van/Jangal/Forest); forest of Gods. Ujgawn sacred grove is situated at 200m altitude (a.m.s.l.) there is also a temple of Devvani.

Distinguished coloured posters with detailed information about the temple and forest are provided by AERF on walls of these temples for the conservation of the sacred groves. In the backside of the Ujgawn temple, AERF team along with local villagers has developed a large plantation patch of different medicinal plants. The plantation patch is protected and surrounded by a wall. The boundary wall has been

prepared by the villagers of Ujgawn for the protection of the plantation patch. All the plants of this patch are very useful and they will certainly be helpful in improving livelihood of the villagers.

RESULTS AND DISCUSSION

In the recent years the awareness regarding conservation of flora and fauna among the local community and in peoples residing in the forest has helped in a large extend in protecting the forest of this area. The tendency of the people have changed as they conduct sacred groves conservation programme in Northern Western Ghats, i.e. eco-restoration of sacred groves, revival of traditional forest conservation practices, conservation assessment of rare medicinal plants, the great hornbill- a flagship species for forest conservation instead of destroying forests for various uses.

Applied Environmental Research Foundation (AERF), Pune, India is a non-profit organization registered under the India societies act 1860, has been working for last 13 years for conservation of natural resources and development of local community in Nothern Western Ghats. AERF publishes a Marathi annual issue named 'Sakav'. The word Sakav means a temporary bridge built on the rivulets, nallahs and rivers during the rainy season and it is a speciality of coastal Maharashtra. The material used for its construction is local *trees* and *climbers*. Building and repairing the Sakav is the most important community activity. There could not be any other appropriate metaphor for linking environment and development process in Konkan region of Maharashtra. AERF conducts programme regarding conservation of nature and flora in school and college together with local people.

AERF believes that conservation of biological resources is best achieved with the support of local communities. This in turn is possible when the community perceives an incentive for itself in the conservation effort. The approach of AERF, reflects this understanding i.e., when people are given alternative opportunities for income generation through non-timber forest products such as medicinal plants and have access to information and technical support, they have incentive to work towards long term conservation of biological diversity.

The conservation programme designed and implemented by AERF provides opportunity for income generation, for the local community, through decentralized bio-diesel resource centers for improving rural energy services and reduce poverty in India. AERF have promoted conservation of forest on private land, balancing conservation and livelihoods, capacity building for linking medicinal plants conservation and sustainable livelihoods in Western Himalayas, India. AERF has working on community resource center for medicinal plants conservation and development programme in Uttarakhand, and awareness for biodiversity act in Himanchal Pradesh. AERF is also promoting the plantation of the rare plant species of the forest to conserve their diversity as well as biomass in the area. All the activities of the AERF are the useful strategies for the conservation of the biodiversity and the development of the local community.

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Effectiveness of Sulfidic Materials on the N, P, K, Mg and S Nutrient Uptake by Rice Plants Grown in Sulfur Deficient Soil under Field Experiment

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Abstract: The experiment was conducted to evaluate the effectiveness of sulfidic materials (SM) and Gypsum (G) application at the rates of 0, 20, 30, 40, 50 and 60 kg S ha^{-1} on the N, P, K, Mg and S nutrient in rice (*Oryza sativa* L., var. BR11: Mukta) grown in sulfur deficient soil were evaluated under field experiment. The contents of N, P, K, Mg and S nutrient in rice shoots at different growth stages of rice were increased by the application of SM and G fertilizer. But the increments were surprisingly high in case of SM compared to G application. In addition, the applied SM increased the average organic matter and available sulfur contents in the soils by 72 % and 229 % increased over control (IOC), respectively, while these increments were 58 % and 196 % IOC for gypsum treatments, indicating that the SM have potential and effective impacts than that of gypsum not only as a source of fertilizer but also to enrich the fertility and productivity status of soil. Moreover, the SM treatment was found to be maintained the high nutrient status in the soil till the final harvest at maturity of rice, reflecting a good indication for its long term use. It is noted that the use of SM did not show any adverse effect on the plant and soil in this study. [New York Science Journal. 2009;2(4):33-41]. (ISSN: 1554-0200).

Key words: sulfur deficient soil, effectiveness of sulfidic materials, gypsum, N, P, K, Mg and S nutrient, rice, field

1. Introduction

Sulfur is the tenth most abundant element in the universe (Stevenson, 1986; Stevenson and Cole, 1999) and ranks thirteenth in abundance in the Earth's crust (Trudinger, 1975). It is one of the major essential nutrients required by all human beings, animals and plants. Agricultural crops require S in amounts similar to phosphorus P, and S is as important as nitrogen (N) in plant growth and in the formation of crop yield and quality (Morris, 2007). In today's agriculture with the emphasis on higher crop yields, there is an increased need for calcium, magnesium and sulfur. To produce at optimum yields, all crops must have an adequate supply of all of the 16 essential plant nutrients. If one or more is lacking in the soil, crop yields will be reduced even though an adequate amount of the other 13 elements are available. This is somewhat analogous to the fact that a wooden bucket will hold no more water than its shortest stave. Crop yields may be limited by the element that is in shortest supply.

Sulfur deficiency has become widespread over the past several decades in most of the agricultural areas of the world, becoming a limiting factor to higher yields and fertilizer efficiency. Maintenance of field S fertility is often overlooked, and S deficiency symptoms in crops are sometimes confused with P or N deficiencies or Al toxicity. Since concentrated fertilizers with a low S content are now widely used, S deficiency problems appear more often (Hitsuda, et. al., 2005). According to estimates of The Sulphur Institute (TSI) based on crop demand, fertilizer efficiency and current inputs, the current S deficit is about 9.6 million tonnes annually. With increased food production raising S requirements and assuming slower expansion rates for S application, this S deficit is projected to grow to 11.9 million tonnes by 2015 (Ming Xian FAN and Donald L MESSICK, 2007) In Asia: In the late 1990s and early 2000s, intensified agricultural production, pressured by the backdrop of food self-sufficiency goals and limited land resources in the globe's two most populous nations, China and India, has created the S nutrient imbalance. This imbalance is expected to grow due to the widespread gap between available production and supply, and crop requirements. Asia's annual S fertilizer deficit is projected to increase from over 5 million tonnes currently to 6.4 million tonnes by 2013, with over 70 % represented by China and India (Morris, 2007). It is noted that about 7 M ha (about 52 %) of agricultural lands are reported to consists of sulfur deficient soils

in the northern region of Bangladesh (SRDI, 1999). The current intensive use of agricultural land for crop production has extended the sulfur deficient areas to about 80 % in the Northern region of Bangladesh (Khan, et al., 2007). Poor crop production as a result of acute sulfur deficiency has frequently been reported by many scientists in different regions of India (Tiwari, et al., 1985) and Bangladesh (Khan, 2000). The current use of gypsum, ammonium sulfate, zinc sulfate, etc. as sulfur fertilizers to the soils can instantly supply the sulfur to crops but the fertilization has to be done for each crop in every year, which was even unable to give satisfactory yield of crop and it is not a good practice for the soils as well as environments. Therefore, a suitable and sustainable source of sulfur is indispensable.

Highest levels of S are found in wetlands, mainly in soils containing acid-sulfate materials, and in alkaline, gypsiferous soils in arid and semiarid regions (Ribeiro, et. al., 2001). The utilize of sulfidic materials (SM) or layers obtaining from acid sulfate soils (ASSs) as sulfur fertilizer for crop production is very scanty. Khan, et al., (2002) reported that the high organic matter (2-9 %) total sulfur (3-7 %) and micronutrients in ASSs or SM deserve attention to use these soil materials for the reclamation of alkaline, calcareous or sulfur deficient soils and also for the amendment for ASSs themselves by the removal of SM from the soil. Khan, et al. (1994) also reported that the ASSs contained high Mg (1.3 to 2.6 c mol kg^{-1}) and Al (1 to 2 c mol kg^{-1}). But the use of high Al contained ASSs or SM did not notice any harmful effects when applied in the soils having pH > 4.5 (Khan, et al., 2002). The present studied SM in an ASS layer, which occupies 0.7 M ha land area in Bangladesh, had low pH (< 3), high sulfate and organic matter (Khan, et al., 2006)

The elimination of SM from the ASSs is not only reclaimed the ASSs for a long time but its use in sulfur deficient or non-fertile soils at the rate of about 300 to 1500 kg ha^{-1} may improve the fertility and productivity of the soils. Khan, et al. (2007) reported that the application of SM at the rate of 75 kg S ha^{-1} for sulfur deficient soils had no negative effect on soil pH, nutrient status in the soils and Sunflower production under pot experiment. They suggested that the application of SM was not only effective as sulfur fertilizer but also enriched the organic matter in the soils. Moreover, many studies have been conducted on the mineralization of elements such as N, P, and K from animal manures in various climates and soil conditions (Ebeling, et al., 2003; Egrinya-Eneji, et al., 2003; Eghball, et al., 2002; Schmitt, et al., 2001). However, there are relatively few that focus on nutrients such as Ca and S (Egrinya-Eneji, et al., 2003). Against this background, the present study was considered to evaluate the impacts of SM or ASSs compared with gypsum as sulfur fertilizer in relation to rice production in sulfur deficient soil under field experiment.

2. Materials and Methods

2.1 Soil collection and analyses

The SM (Cheringa acid sulfate soil) used for this study was obtained from the surface soil (depth of 0-15 cm) at Dulahazara in the Cox' Bazar district (Latitude 1206.2 rad or 21°3' N, Longitude 5220.0 rad or 91°6' E) in Bangladesh. Soils were collected from each replicated pots using Cork borer (2 cm diameter), then air-dried and screened by 1 mm sieve. The soils were oven dried at 105°C before analysis. The particle size distribution of the initial soil was determined by the pipette method (Day, 1965) with 1 M CH_3COONH_4 (pH 5.0) and with 30 % H_2O_2 to remove free salts and organic matter. Soil pH was measured by the soil-water ratio 1:2.5 and for the oven dried soil 0.02M $CaCl_2$ (1:2.5) suspension (Jackson 1973) using a Corning pH meter Model-7. For saturation extract of soils, the electrical conductivity (soil solution has extracted from saturated soil paste through vacuum pump: Richards, 1954), water soluble Na and K (Gallenkamp flame photometry using 589 and 766 nm filters, respectively: Black 1965), Ca^{2+} and Mg^{2+} (Pye UniCam-SP 9 atomic absorption spectrometry: Hesse, 1971) were determined. Organic matter content was determined (Nelson and Somners, 1982) by wet combustion with $K_2Cr_2O_7$. Available N (1.3M KCl extraction, Jackson, 1973), available P (0.002 N H_2SO_4, pH 3 extraction, Olsen, et al., 1954) and available S ($BaCl_2$ turbidity, Sakai, 1978) were determined. Cation exchange capacity was determined by saturation with 1 M CH_3COONH_4 (pH 7.0), ethanol washing, NH_4^+ displacement with acidified 10 % NaCl, and subsequent analyses by steam (Kjeldhal method) distillation (Chapman, 1965). Exchangeable Na^+, K^+, Ca^{2+} and Mg^{2+} were extracted with 1 M CH_3COONH_4 (pH 7.0) and determined by flame photometry (Na^+, K^+) and atomic absorption spectrometry (Ca^{2+}, Mg^{2+}). Total sulfur was obtained by digestion with a mixture of concentrated HCl/HNO_3 (1:3) and determined by turbidity method (Sakai, 1978).

2.3 Field experiment

The field experiment was conducted at Tongi, Gazipur district, Bangladesh during the period for June to October, 2000 to evaluate the impacts of SM compared with G as a source of sulfur fertilizer in relation to rice (*Oryza sativa* L., var. BR11: Mukta) production grown in sulfur deficient soil. The experimental treatments on the basis of furrow slice of the studied soils were: Control, 0 (no application of SM and G); SM_{20}, SM_{30}, SM_{40}, $SM_{50,}$ SM_{60} (SM 20, 30, 40, 50, 60 kg S ha^{-1}) and G_{20}, G_{30}, G_{40}, $G_{50,}$ G_{60} (G 20, 30, 40, 50, 60 kg S ha^{-1}). Each treatment was replicated thrice. Thirty three plots were selected as per experimental design (2 fertilizers X 6 doses = 12-1 = 11 X 3 = 33) having each plot size of 2 square meter (2 X 1 meter).

The soil in each plot was fertilized with N, P and K at the rates of 80, 40 and 60 kg ha^{-1} as urea, triple super phosphate (TSP) and murate of potash (MP), respectively. The full dose of TSP and MP and half of urea were mixed with the soil during plot preparation. The remaining urea was applied in equal splits, one at the active tillering stage of rice and the other at the panicle initiation stage. As per treatments, the soils in the plot were also subjected to the application of SM and G at the rates of 0, 20, 30, 40, 50 and 60 kg S ha^{-1} during plot preparation. Both the SM and G were dried, milled and sieved (1 mm sieve). Thirty five days old healthy and uniform seedlings were transplanted at the rate of five plants per hill and 60 hills per plot (row to row and hill to hill distance were 15 cm). The soils in the plots were irrigated by river water whenever necessary to maintain the soil under moist to wet conditions required for the production of rice. Seedlings were collected by the courtesy of Bangladesh Rich Research Institute (BRRI), Gazipur, Bangladesh.

2.4 Plant collection and analysis

At different stages of growth of rice shoot, the nutrients content were determined at 30 (20-40 early tillering stage = ETS), 60 (41-70 maximum tillering stage = MTS) and 110 (harvesting at maturity) days after transplanting (DT). The N contents were analyzed by the H_2SO_4 digestion through the micro-Kjeldhal method (Jackson, 1973) and P contents by spectrometry (Jackson, 1973); K content by Gallenkamp flame photometry (Black, 1965); S contents by turbidometry (Jackson, 1973) and Mg contents by atomic absorption spectrometry (Hesse, 1971) in HNO_3-$HClO_4$ acid (2:1) digest. The level of significance of the different treatments was determined at different stages of growth using Duncan's New Multiple Range Test (DMRT) and least significance different (LSD) techniques (Zaman, et al., 1982).

3. Results and Discussion

3.1 Sulfidic Materials (SM)

The SM was collected from the surface (depth: 0-15 cm) of an acid sulfate soil (Typic Sulfic Halaquept, detailed: Khan, et al., 2006) showed a silty clay loam texture with pH values of 3.3 (0.02 M $CaCl_2$) and 3.8 (field), indicating that the SM had probably accumulated a large amount of pyrite which had produced H_2SO_4 in the laboratory by oxidation. The EC, available and total sulfur and organic matter content in the SM were very high (Table 1). The content of Ca in SM was low compared with the Mg content, which might be due to occasional flooding with sea water rich in Mg. The Na content was also high due to the flooding with high saline water. The SM was in fact a fertile but unproductive soil due to its high acidity, salinity and imbalance of nutrients.

3.2 Conditions of initial and post harvested soils

The studied soil had silty clay loam textures, initial pH values of 5.0 to 5.3 as determined by the different conditions. These sulfur deficient soil was subjected to the application of SM and G in relation to rice production. The pH values at different conditions of the average soil data of all the treatments at post harvesting were found to be decreased by 0.1 to 0.3 pH units compared with the initial soil, indicating that the application of acidic SM on these soils had negligible influences on the pH of the soils. On the other hand, the SM strikingly increased the initial low content of organic matter, N, P, K, Ca, Mg, available and total sulfur in the soil by 2 to 233 % compared with the initial soils (Table 1), which was due to the high nutrient status of the applied SM though there might be a little contribution from the plant roots. The base saturation of the initial soil was 85 % which was increased to 89 % at the final harvesting of rice, (Table 1). These increases of base saturation were attributed to the high content of basic cations in the applied SM. The EC values of the soils were found to be increased from 1.0 to 2.1 dS m^{-1}, which are attributed to the higher EC values of the SM used. However, these increased levels of EC values might not have remarkable

influence on the production of rice.

3.3 Sulfur and organic matters in the soils

The available S contents of the soil was found to be increased by the application of SM and G but the effects were more pronounced in case of SM and the increments were significantly ($p \leq 0.05$) stronger with the passes of time (Table 2 and Figure 1). Apart from fertilizer rates, the applied SM and G increased the available S contents by 295 and 218 %, respectively at post harvesting of rice at maturity (Table 2). This might be due to the contents of other essential nutrients especially N in SM (Table 1), which enhanced sulfur uptake by the rice compared with the G treated plots. On the other hand, S content was found to be increased by the treatments but decreased in few cases by the passes of time was attributed to the uptake of rice plant (Table 2).

The content of organic matter in the soil throughout the experimental period was found to be improved a little by the different rates of gypsum fertilization, whereas almost all the doses of SM significantly increased the organic matter status in the soils and the increments were more striking with the higher doses of SM (Table 2). The application of SM increased the average organic matter in the soil by 72 % IOC at post harvesting of rice at maturity, while these increments were 58 % for G treatments. These increments in organic matter status in the soil were attributed to the high content of organic matter in the applied SM and the little enrichment of organic matter by the G treatments were attributed to the contribution of cultivation processes. Shamim, et al. (2008) also found the same findings and reported that the application of SM at the rate of 160 kg S ha^{-1} for sulfur deficient soils had no negative effect on nutrient status in the soils and rice production under pot experiment.

3.4 Nutrition of rice

At different growth stages of rice, the contents of N, P, K, Mg and S in rice shoot were increased by the SM and G application. The increments were more striking in case of SM compared to G application (Table 3). The lowest contents of these nutrients were observed for the control treatments in the soil. The average S contents in plant tissue of all the SM treatments at the final harvesting (110 DT) of rice were increased by 156 % compared with the control treatments. But these increments of S by the average of all G treatments were 133 % for the rice plants grown in sulfur deficient soils. It is mentioned that sulfur concentration in rice shoots decreases over time. These findings suggest that the impacts of SM as S-fertilizer were much higher than G and would also be effective for the subsequent crops as indicated by the high contents of nutrient in rice plants at final harvesting (110 DT) stages. The use of SM from ASSs not only recover S deficiency of rice plants but also enhanced the growth of rice and improved the fertility status of the studied soils compared to gypsum. Moreover, the removal of SM from ASSs may lead the reclamation of acute problem of the ASSs. Khan, et al., (2002, 2007) reported that the nutrient uptake by tomato, onion and sunflower were strikingly increased by the application of SM compared to G and $MgSO_4$.

Table 1. Some selected properties of initial soils (depth 0-15 cm, oven dry basis), sulfidic materials and the average soils of all the treatments at post harvesting of rice used during field experiment.

Soil properties	Studied soil			Sulfidic Materials
	Before use	After use	% †IOC	(‡ASSs)
Textural class	Silty clay loam			Silty clay loam
Soil pH (Field)	5.3	5.2	-	3.8
Soil pH (Soil: Water=1: 2.5)	5.2	4.9	-	3.6
Soil pH ($CaCl_2$=1.2.5)	5.0	4.7	-	3.3
E C (1: 5 dS m^{-1})	1.0	2.1	110.0	19.0
Organic matter (g kg^{-1})	7.0	9.2	31.4	40.0
Extractable N (m M kg^{-1})	0.2	0.25	25.0	3.6

Available P (m M kg^{-1})	0.5	0.51	2.0	0.1
CEC (c mol kg^{-1})	16.1	17.8	10.6	17.2
Base saturation (%)	84.6	89.2	5.4	21.1
Exchangeable cations (c mol kg^{-1})				
Sodium	0.37	0.65	75.7	2.13
Potassium	0.07	0.14	100.0	0.24
Calcium	6.45	6.62	2.6	0.31
Magnesium	3.61	3.99	10.5	0.95
Water soluble ions (c mol kg^{-1})				
Sodium	0.12	0.21	75.0	4.8
Potassium	0.24	0.32	33.3	0.3
Calcium	3.8	3.94	3.7	0.3
Magnesium	2.64	3.6	36.4	3.3
Available sulfur	0.03	0.1	233	35.1
Total sulfur	1.56	2.87	84.0	165.6

†IOC = Increased over control, ‡ASS = Acid sulfate soil

Table 2 Contents of sulfur and organic matter of the soils at different growth stages of rice as influenced by the application of sulfidic material (SM: kg S ha^{-1}) and gypsum (G: kg S ha^{-1}) in the sulfur deficient soil.

Treatment	**Available sulfur (m M kg^{-1})**			**Total sulfur (m M kg^{-1})**			**Organic matter (g kg^{-1})**		
denotation	30 DT†	60 DT	110 DT	30 DT	60 DT	110 DT	30 DT	60 DT	110 DT
Studied soil: Silty clay loam, pH 5.2, Organic matter=7.0 g kg^{-1}, Total S=15.6 and available-S=0.30 m M kg^{-1}									
Control	0.32d	0.28e	0.26d	15.9d	15.4d	13e	7.1c	6.6b	6.1d
SM_{20}	0.38c	0.61c	0.74b	18d	15.7d	13.2e	7.3b	6.6b	6.9c
SM_{30}	0.46b	0.68b	0.79b	24.3c	22.1c	19.4d	7.4b	7.1b	8.1b
SM_{40}	0.59a	0.72b	0.81a	32.1b	28.2b	25.3b	7.8a	7.3a	8.3b
SM_{50}	0.62a	0.81a	0.87a	38.5a	35.1a	32.1a	8.1a	7.8a	9.2a
SM_{60}	0.65a	0.86a	0.9a	40a	36.3a	32.2a	8.4a	8.1a	9.4a
G_{20}	0.34c	0.56d	0.63c	17.4d	14.5d	12.8e	6.3c	6.4b	6.8c
G_{30}	0.4c	0.59c	0.67c	21.2c	16.6d	13.5e	6.9b	6.5b	7.3c
G_{40}	0.52b	0.65c	0.71b	23.5c	19.2c	15.6e	7.3b	6.7b	7.6b
G_{50}	0.59a	0.74b	0.78b	32.3b	28.6b	24.1c	7.6a	7.2b	8.1b
G_{60}	0.61a	0.78a	0.83a	36.2a	31.4b	27.8b	8a	7.8a	8.8a
LSD at 5%	0.06	0.08	0.09	3.8	3.5	3.0	0.8	0.75	0.9
SM-IOC (%)	110.94	228.57	295.19	140.41	123.05	135.00	37.32	39.77	71.72
G-IOC (%)	92.19	196.43	218.08	105.35	79.06	80.38	27.11	31.06	58.20

†DT = days after transplanting, ‡In a column, means followed by a common letter are not significantly different at 5% level by LSD. IOC = Increased over control.

Table 3 Effect of sulfidic materials (SM) and Gypsum (G) on the nutrients contents (g kg^{-1}) at different stages of growth of rice shoot in the sulfur deficient soil.

Treatment	Nitrogen		Phosphorus		Potassium		Magnesium		Sulfur	
denotation	60 DT†	110 DT	60 DT	110 DT	60 DT	110 DT	60 DT	110 DT	60 DT	110 DT
	(‡MTS)	(¶Maturity)	(MTS)	(Maturity)	(MTS)	(Maturity)	(MTS)	(Maturity)	(MTS)	(Maturity)
Control	20.2	7.8d	1.1	0.9e	22.3	15.5c	5.2	2.8c	1.9	1.3d
SM_{20}	20.7	9.2c	1.5	1.2d	26.2	16.4b	5.5	3.1b	2.6	1.8c
SM_{30}	21.5	9.9b	1.9	1.4c	26.7	16.7b	6.1	3.2b	3.1	1.9c
SM_{40}	22.3	11.4a	2.2	1.8b	27.4	17.5b	6.9	3.4b	3.7	2.5b
SM_{50}	23.6	11.8a	2.5	2.1a	29.6	18.8a	7.3	3.8a	4.2	3.4a
SM_{60}	24.2	12.5a	2.6	2.3a	30.1	19.7a	7.7	4.1a	4.4	3.7a
G_{20}	20.3	8.6c	1.2	1.1d	25.8	15.8b	5.3	3c	2.1	1.5c
G_{30}	20.6	9.1c	1.5	1.3c	26.4	15.9b	5.6	3.1b	2.3	1.8c
G_{40}	21.5	9.7c	1.8	1.5c	26.9	16.7b	6.2	3.2b	2.8	2.6b
G_{50}	21.9	10.4b	2.2	1.8b	28.1	17.5b	6.7	3.2b	3.5	2.9b
G_{60}	22.8	11b	2.3	2b	29.3	18.6a	7.1	3.5b	4.1	3.3a
LSD at 5%		1.2		0.2		1.8		0.38		0.36
SM-IOC (%)	38.99	75.64	143.18	144.44	56.95	43.71	61.06	57.14	136.84	155.77
G-IOC (%)	32.55	56.41	104.55	113.89	53.03	36.29	48.56	42.86	94.74	132.69

†DT=days after transplantation of rice, ‡MTS=maximum tillering stage of rice, ¶Maturity=maturity stage of rice, In a column, means followed by a common letter are not significantly different at 5% level by LSD. IOC=Increased over control.

4. Conclusion

In rice shoots, the content of N, P, K, Mg and S at different growth stages was increased by the application of sulfidic materials (SM) and gypsum (G). But the increments were surprisingly high in case of SM compared to G fertilizer. The use of SM and G increased the available S by 295 and 218 % increased over control (IOC) at post harvesting of rice at maturity, suggesting that the SM compared with G as a source of S-fertilizer was potential and effective for the recovery of S deficiency as well as fertility status of the soils. In addition, the improved knowledge of the available and total sulfur in the soil and plant over time can help or lead to a more rational use of fertilizers. The high organic matter (40.0 g kg^{-1}), available-S (35.1 c mol kg^{-1}) and total S (165.6 c mol kg^{-1}) and other nutrient contents, specially micro-nutrient of the SM deserve attention to use these soil materials for the reclamation of poor soils like saline, alkaline, calcareous, sulfur deficient soils, etc. But further field research is essential to find out the optimum doses of SM for different soils under variable conditions.

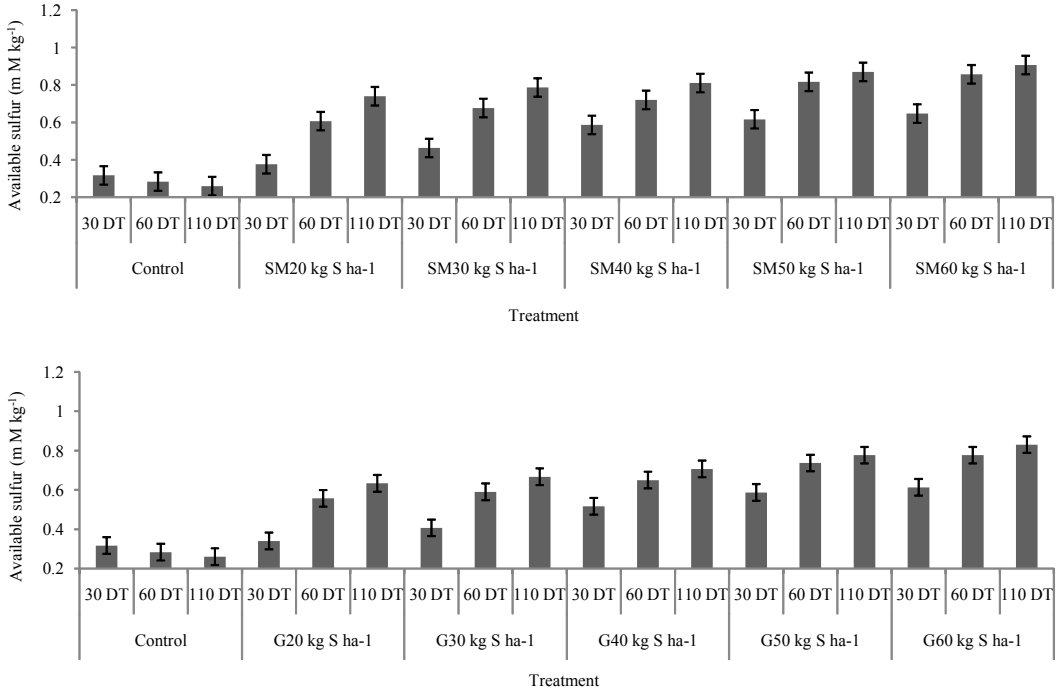

Figure 1. Effect of sulfidic material (SM) and gypsum (G) on the available sulfur at different growth stages of rice in the sulfur deficient soil. Vertical bars indicate ± standard errors of means.

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Tree Layer Characteristic and Regeneration pattern of central Himalayan Forest in relation to catchments area

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ABSTRACT: The present study was carried out in the forest located in the catchments of Nainital lake located in Uttarakhand. To study various qualitative and quantitative parameters, the study site was divided into North- East aspect and South – West aspect. In North East aspect two forests, Oak forest (hill base), and Oak-conifer forest (hill top and mid hill) were studied. Along the South-West aspect also three forests were studied: Oak forest (hill base), mixed forest (mid hill) and mixed forest (hill top). A total of 8 tree species were reported across all the study sites. These were: *Quercus leucotrichophora, Quercus floribunda, Cupress torulosa, Cedruss deodara, Rhododendron arboreum, Acer pictum, Aesculus indica and Cornus macrophylla.* The density within each forest ranged from 10 – 250, 30- 220, 120 – 380, 10 – 150, 20- 130 and 20 – 180 trees/ ha. Total density was found ranging from 220-560 trees / ha across the study sites. Abundance/frequency (A/F) ratio was found ranging from 0.01- 0.08 among the forest sites indicating that the species were distributed in regular, random and random – contagious pattern. The total basal area ranged from 16.7-69.9 m^2/ ha and the total IVI (269.93 – 299.9) across the forest studied. The moisture in the northern aspect ranged from 45.14% to 32.29%, where as the soil moisture in southern aspect ranged from 39.68% to 30.12%. The soil carbon in the northern aspect is found to be higher than the southern aspect. The soil carbon in the northern aspect ranged between 2.9% (0-10cm) to 1.3%(30-60cm),where as in southern aspect it varies from 2.3%to0.8%.Bulk density ranged between 0.88gm g cc^{-1} to 0.91gm gcc^{-1}in northern aspect while in southern aspect it ranged 0.79g $cc^{-1}$to 0.82g cc^{-1}. Based on the study, it is concluded that the forests which were close to the human habitation has suffered much damage than the sites far from the human settlements. The poor occurrence of seedlings and saplings in the studied forests indicate that immediate efforts are needed to boost the regeneration and employing suitable silvicultural and management practices for preserving the catchment protection value of the forest of Nainital lake catchment. [New York Science Journal. 2009;2(4):42-45]. (ISSN: 1554-0200).

KEY WORDS: Vegetation analysis, composition, catchments, regeneration

INTRODUCTION

The Indian subcontinent is a region of moderate to very high biodiversity including two of the global hot spot of vascular plant endemism in the Western Ghats and the Eastern Himalaya (Myers et al, 2000). In the central Himalayan region forest is potential vegetation above up to 3500 to 4000 m elevation. (Singh and Singh,1987).The Himalayan forest vegetation ranges from tropical dry deciduous forest in the foothills to alpine meadow above timberline (Singh and Singh,1992), however as data collected from land's imaginaries indicate, right now only 29% of the reported area (51,000sq km^2) is forested and good forests (with more than 60%forest cover) occur only in 4.4% of the area (Singh and Singh, 1987). Concentration of human settlements in the forest area, lopping and felling and occasional fire spreading from pine forest have reduced the area under forest (Champion and Seth,1968).The plant diversity is found extremely rich from the valley regions to the highly elevated alpine meadows (Sati, 2005). Forest diversity is the main source of live hoods of people living in Uttrakhand central Himalaya (Ram et al, 2004). Among the natural resource of Uttarakhand, forest are the most important both economically and environmentally. The forest area is reported to be 3,466 thousand ha and accounts for around 62.27%0f the area of the Uttarakhand. Through out the state, serious environmental problems have already emerged. There environmental problems are particularly noticeable in main land of Uttarakhand as a form of degradation and depletion of forest resources (Sati, 2005). In Uttrakhand, composition of forest is diverse varies from place to place because of varying topography such as plains, foothills and upper mountains (Singh, 2006). Strategies are being suggested to receive the forest cover in the region, including the replacement of agriculture by forestry (Singh and Singh, 1987), because of the human onslaught on the forest, the ecosystem succession

of communities and regeneration affects. To study the forest it is necessary to know the phytosociology of the forest. According to (Sexana and Singh, 1982), Himalaya offers and array of forest types below the timber line, and is cradle of major river of India harboring a network of catchments areas. As the catchments efficiency depends upon the type quality and stratification of forest vegetation a quantitative evaluation of its vegetation is pre-requisite. Some scientist have made few studies (Puri, 1960), (Champion and Seth, 1968 et al) found variation in the humid tropical forest and forest in the South East Asia respectively. Regeneration of the structure of a forest community can be communicated by constituting a profile diagram. The present study deals with tree layer compositions of forest and regeneration pattern of central Himalayan forest in relation to catchments area.

MATERIAL AND METHODS

The study area Nainital is located between 29º 21'- 28º 24' and north latitude between 1938 m to 2292 m elevation. For the detail study of tree layer composition, characteristic of forest and aspect along the elevational gradient i.e. hill base (1938-2000m) hill slope (2000-2110m) and hill top (2110-2292m).In the past both the aspect are subjected to landslides (based on personal inventory with the locals), on aspects between located 1938 to 2110m, the characteristic features anthropogenic disturbances and absence of regeneration. Altitudinaly the study area was located in a temperate environment but latitudnally it exists with in the subtropical belt. The basic climate pattern is governed by monsoon. The annual rainfall was 200-300mm of which three fourth occurred in rainy season (Mid June to September). The mean monthly temperature ranged between 17˙0˚ c (January) and 33˙0˚ c (April), and mean minimum temperature ranged between 0˙0˚ c (January) and 14.5˚ c (August). The study was conducted during the year 2004-2005 from each site; the composite soil samples were collected from 0-10cm, 10-30cm, 30-60cm.depths packed in polythene bags and brought to the laboratory for analysis. Moisture content was determined on dry weight basis. Soil bulk density was determined by (Mishra1968). Soil carbon percentage was determined by (Walkey and Blacks's methods, 1958).Vegetation analysis made for all the sites. Tree layer was analyzed sampling 10 quadrates 10x10 size in each site. The size and number of sample was determined following (Saxana and Singh, 1982). The vegetational data were quantitatively analyzed for abundance, density, and frequency (Curtis and Mcintosh, 1950). The importance value index (IVI) for the tree layer was determined as the some of the relative frequency, relative dominance (Curtis, 1950).The distribution pattern of different species using the ratio of abundance to frequency.

RESULTS AND CONCLUSION

SOIL

The moisture in the northern aspect ranged from 45.14% to 32.29%, where as the soil moisture in southern aspect ranged from 39.68% to 30.12%. The soil carbon in the northern aspect is found to be higher than the southern aspect. The soil carbon in the northern aspect ranged between 2.9%(0-10cm)to 1.3%(30-60cm),where as in southern aspect it varies from 2.3%to0.8%.Bulk density ranged between 0.88gm g cc^{-1} to 0.91gm gcc^{-1}in northern aspect while in southern aspect it ranged 0.79g $cc^{-1}$to 0.82g cc^{-1}.

TREE LAYER

On the northern aspect at the hill base the lowest tree density was reported for *Acer pictum* (10ind-ha^{-1}) and the highest for *Quercus leucotrichophora* (150 ind-ha^{-1}). At the hill slope the lowest density was reported for *Aesculus indica* and *Cupress torulosa* (20 ind –ha $^{-1}$each) and highest for (Quercus leuchotrichophora130ind-ha^{-1}), Where as at hill top the lowest density was reported for *Rhododendron arboreum* (20ind ha^{-1}) and highest for *Quercus leucotrichophora* (130ind-ha^{-1}), where as at hill top the lowest density was reported for *Aesculus indica* and *Cupress torulosa* (20ind-ha^{-1}each) and highest and highest for Quercus leuchotrichophora (130ind-ha^{-1}), where as hill top the lowest density was reported for *Rhododendron arboretum* (20ind ha $^{-1}$) and highest for *Quercus leucotrichophora* was (180ind-ha^{-1}). *Quercus leucotrichophora* was dominant all the sites (IVI=76.33) and hill top (IVI=74.59) and *Cedruss deodara* at hill slope (IVI=102.64).

In the southern aspect at the hill base the lowest density was reported for *Cornus macrophylla* and *Cupress torulosa* (10ind ha^{-1}) and highest for *Quercus floribunda* (250ind^{-1}). Density at hill slope ranged between (30ind-ha^{-1}*). Rhododendron* arboretum and *Cupress torulosa* (220ind ha^{-1}) for *Quercus floribunda*, where as it ranged between 120ind ha^{-1} *Quercus leuchotrichophora* and 380ind –ha $^{-1}$for Quercus

floribunda. The maximum (IVI=120.26) followed by *Quercus leuchotrichophora*(IVI= 82.04) and *Cupress torulosa*(IVI=78.1). At hill slope *Quercus leucotrichophora* was the dominant species (IVI= 85.73) followed by *Cupress torulosa* (IVI= 82.04) and Cupress *torulosa(*IVI=78.1). At the hill slope *Quercus leucotrichophora* was the dominant species (IVI=85.73) followed by *Cupress torulosa*(IVI=78.55) and *Quercus floribunda* (Quercus *leucotrichophor*(IVI=77.98).At the hill top IVI of *Quercus leuchotrichophora* respectively.

REGENRATION PATTERN

The study sites were to close human habitation, this indicates that lack of regeneration in each forest site there were identified no seedlings and saplings because the sites were also constructed by the builders and encroached by the local residents.

CONCLUSION

Loss of forest in central Himalayan region results in severe, ecological and economic cost lost watershed protection, regional climate change, reduced supply of timber, fuel wood, fruits etc, and also affects peoples lives (Jagdish et al,1997). As far as the species concerned in study area, total 08 species were reported in all the forest sites; however the range was 2-5 species, which were much less than the value 28 reported for central Himalayan forests (Upetri et al,1985) and 17 species for Oak Reserve forest (Bisht and Lodhiyal, 2005).This indicates that the most of the species has been disappeared from the study forest site because of human pressure and illegal tree cuttings this tempo need to be checked.

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Influence Of Indoor Environment On Health And Productivity

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ABSTRACT: This paper presents a synopsis of the influence of indoor environment on workers' health, comfort and productivity, conducted at a beverage bottling facility in Ilorin, Nigeria. A three-step regimen method was used to achieve the desired solution. Evidence from the review of observed complaints, depicted that continual environmental stress drain physical and mental resources and ultimately affect human performance and decrease productivity. Available programs were recommended to improve and maintain good indoor environmental quality specifically through good indoor air quality. [New York Science Journal. 2009;2(4):46-49]. (ISSN: 1554-0200).

Key words: comfort, environmental stress, health, indoor air quality, indoor environment, productivity

INTRODUCTION

Evidence from workplaces depicts various environmental conditions that are closely associated with the incidence of objectively measurable adverse health effects that is rapidly emerging. These indoor environmental problems can result in increased absences because of respiratory infections, allergic diseases from biological contaminants, or adverse reactions to chemicals used in industries. Building factors or pollution in buildings most frequently and consistently associated with respiratory health effects are the presence of moisture, water damage, and microbiological pollutants (Bornehag and Blomquist, 2001); animal and other biological allergens (Platts-Mills, 2000); and combustion products (Burr, 2000), including nitrogen dioxide (Pilotto et al.,1997; Norback et al., 2000). Other risk factors for respiratory health effects include: moisture or dirt in HVAC systems (Sieber et al., 1996); low ventilation rates (Menzies et al., 1993; Milton et al., 2000); formaldehyde (Pazdrack et al., 1993; Wantke et al., 1996; Garrett et al., 1999); chemicals in cleaning products (McCoach et al., 1999; Zock et al., 2001); and outdoor pollutants or vehicle exhaust (Wyler et al., 2000).

Exposures in indoor environments and health influences due to such exposures vary between regions of the world. In developing regions limited number of studies has been conducted regarding indoor air quality (IAQ) and health. Studies have dealt mainly with associations between indoor air pollution, due to unventilated burning of biomass, and health effects such as acute respiratory infections, chronic obstructive pulmonary disease and lung cancer. World health organization (WHO) has calculated that burning of solid fuel for cooking and heating in developing countries might be responsible for nearly 4% of the global burden of disease, i.e. approaching 2 million premature deaths per year (Smith, 2003). This is one of the main environmental health issues of the world, but so far little recognized.

The effects of IAQ on productivity became an issue only in the last decade, as a result of extensive research and an understanding of the strong connections between factors such as ventilation, pollution among others, and adverse effects on health and comfort. Evidence is increasing that health, comfort, and performance of adults improve at higher ventilation rates (Sundell et al., 1991; Sundell, 1994; Mendell, 1993; Seppanen et al., 1999; Apte et al., 2000). In addition, a recent controlled study in office buildings

found that short-term sick leave, often associated with respiratory illness, was significantly associated with low ventilation rates (Milton et al., 2000).

There is widespread concern that indoor environments affect occupants' health, comfort and performance (United States Environmental Protection Agency, 2001). Thus, office and industrial facilities should be designed, built, and maintained in ways to minimize and control sources of pollution, provide adequate exhaust and outdoor air ventilation by natural and mechanical means, maintain proper temperature and humidity conditions, and be responsive to workers with particular sensitivities such as allergies or asthma. Failure to deal adequately with any of these issues may go unnoticed, but can and often does take its toll on health, comfort, and performance of workers.

Many risk factors and outcomes in the area of this study are not well defined, conducting this research studies has been challenging and the interactions explored here are far-reaching. Nevertheless, this paper presents a comprehensive synopsis of the influence of indoor environment on workers health, comfort and productivity.

METHODS

This research study area was Ilorin metropolis, Kwara state capital; an ancient city about 500km from Abuja, the federal capital; strategically located at the geographical and culture confluence of the Northern and Southern Nigeria. This study was conducted at a beverage bottling plant for an eight-week period. The study population was the 293 permanent workers in the facility; and these workers donned, at a minimum, long coats and anti-slip boots.

The following methods were devised to best serve this objective. These include

1. A critical review of the literature was made to identify comparable studies that had been performed by other researchers. The databases of Environmental, Health & Safety (EHS), PubMed, the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) among others were utilized and manually searching key relevant journals and conference proceedings to research comparable studies.
2. Afterward, a review of injury and illness records was performed to identify areas of concern, pattern and seriousness of injury and define opportunities for intervention.
3. The health symptom structured questionnaire was administered at the bottling facility for data collection, completed by high and low cadres of staff.

RESULTS AND DISCUSSION

The literatures found were comprehensive though not exhaustive on indoor environmental issues couple with productivity, but the studies that were sited assisted in the recognition, evaluation and control of potential environmental stress hazards.

Medical records; that is, the industrial injuries registered provide a historic look at occurrences of allergic and asthmatic diseases among other health effects due to changes in environmental exposures rather then genetic changes. These illness rates and incidents yielded valuable information about the types of environmental stresses present and facilitated the prediction of potential future victims, stemming from the situation.

Evidence from the review of documented complaints, however, suggests that continued environmental stress can drain physical and mental resources and ultimately affect human performance and decrease productivity. For instance, evidence from office and the factory workers depicts that, when individuals experience just two symptoms of discomfort (e.g., dry eyes, itchy or watery eyes, dry throat, lethargy, headache, chest tightness); they begin to perceive a reduction in their own performance. Studies have suggested that the perception increases as the number of symptoms increases, averaging a 3-percent loss with three symptoms, and an 8-percent loss with five symptoms (Raw et al., 1990). This suggests that when large numbers of workers experience signs of discomfort related to the air inside their workstations, productivity will diminish over time. Productivity is certainly expected to suffer if conditions are serious enough for workers to complain. However, lack of complaints is not an indication that performance cannot be improved. This study for instance, symptoms were solicited through questionnaires (as opposed to complaints); that is, the reductions in performance were recorded under circumstances that easily could have gone unnoticed because of the absence of complaints.

A review of building investigation reports suggests significant benefits to health and performance from good HVAC maintenance (Sieber et al., 2001). Presumably, these benefits result because properly maintained HVAC systems can provide consistently good thermal and ventilation control while also reducing the risk of biological contamination.

RECOMMENDATIONS

As a result of the poor IAQ identified from the conditions of this facility, the following was the list of recommendations.

1. Efforts are needed to be focused on reducing the humidity levels in the climate controlled areas. Humidity levels that exceed 60% are considered to be beyond the level of comfort for workers (Handy and Lafreniere, 2006). The installation of dehumidification equipment can help to alleviate this problem.
2. Temperature fluctuations should be controlled. Workers have shown stress when temperature deviations exceed 4 degrees C during the course of their work shifts (Handy and Lafreniere, 1999). In essence, if the process temperature required is 45 degrees F, keep it within a degree or two of 45 degrees F during the course of the production shift as well as throughout the work year. Further, it was recommended that, during seasonal changes in the temperature, evaluations should be made to eliminate major fluctuations in temperature. The possible installation of a modern environmental control system should be evaluated on cost and benefit merits.
3. For the conditions of the facility, it appeared that poor IAQ results from failure to follow practices that help create and maintain a healthy indoor environment, so it was recommended that good HVAC maintenance and being proactive in managing potential IAQ hazards will assist with maintaining the indoor environment of this facility.

However, industries should take advantage of available programs to improve and maintain good indoor environmental quality specifically through good indoor air quality in their facilities. Programs can be targeted to the maintenance of existing facilities and to new facility construction.

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Comparative studies on the binding potential and water stability of duckweed meal, corn starch and cassava starch

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Abstract

Duckweed meal was experimented for its binding potential and water stability property in pelleted fish feed. Two sets of feeds formulated at 45% crude protein were used for the experiments. The first set had three experimental feed namely D_1, D_2 and D_3 containing duckweed meal, corn starch and cassava starch at 2% respectively used for Experiment 1 while the second set had four formulated feeds namely Diets A, B, C and D containing 0%, 10%, 20% and 30% duckweed meal respectively used for Experiment 2. The experimental feeds were observed for sinking time index, absorption efficiency rate, relative absorption rate and water stability. The result of the experiments showed that highest water stability indices were recorded from diets with duckweed meal used as feed binder compared to cornstarch and cassava starch. Water stability potential also increased with increasing levels of duckweed meal in the experimental feeds. Based on the results of this study, there are indications that the inclusion of duckweed meal in fish feeds could improve its binding potential and water stability. [New York Science Journal. 2009;2(4):50-57]. (ISSN: 1554-0200).

Keywords: Binding potential, water stability, duckweed meal, sinking time, absorption efficiency

Introduction

The success of any fish farming depends largely on the provision of suitable and economical fish feed through which optimum growth can be obtained.

When the composition of a feed is considered, more attention is given to those components, which provide nutrient to the cultured species at the required level (Akimuya, 1988; Eyo, 1994). Fish feed are lost in water system due to early disintegration and leaching, thus making nutrient unavailable to fish. The implications are poor weight gain, unhealthy environment and economic losses to farmers. Therefore fish feed must be bonded well to ensure stability in water and nutrients retention for a considerable period of time (Hilton and Slinger, 1981). There is still some wastage of nutrient due to the generous safety margin applied by feed manufacturers, which are brought about by instability of nutrients in pond water (N.R.C, 1983).

Binders are used in fish feed to improve the feed consistency, minimize wastage, reduce disintegration and loss of nutrients thereby increasing feed efficiency (Hastings, 1971; Storebakan, 1985). According to Stiver (1970) there are at least three actions by which binders increase the hardness, help the feed to float and increase water stability of pellets.

As a result of scarcity and high cost of fish feed components several studies have been carried out to evaluate different types of natural, modified or synthetic substances used as binding agents for aquatic feed which have been reviewed by Hung (1989) and Heinen (1981). In this study duckweed meal used as fish feed component due to its high nutritive value was assessed for its binding potential and water stability in pelleted fish feed.

Materials and methods.

Duckweed (*Lemna pauciscostata*) was collected in the out door concrete tank in the Hatchery Complex of the National Institute for Freshwater Fisheries Research, New Bussa, Nigeria.

They were harvested with the aid of scoop net and brought to the Federal College of Freshwater Fisheries Technology, New Bussa, Nigeria in a sack after which they were spread on a flat wooden surface and sun dried for 3 days. The dried duckweed was gathered and grounded to fine powder using a milling machine. The ground duckweed meal was sieved through a mesh size of 2mm and stored in a polythene bag.

The fixed ingredients used were fishmeal, soybean meal, groundnut cake, and yellow maize. Binders used along with duckweed meal were cassava starch and guinea cornstarch. All ingredients were obtained locally within New Bussa. Yellow maize grain and locally extracted groundnut cake (kulikuli) were milled separately into fine powder by the hammer-milling machine sieved to obtain small particle size. Raw soybean (*Glycine max*) grown locally around New Bussa was toasted before being grounded to powder.

The feed ingredients were weighed into a bowl using a sensitive weighing balance model OHAS-LS-400. The ingredients were made into diet of 5mm dough and pelleted manually with a pelleting machine. This helped the pellets to form very fine,, smooth and well-compacted pellets. The pellets were spread evenly and sun dried. Three feeds namely D_1, D_2, D_3, were prepared for Experiment 1 containing two percent duckweed, cassava starch and guinea cornstarch respectively as a binder (Table 1). Diet A, B, C, D were prepared for Experiment 2 containing 0%, 10%, 20% and 30% duckweed meal l respectively (Table 2). 0% served as control.

Table 1: Percentage composition of experimental feed (Experiment 1)

Ingredients	**D1**	**D2**	**D3**
Fish meal	30	30	30
Yellow maize	5	5	5
Soybean meal	30	30	30
Groundnut cake	29	29	29
Vitamin premix	2	2	2
Bone meal	1.5	1.5	1.5
Salt	0.5	0.5	0.5
Duck weed meal	2	----------	----------
Guinea corn starch	---------	2	---------
Cassava starch	----------	--- -------	2
Total	**100 %**	**100 %**	**100 %**

Table 2: Percentage composition of experimental feed (Experiment 2)

Ingredients (g)	**A (0%)**	**B (10%)**	**C (20%)**	**D (30%)**
Duckweed meal	0	2.6	5.2	7.8
Fish meal	26	23.4	20.8	18.2
Yellow maize	48	48	48	48
Soybean meal	15	15	15	15
Groundnut cake	6	6	6	6
Vitamin premix	2	2	2	2
Bone meal	2.5	2.5	2.5	2.5
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100

Six and eight aquaria glass tanks of 60 cm x 30 cm x 30 cm were used for the experiments 1 and 2 respectively. The glass tanks were properly washed and filled with clean water to half of its volume. Two

glass aquaria tanks were allocated to each treatment. 1g each of the two experimental feeds were taken and dropped into each of the glass tanks respectively for 1 hour to determine their sinking index and absorption rate. 5 g each of the two experimental feeds were also taken and put inside a nylon sieve cloth and immersed in the glass tank for 1 hour to determine the water stability potential (Dry matter percentage).

Proximate composition of the following nutrients from the experimental feeds was determined using standard procedures of AOAC (2000): moisture, crude protein, lipid, crude fibre and ash.

Water stability indices.

The following water stability indices were calculated.

Weight gain. (g): This was computed from the difference between the initial and final weight measured using sensitive balance.

Weight gain (g) = $(W_f - W_i)$

Sinking time rate (S.T.R): calibrated Stopwatch was used for the timing and recorded in seconds

Volume of water absorbed: The volume of water absorbed was determined in relation to the density of water (1g/cm). Volume of water absorbed = Mass (g) x density of water (g/cm).

Relative absorption rate $= \frac{W_f - W_i}{W_i} \times \frac{100}{1}$

Absorption efficiency rate (cm^3/sec).

$$= \frac{\text{Volume of water absorbed}}{\text{Time taken}}$$

Sinking time index (Sec^{-1})$= \frac{1}{\text{Time taken}}$

Water stability (%)

$$= \frac{\text{Final sample wgt.(\%) X LDM}}{\text{Initial sample wgt (\%) X IDM}} \times \frac{100}{1}$$

Where W_f = Final sample weight, W_i= Initial sample weight, IDM = Initial sample dry matter, LDM = final sample matter (Fagbenro and Jauncey 1995).

Results

The proximate analysis of duckweed meal (Table 3) showed high percentage of crude fibre and ash, 14.5% and 14.13% respectively; low moisture and lipid contents-2.8% and 4.90% respectively. The crude protein was 34.8%. Table 4 shows the proximate analysis of the experimental feeds. Highest crude protein of 45.06% was recorded in 0% duckweed meal (control) while the lowest, 41.87% was analyzed from 30% duckweed meal inclusion. The 0% duckweed feed had the lowest crude lipid of 11.76% while 20% duckweed meal inclusion had the highest crude lipid of 14.29%. Ash content was within the range of 12.00 -13.23% in all the experimental feeds. There was no significant difference ($P \geq 0.05$) between the proximate compositions of the feeds at different duckweed inclusion levels.

Table 5 shows sinking index and absorption rate of cassava and corn starches compared with duckweed meal. From the results the experimental feed containing duckweed meal had the highest sinking time of 4 sec while the lowest , 2 sec was recorded in feed with cassava starch. The maximum absorption efficiency rate and relative absorption rate of 2.92x10-4 cm^3sec^{-1} and 105% respectively were recorded from feed with duckweed meal while the lowest values of 1.72x10-4 cm^3sec^{-1} and 62.0% respectively were recorded from feed with cassava starch. Fig. 1 shows the relativeness of the feed stability indices. There was no significant difference ($P \geq 0.05$) between the absorption efficiency from all the experimental feeds. The feed containing duckweed meal however had the highest sinking time and volume of water absorbed.

Table 6 shows water stability potential (Dry matter) of the experimental feeds containing duckweed meal, cassava starch and cornstarch. The highest water stability of 82.81% was recorded in Diet 3 (cassava starch) while the lowest of 78.85% was recorded in Diet 1 (duckweed meal) (Fig.2). There was no significant difference ($p \geq 0.05$) between the water stability of the experimental feeds.Fig.3 shows the water stability of duckweed meal at different inclusion levels. Water stability increased with increase in duckweed meal in the experimental feeds.

Table 7 shows the sinking index and absorption rate of the experimental feeds with different percentage inclusion of duckweed meal. The highest sinking time of 488sec was recorded from 30% duckweed meal inclusion while the lowest; 193 sec was recorded in 0% feed. The volume of water absorbed by the experimental feeds was lowest in 0% duckweed meal (0.50cm^3) and highest (0.61cm^3) in 30% duckweed meal. There was no significant difference (P≥0.05) between the water stability indices at different duckweed meal inclusion levels.

Sinking time index/sec was highest in 0% duckweed meal with $5.18x10^{-3}$ and lowest in 30% with $2.05x10^{-3}$. Table 8 shows water stability potential (dry matter) of feeds with different percentage inclusion of duckweed meal. Percentage water stability of 0% duckweed meal was 86.49%, 10% was 98.2%, 20% was 98.41% and 30% having 99.20%.

Table 3: Proximate composition of nutrients in duckweed meal

.

Component	Percentage (%)
Moisture content	2.80
Crude protein	34.80
Lipid	4.90
Crude fibre	14.50
Crude ash	14.13
Nitrogen free extract	43.37

Table 4: Proximate composition of nutrients in experimental feeds (Experiment 2).

Percentage inclusion of duckweed meal	Moisture content%	Crude protein%	Lipid%	Crude fibre%	Ash%
A (0%)	2.30	45.06	11.76	4.90	13.23
B (10%)	1.05	43.35	14.02	6.50	12.30
C (20%)	1.36	42.56	14.29	4.46	12.00
D (30%)	2.46	41.87	12.83	5.13	12.83

Table 5: Sinking index and absorption rate of binders used.

Indices	Diet 1 (Duckweed meal)	Diet 2 (Guinea corn starch)	Diet 3 (Cassava starch)
Initial weight (g)	1.0	1.0	1.0
Final weight (g)	2.05	1.90	1.62
Weight gained (g)	1.05	0.90	0.62
Duration in water	1 HOUR	1 HOUR	1 HOUR
Sinking time (seconds)	4.00	3.00	2.00
Sinking time index. (sec^{-1})	2.5 X 10^{-1}	3.33 X10^{-1}	5.0 X 10^{-1}
Volume of water absorbed	1.05Cm^3	0.90Cm^3	0.62Cm^3
Absorption efficiency rate (cm^3/sec)	2.92 X 10^{-4}	2.50X 10^{-4}	1.72 X 10^{-4}
Relative absorption rate %	105.0	90.0	62.0

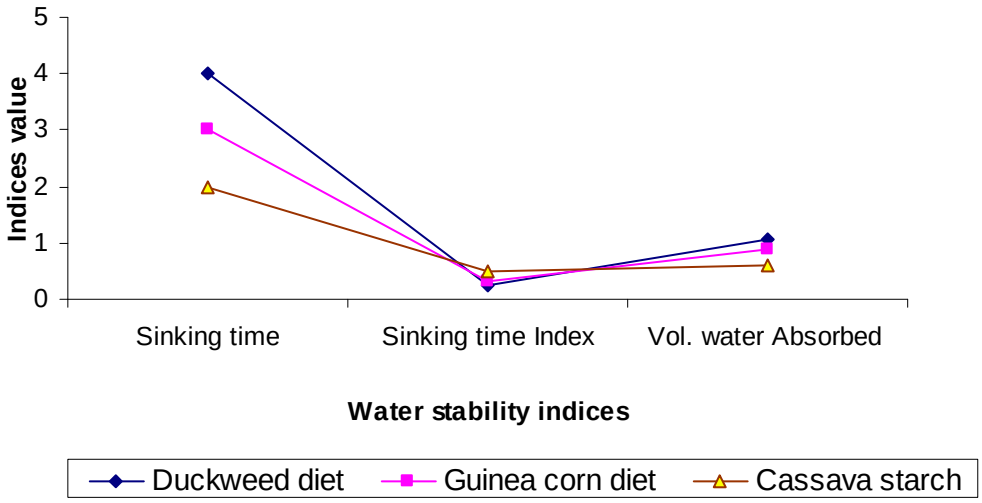

Figure 1.Relativeness of the feed stability indices

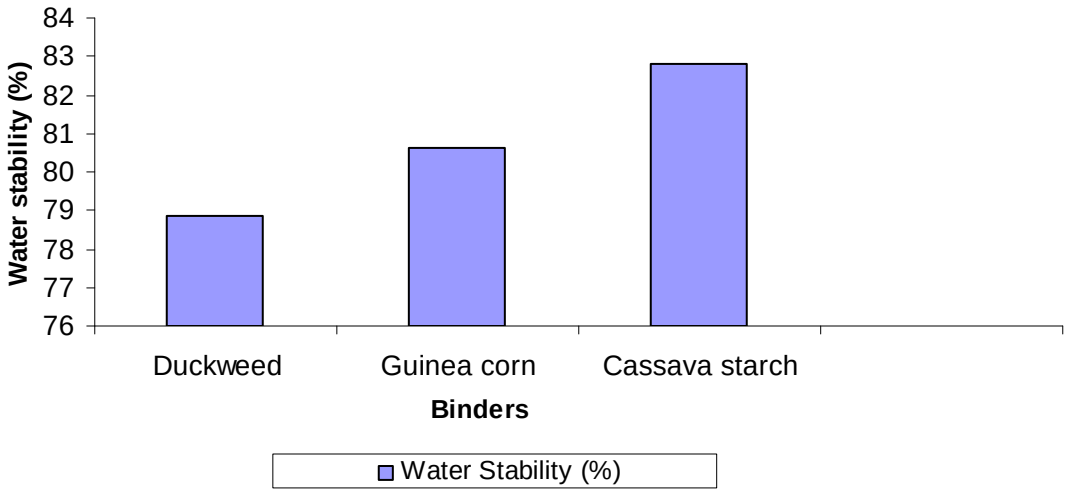

Figure 2. Variation in water stability (%) of different binders.

Table 6: Water stability potential (dry matter) of binders used

Parameter	DIET 1 (duckweed meal)	DIET 2 (guinea corn starch)	DIET 3 (cassava starch)
Initial weight (g)	5.0	5.0	5.0
Final weight (g)	4.40	4.46	4.54
Initial dry matter (g)	89.90	90.40	91.20
Final dry matter (g)	88.00	89.20	90.80
%Water stability	78.85	80.64	82.81

Table 7: Sinking index and absorption rate of diets with different percentage inclusion of duckweed meal.

Parameters	(a) 0% duckweed	(b)10% duckweed	(c) 20% duckweed	(d) 30% Duckweed
Initial weight (g)	1.0	1.0	1.0	1.0
Final weight (g)	1.50	1.51	1.60	1.61
Weight gained (g)	0.50	0.51	0.60	0.61
Sinking time (second $^{-1}$)	193	327	395	488
Duration in water	I HOUR	1 HOUR	1 HOUR	1 HOUR
Volume of water absorbed	0.50Cm^3	0.51Cm^3	0.60Cm^3	0.61Cm^3
Absorption efficiency rate (cm^3/sec)	1.39 X 10^{-4}	1.42 X 10^{-4}	1.67 X 10^{-4}	1.69 X 10^{-4}
Relative absorption rate %	50	51	60	61
Sinking time index. (Sec^{-1})	5.18 X 10^{-3}	3.06 X 10^{-3}	2.53 X 10^{-3}	2.05 X 10^{-3}

Table 8: Water stability potential (dry matter) of diets with different percentage of duckweed meal

Parameters	(a) 0% Duckweed meal	(b) 10% Duckweed meal	(c) 20% Duckweed meal	(d) 30% Duckweed meal
Initial weight(g)	5.0	5.0)	5.0	5.0
Final weight (g)	4.65	4.95	4.96	4.9
Initial dry matter {%)	90.86	97.52	97.85	97.15
Final dry matter (%)	84.50	96.55	97.07	95.21
% Water stability	86.49	98.02	98.41	96.04

Discussion

The use of synthetic binders in feed formulation has been a globally accepted technology but the norms of their side effect being non-biodegradable calls for more reliable binders of natural origin that will have no negative effect on the fish fed and harm to the consumer. Falayi *et al.* (2000) reported a comparative work on the binding capacity of some synthetic and natural binders. They reported that cassava starch was the best binder. The result from this study also shows the same inference.

The proximate analysis results were similar to the one reported by Skillicorn, *et. al* (1993) who stated that duckweed meal had 30% crude protein; ether extract, 6% along with nitrogen free extract, 45%. Ahahamad et al., (2003) also reported similar value of crude protein. Mbagwu and Adeniji (1988) and Mbagwu et al., (1987) both reported 4.40% as the maximum crude lipid content in duckweed meal while Culley and Epps (1973) and Culley *et al.* (1981) reported 6.3% as the maximum lipid content when they concluded analysis on various species of duckweed. The results from this experiment were similar to those reported by these authors. NRC (1993) reported that binders are incorporated into fish feeds to improve stability in water, increase pellet firmness, and reduce the amount of fines produced during processing and handling. The water stability indices calculated from this study showed no significant difference between duckweed meal, cassava starch and cornstarch incorporated feeds.

Conclusion and recommendation.

Duckweed meal has been in used as a feed ingredient in fish feed. Its utilization as a binder is therefore encouraged, as this will be of economic importance to the fish farmer serving as a nutrient source as well as a binder enhancing feed stability in water. This will no doubt reduce feed wastage and improve water quality thereby stimulating healthy growth and performance in cultured fish.

The result of this study shows the potential of duckweed meal being used as a binder to improve water stability in pelleted fish feed.

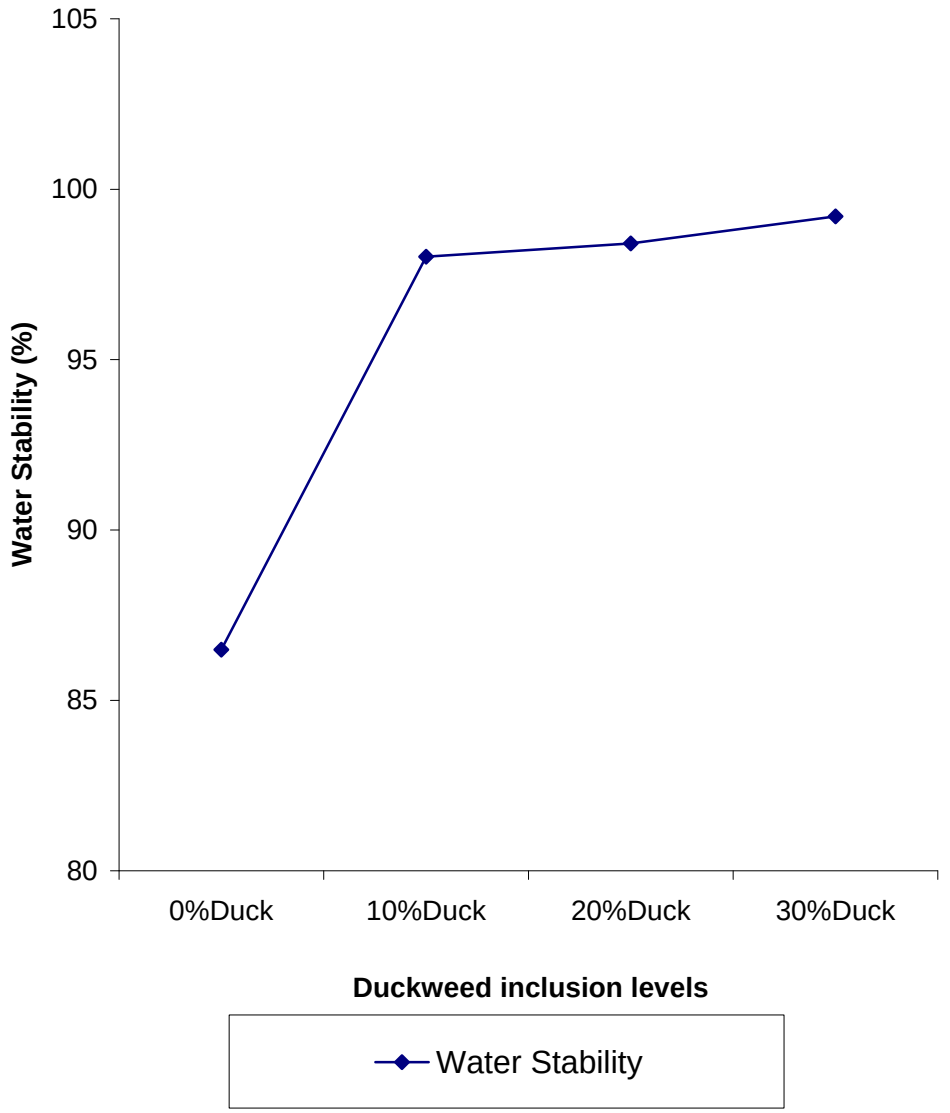

Figure 3. Water Stability of Duckweed meal at different inclusion levels.

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Phytosociological Analysis and Distribution Patterns of Tree Species: A case study from Govind Pashu Vihar, National Park, Uttarakhand

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ABSTRACT: Six forest stands located in and around Govind Pashu Vihar National park of Uttarakhand were studied for distribution pattern and species richness. Among tree species the total forest density ranges from 470 ind/ha- 600ind/ha. The maximum density were reported for *Pinus smithiana* (290ind/ha) while the least density for *Pinus wallichiana* (20ind/ha) while the total density of the saplings and seedlings ranged from 90-140 ind/ha and 50-510 ind/ha respectively. The distribution pattern of trees, indicated that most of the species were distributed randomly following regular distribution while few species were contagious distribution while in saplings contagious distribution were not found similarly in seedlings instead of contagious distribution, regular distribution were not present. [New York Science Journal. 2009;2(4):58-63]. (ISSN: 1554-0200).

Key words: Species richness, distribution pattern, study sites, vegetation, Garhwal Himalaya.

INTRODUCTION

The Himalayan mountain ranging from 27˚ 38' north latitude to 72˚ 98' east longitude embody a diverse and characteristics vegetation distributed over a wide range of topographical variation (Gupta, 1963). The Himalayan moist temperate forest extends from 1500-3000m asl in Western Himalaya is of the immense significance from the environmental conservation and sustainable development (Sharma and Baduni, 2000). The variable topography of the area supports luxuriant vegetation between 2200-2800m exhibit a dense canopy of Quercus species at moist situations (*Quercus floribunda*, *Quercus semicarpifolia*, *Quercus leucotrichophora*). Above 2800 m oak-conifer association occur where, *Quercus semicarpifolia*, *Abies pindrow*, *Piceae smithiana Pinus wallichiana*, *Taxus wallichiana* are in the dominant form (Bhandari, 1984).These forest have been under severe biotic pressure (Lopping, grazing and firewood collection) from human and livestock population which influence the rapid and frequent changes in land and resource use, reduction in species number, change in the climate pattern. These changes directly affect biodiversity (Heywood, 1995).

The present study provides a quantitative information and distribution pattern of recorded species of the study sites.

MATERIALS AND METHODS

The study area is located 30˚ 35' and 30˚ 18' north latitude and 77˚ 49' and 78˚ 37' east longitude in the temperate part of the western Himalaya in the altitudinal range of 1000-3200m, divisible in six different study sites. The climate of the lower part of study site have subtropical with more or less humid monsoon season from July to September at higher elevation it is cool even in June, winter is long with heavy snowfall from December to March. Soil mainly composed red loam and meadow type. Phytosociological analysis in the area was done by placing randomly 10, 100m^2 circular quadrats, the size and number of samples was determined following Saxena and Singh (1982). The vegetation data were calculated for density, frequency, abundance (Curtis and McIntosh, 1950). Importance value index for trees was determined as the sum of the relative density relative frequency, relative dominance (Curtis, 1959). Trees were consider to be individual >30cm cbh (Circumference at breast height), Sapling 10-30cm cbh and

seedling <10cm cbh (Saxena and Singh, 1984). Abundance to frequency ratio was done following Curtis and Cottam (1956) Distribution patterns were considered to be <0.025 regular distribution, 0.025-0.05 random distribution and >0.05 contagious distribution. Species richness was determined following Whittaker (1972) by tabulating the number of species in each site. Species diversity was computed by using Shannon-Wiener (1963).

Species	**I**			**II**			**III**		
	Density (Ind/ha)	**A/F**	**IVI**	**Density (Ind/ha)**	**A/F**	**IVI**	**Density (Ind/ha)**	**A/F**	**IVI**
Abies pindrow	180	0.018	114.24	180	0.022	85.76	-	-	-
Pinus wallichiana	90	0.036	126.53	120	0.048	58.64	60	0.006	35.87
Picea smihtiana	200	0.024	59.31	140	0.021	73.57	-	-	-
Cedrus deodara	-	-	-	70	0.043	39.88	-	-	-
Taxus wallichiana	-	-	-	90	3.6	42.15	-	-	-
Pinus roxburghii	-	-	-	-	-	-	170	0.047	90.64
Querques leucotrichophora	-	-	-	-	-	-	170	0.034	60.09
Querques floribunda	-	-	-	-	-	-	190	0.038	66.42
Rhododendron arboreum	-	-	-	-	-	-	80	0.05	29.99
Pyrus pashia	-	-	-	-	-	-	30	0.03	16.96
Total	**470**			**600**			**620**		

Table 1: Phytosociological attributes of Trees at different study sites

Abbreviations: ind/ha = individual per hectare, A/F= Abundance/ Frequency, TBA = Total Basal Area, IVI= Importance Value Index,

RESULTS

Phytosociological analysis of vegetation at different study sites are given in table1and 2. A total of 10 species of Trees and Seedlings, 9 Saplings species were recorded from the study sites. Among the Trees, the maximum density was that of *Piceae smithiana* (290ind/ha) at siteV and least density was that of *Pinus wallichiana* (20ind/ha) in site VI. Among trees *Piceae smithiana* was the dominant (IVI-147.2) in site V following *Piceae smithiana* (IVI=145.27) and *Pinus wallichiana* (IVI=126.53) of site VI and I respectively. While least dominant species was *Taxus wallichian*a (IVI=13.31) in site VI (Table 1 and 2). The distribution pattern of study site indicates that mostly species are in random distribution while some of them were distributed regularly very few of them distributed contagiously (Table 1 and2).

Table 2: Phytosociological attributes of Saplings at different study sites

Species	I		II		III		IV		V		VI	
	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F
Abies pindrow	30	0.075	-	-	-	-	-	-	70	0.028	50	0.055
Pinus wallichiana	-	-	30	0.033	-	-	-	-	-	-	-	-
Piceae smithiana	60	0.066	60	0.037	-	-	-	-	50	0.055	110	0.044
Cedrus deodara	-	-	20	0.05	-	-	-	-	-	-	-	-
Taxus wallichiana	-	-	10	0.1	-	-	-	-	40	0.1	70	0.077
Pinus roxburghii	-	-	-	-	-	-	210	0.025	-	-	-	-
Ouerques leucotrichophora	-	-	-	-	80	0.05	120	0.033	-	-	-	-
Ouerques Floribunda	-	-	-	-	50	0.031	-	-	-	-	-	-
Rhododendron. arboreum	-	-	-	-	40	0.1	80	0.05	-	-	-	-

Table 3: Phytosociological attributes of seedlings at different study sites

Species	IV			V			VI		
	Density (Ind/ha)	A/F	IVI	Density (Ind/ha)	A/F	IVI	Density (Ind/ha)	A/F	IVI
Abies pindrow	-			150	0.030	71.3	100	0.027	63.55
Pinus wallichiana	170	0.02	98.42	-	-	-	20	0.05	77.87
Rhododendron arboreum	50	0.055	21.4	-	-	-	-	-	-
Cedrus deodara	-	-	-	70	0.028	34.33	-	-	-
Taxus wallichiana	-	-	-	80	0.032	47.13	150	0.023	13.31
Pinus roxburghii	150	0.018	91.13	-	-	-	-	-	-
Querques leucotrichophora	210	0.002	89.03	-	-	-	-	-	-
Piceae smithiana	-	-	-	290	0.029	147.2	240	0.029	145.27
Total	**580**			**590**			**510**		

Species	I		II		III		IV		V		VI	
	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F	Density (ind/ha)	A/F
Abies pindrow	90	0.036	-	-					90	0.056	200	0.08
Pinus wallichiana	210	0.233	-	-	40	0.1	60	0.066	-	-	-	-
Piceae smithiana	170	0.068	-	-	-	-	-	-	-	-	180	0.072
Cedrus deodara	-	-	-	-	-	-	-	-	50	0.055	-	-
Taxus wallichiana	-	-	-	-			-	-	-	-	130	0.052
Pinus roxburghii	-	-	-	-	140	0.056	150	0.093	-	-	-	-
Ouerques leucotrichophora	-	-	-	-	80	0.032	120	0.033	-	-	-	-
Ouerques Floribunda	-	-	-	-	50	0.056	-	-	-	-	-	-
Rhododendron. Arboretum	-	-	-	-	-	-	140	0.155	-	-	-	-
Pyrus pashia	-	-	-	-	110	0.044	-	-	-	-	-	-

Table 4: Species diversity of different study sites.

Sites	Parameters	Trees	Saplings	Seedlings
I	SR*	3	2	3
	SD**	1.51	0.92	1.52
II	SR	5	4	0
	SD	2.24	1.73	0
III	SR	5	3	5
	SD	2.14	1.52	2.13
IV	SR	4	3	4
	SD	1.9	1.47	1.93
V	SR	4	3	2
	SD	1.77	1.54	0.94
VI	SR	4	3	3
	SD	1.66	1.5	0.91

*SR = Species Richness for Trees (per 100 m2), Saplings And Seedling (per 25m2).
**SD= Species Diversity (density based).

DISCUSSION

The total tree density value ranged from 140-750 trees/ha in Pindari catchments forest (Pangtey et.al., 1989), 820 trees/ha in natural forest of Gangotri, (Dhaulakhandi et.al. 2008). The total tree density value of the present study sites ranged from 470-590 ind/ha, these values were within the range values reported earlier by Pangtey et.al. (1989), Dhaulakhandi et.al. (2008). According to Saxena and Singh (1982) total tree density for temperate forests of Kumaun Himalaya ranged from 420-1640 trees/ha. Saxena and Singh, (1982), but these values for temperate forests of Garhwal Himalaya ranged from 652-1028 trees/ha (Kumar et.al. 2001). The total saplings density ranges from 90-410 ind/ha while seedlings density varied from 50-510 ind/ha. The distribution pattern of tree, sapling and seedling layers indicated that most of species are distributed randomly, while some species of trees and saplings were in regular distribution however in tree layer very few of them were in contagious distribution while contagious distribution is absent in saplings instead of this regular distribution were absent in saplings . These values were similar as earlier reported by Dhaulakhandi et.al. (2008). Odum (1971), emphasized that contagious distribution pattern is the commonest pattern in nature. Kumar and Bhatt (2006), also reported the contagious distribution pattern in forests of Garhwal Himalaya. Species diversity of the present study site ranged from 1.9-2.24 which is more or less similar to the value calculated by Braun (1950) in certain temperate forest and similar to the value calculated by Singh and Singh (1987) (1.19-2.15) in chir pine mixed forest of central Himalaya. Conversion of forest land to agricultural land, lopping for fuelwood, deforestation for household purposes have severly threatened the plant biodiversity. The conferous dominant forest have high economic value but due to close proximity to human interference these forest suffer various level of disturbances which would be the causitive factor regarding loss of plant biodiversity.

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Iron In Natural Garnets: Heat And Irradiation Induced Changes

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ABSTRACT: The optical absorption spectra of some natural single crystal garnets from Izom, Nigeria have been measured in the visible and UV (14,000 – 35,000cm^{-1}) region of light spectrum. Room temperature spectra of the garnets show absorption peaks due to ferric and ferrous ions in octahedral and dodecahedral coordination respectively. Mn^{2+} absorption bands are also present in the spectra. Upon heating in air to 650^{0}C, the Fe^{3+} absorption bands at 20,200: 21,700; 23,300; 27,250 and 29,200 cm^{-1} become enhanced in intensities while the Mn^{2+} bands at 20,800 and 21,050cm^{-1} disappeared. The Fe^{3+} bands in the spectra become slightly depressed after heating in charcoal and are not too noticeable because of the intense nature of the Fe^{3+} bands in the spectra. X-irradiation produced enhancements of Fe^{2+} bands at 16,200 17,600 cm^{-1} and Mn^{4+} band at 27,200cm^{-1} respectively. Because of its broadness, the intense broad band at 29,200 cm^{-1} is hereby interpreted to be due to Fe^{2+} Fe^{3+} charge transfer. However, no changes in the optical spectra was produced after treatment with UV light. [New York Science Journal. 2009;2(4):64-73]. (ISSN: 1554-0200).

Keywords: Spectra, natural garnet, absorption band, heating, x- irradiation, UV light.

INTRODUCTION

Garnets constitute a silicate mineral species with variable crystallo-chemical properties and mode of occurrence. This diversity is brought about in part by the ability of the garnet structure to accommodate cations with a wide range of sizes and valence states. Garnets also possess a wide variety of colours mainly resulting from incorporation of very different types and amounts of transition elements into X (dodecahedral), Y (octahedral), and Z (tetrahedral) coordination sites. The colours exhibited vary from white to shades of red, brown, yellow, green and black, depending on the transition ion impurities and their concentration.

The interrelationship between chemistry and crystal structure of garnet has been the subject of a considerable amount of research in the past three decades within three fields of scientific interest. In the earth science, the garnets are studied because of their importance as rock forming minerals in the earth's crust and upper mantle (Carbno and Canil, 2002). They occur as stable phases in a wide range of pressures, temperatures and chemical environments. Although they are most commonly associated with contact (Gaspar et al, 2008) and regional metamorphic rocks, they are also found in igneous rocks ranging from granites to peridotites (Batumike et al, 2001) as well as in felsic volcanics and pegmatites. Secondly, in solid state physics, synthetic non-silicate garnets are investigated because of their ferrimagnetic and laser properties. Thirdly, garnets are useful as gemstones in jewellery in which colour is one of the important properties because it contributes greatly to the value of gems. Garnets are one of the best gemstones, therefore, studies on their colour phenomena become both of economic and scientific interest.

Optical absorption spectroscopy is of potential use to characterize site occupancy in crystals both qualitatively (by observation and assignment of spectral bands to specific cation in specific sites, Burns, 1970a) and quantitatively (by comparison of spectral intensities, Burns, 1970b). However, as the distribution of ions among the different cation sites is likely to vary depending on the genesis of the particular garnet, the optical spectrum is thus expected to be a useful tool for the determination of site distribution of the ions. Therefore, attempts have been made to characterize site occupancies in the

garnets. The complexity of the garnet spectra, however, makes some assignments and interpretations uncertain.

The optical absorption spectra of natural almandine single crystal garnets from Izom, Central Nigeria, have been measured in the visible and near UV regions of light spectrum (14,000-35,000cm^{-1}) and optical absorption bands of Fe have been identified and characterized. Earlier absorption band studies by Manning (1967, 1967a, 1970a, 1970b and 1972), Slack and Chrenko (1971), White and Moore (1972), Runciman and Sengupta (1974), Newman et al, (1978), Kholer and Amthauer (1970) and Chaunyi (1981) on garnets have not only identified absorption bands due to Fe^{3+}, Fe^{2+}, Cr^{3+}, Mn^{2+} and other impurity cations but also assigned them to cation coordination sites (X, Y and Z). However, the optical absorption spectra of the silicate garnets in the 14,000 – 35,000cm^{-1} region are perhaps the most complicated observed for any mineral. As many as 15 to 20 distinct bands have so far been reported in this relatively narrow spectral range.

The present study is an attempt to understand the response of Fe in the garnet crystal structure to heating, irradiation and UV light treatments. Changes observed are expected to contribute to knowledge of the crystal chemistry and colour of garnets. An attempt is made to explain the observed changes in the Fe and Mn optical absorption spectra and also to assign the band at 29,200cm-1, which has hitherto not been assigned (cf. Manning, 1967).

MATERIALS AND METHODS

Garnet Samples

The specimens used consisted of five wine red almandine garnet crystals. The crystals were collected from Izom, near Abuja in central Nigeria. The samples were selected for crystallinity, size and phase purity. Generally, the crystals measured about 2cm by 1cm and are big enough for optical absorption studies. Perfectly oriented wavers were cut from each of the crystals and polished on both sides to thickness of approximately 1.7mm. Preliminary transmitted light spectroscopy studies indicated that the crystals show colour zoning. Care was taken to ensure that areas of uniform colour and enough width were selected for the optical absorption spectral study.

Chemical Analysis

The garnets were chemically analysed by electron microprobe for seven major and trace elements. In these analyses, all of the Fe has been assumed to occur as Fe^{2+}. However, Utsunomiya et al, (2005) have shown that although Fe in unirradiated natural garnets consist dominantly of Fe^{2+} ions, some Fe^{3+} ions are also present. Indeed, the spectra of the unrradiated natural samples in this study contain Fe^{3+} absorption bands.

Optical Absorption Spectra

Optical absorption spectra were recorded in the range 14,000-35,000cm^{-1} by means of a Cary Model 14R spectrophotometer. All spectra were run at room temperature. The diameter of the spectrophotometer measuring circular slit was 2mm. The optical absorption spectral measurement method of Cohen et al (1985) was employed. Garnet belongs to the cubic system, and has identical spectra in all orientations to the polarized light. Therefore, only the normal light spectrum has been measured. All absorbance values reported here and shown in the figures are accurate to within approximately ± 2% verified using standard absorption screens.

Heat Treatment Experiments

Heating in oxidizing (air) and reducing (charcoal) conditions was done in order to observe if any changes would occur in the colour or intensities of absorption bands of Fe and Mn in the spectra. The samples wee heated in air to see whether or not oxidation of Fe^{2+} and Mn^{2+} would take place. This was done by placing the sample on a very clean block of high-purity fused silica and heating in an electric furnace for 3hours at 650^{0}C.

The sample was similarly heated in charcoal, which was used as a reducing medium for 3 hours at 650^{0}C. Care was taken to ensure that the sample was completely covered by the charcoal powder. Optical absorbance measurements were taken as in the oxidizing condition.

X-irradiation

Ion irradiation effects in garnets have recently become a subject of topical reseach interest (Eby et al, 2001; Calligaro et al, 2002; Utsunomiya et al, 2002 (a); 2002 (b); 2005). The samples were subjected to X-irradiation for 24 hours from a 50KV source run at 35ma. The sample was wrapped in aluminum foil before it was put in the cell for irradiation in order to minimize the possible bleaching action of ambient light.

UV Light Treatment

The optically good crystals were illuminated with UV light produced by a high pressure Xenon-Mercury lamp to observe if any colour change would occur. Illumination time was four hours after which the samples were cooled to room temperature and the absorption spectra taken.

RESULTS

The results of electron microprobe analyses for the major and trace elements are shown in Table 1. The analyses show that the garnets are enriched in Mn. Figure 1 and Table 2 show the optical absorption bands of the room temperature normal spectrum of unirradiated almandine garnet. The bands at 27.260 and 29.200cm^{-1} displayed broad intensities (Figs. 1, 2 and 3). The spectra obtained after heating in air indicated that the Fe^{3+} bands at 20.000; 21,700; 23,300 and 27,260cm^{-1} became enhanced in intensities.

Table 1. Electron microprobe analysis of almandine garnets (All results in wt. percent)

	AD1		AD2		AD3		AD4		AD5
SiO_2	37.12	37.39	37.23	37.20	37.18				
Al_2O_3	20.00	19.78	20.15	20.26	20.05				
TiO_2	0.05		0.03		0.03		0.02		0.01
FeO	34.01	34.32	34.27	34.15	34.18				
MgO	3.01		22.96	2.98		3.02		3.01	
MnO	2.63		2.71		2.69		2.62		2.73
CaO	3.18		2.78		2.65		2.75		2.83
	100.00	99.97	100.00	100.02	99.99				

Table 2. Survey of reported bands (cm^{-1}) of Fe in natural almandine garnets at room temperature

Electron Volts (eV)	Manning (1967)	Chrenko	Slack and White (1971)		Moore and (1972)		This work	This work (650^{0}C)	Assign-ment
1.80	14.500	14.500	14.500	14.700	14.680		(Fe^{2+})viii		
2.02+	16,300	16,300	16.300	16.200	16.150+		(Fe^{2+})viii		
2.19+	17.500	17.500	17.470	17.600	16.600+		(Fe^{2+})viii		
2.38	19.200	19.200	19.200	19.200	19.200		(Fe^{2+})viii		
2.46	19.800	19.800	19.850	20,000	20.000		(Fe^{2+})viii		
2.58					20.800	20.800	D	Mn^{2+}	
2.61					21.250	21.050	D	Mn^{2+}	
2.70+	21.800	21.700	21.650	21.800	21.700+		(Fe^{2+})vi		
2.89+	23.500	23.900	23.350	23.300	23.300+		(Fe^{2+})vi		
3.10	25.100			25.025				(Fe^{2+})viii	

3.39+ → 27.300 27.650 27.200 27.200 27.200+ (Fe^{2+})vi → Mn^{4+}

362+ 29.000 → 29.200 29.200+ Fe^{2+} → Fe^{3+}

D = disappeared
+ = enhanced upon heating and X – irradiation

The yet unassigned band at 29.200 cm^{-1} also became enhanced in intensity while the Mn^{2+} bands at 20.800 and 21.050cm^{-1} disappeared (Figs. 2a, 2b and 2c). The Fe^{3+} became slightly depressed after heating in charcoal. X-irradiation produced enhancements of Fe^{2+} bands at 16.200 and 17.600 cm^{-1} and Mn^{4+} band at 27,200 cm^{-1} (Fig 3) respectively. However, no changes in the optical spectra were produced after treatment with UV light.

DISCUSSION

The results of the microprobe analyses of representative samples of the garnets used for optical absorption spectra studies are shown in Table 1. Of the transition ions present in the samples, iron is found to be most abundant. Generally, iron containing garnets exhibit some of the complicated visible spectra yet observed in transition ion-containing minerals. These are due to the spin-forbidden transitions of Fe^{3+} and Fe^{2+}. Garnet spectra also often contain optical bands of other cations especially Mn^{2+}, Mn^{4+} etc.

The structure of garnets has been described by many authors, notable among who are Gibbs and Smith (1965) and Novak and Gibbs (1971). Based on the structure, various workers, like Maning (1967), Slack and Chrenko (1971), Moore and White (1972), Runciman and Sengupta (1974), Huggins et al (1977) and Chuanyi (1981) have attempted to assign Fe^{3+} and Fe^{2+} to coordination sites in garnets (Table 2). These assignments remain uncertain because of the complexity of the garnet spectra. Apart from the high variety of impurity cations (transition ions) that can enter the structure, garnets display efficient packing of oxygen in their structure (Meagher, 1982). The efficiency in packing is brought about by the lack of tetrahedral polymerization and the large number of shared polyhedral edges. This latter factor inhibits easy diffusion of cations in the structure even at high temperatures.

All the optical bands obtained for natural garnets in the present study very closely correspond to those from previous studies. The spectra for heated and irradiated garnets are however not, until now, known to have been reported; nor has the observed band at 29,200 cm^{-1} been previously explained or assigned (cf. Manning, 1967). The bands at 21,700 and 27,260 cm^{-1} have been previously assigned to Fe^{3+} in the octahedral site. These assignments and interpretations, however, need to be re-considered and particularly in the light of the obtained chemical composition of the garnets (Table 1). The present analyses of these samples now compel us to take another careful look at these earlier assignments and interpretations. It is particularly important to also consider the contribution of optical bands of Mn to the general spectra. Heating and X-irradiation treatments reported here have assisted in explaining, at least, part of these phenomena. The quantity of Mn in the studied samples (Table 1) indicates that the Mn^{2+} and Mn^{4+} ions play some role in the development of the garnet spectra after heating and X-irradiation. Bands due to Mn^{2+} have been found to occur at 20,050cm^{-1} while those due to Mn^{4+} either as spin allowed or spin-forbidden occur at 16,200: 16,400; 16,800; 22,700; 23,200; 26,600 and 27,200 cm^{-1}. This is bound to affect the spectral bands of both ions in a mineral rich in both elements. It is hereby proposed that the observed changes in spectra after heating and X-irradiation involve Fe^{2+}, Mn^{2+} and Mn^{4+} and not only Fe^{3+} and Fe^{2+} as previously interpreted (Manning, 1972).

Heating in air produced enhancement in intensities of the bands at 20,000; 21,700; 23,300; 27,260 and 29,300 cm^{-1} as a result of oxidation of Fe^{2+} to Fe^{3+}. The Mn^{2+} bands at 20,800 and 21,050 cm^{-1} disappeared in the process also because of oxidation of Mn^{2+} to Mn^{4+}. The oxidation of both Fe^{2+} and Mn^{2+} ions is an easy process because they

occur in the dodecahedral sites and are not tightly bonded like those occurring in the octahedral sites. On heating in charcoal, the Fe^{3+} bands became only slightly depressed indicating slight reduction of Fe^{3+} to Fe^{2+}. This is because the structure of garnets and the octahedral coordination of Fe^{3+} make its dislodgment from the site difficult. Because the Fe^{3+} bands are intense and broad, these depressions in intensities are not too noticeable. The process of X-irradiation involving Fe^{3+} and Mn^{2+} can be considered to proceed as follows: $Mn^{2+} + 2Fe^{3+} \longrightarrow Mn^{4+} + 2Fe^{2+}$.

This process explains the enhancement of intensities of the Fe^{2+} bands at 16,200 and 17,600cm^{-1} and Mn^{4+} band at 27.200cm^{-1}. This observation is in agreement with the findings of Utsunomiya et al (2005). The enhancements at 16,200 and 17,600cm^{-1} are due to the produced Fe^{2+} and also that at 27,200 cm^{-1} is due in part to contribution form the produced Mn^{4+}. The band at 29,200 cm^{-1} became enhanced in intensity on X-irradiation. This is due to reaction of the produced Fe^{2+} with nearest neighbour Fe^{3+} giving Fe^{2+} Fe^{3+} intervalence charge transfer band (Manning, 1973). The broadness and intensity of this band make this assignment more likely than any other. Also, samples elsewhere that have not shown optical bands due to Fe^{3+} do not have this band in their spectra.

Exposure of the samples to UV light was to see if any bleaching of the colour would occur. There was no change in the colour or intensity of the spectra of the garnets. It shows that the colour of garnet is not affected by exposure to UV light or X-irradiation. This property recommends the crystals as good gemstones.

CONCLUSION

The following conclusions can be drawn from this study. The optical absorption bands in almandine garnet crystals are affected by heating and X-irradiation. Bands of Fe^{3+} and Mn^{4+} are enhanced on heating in air and X-irradiation as a result of oxidation of Fe^{3+} and Mn^{2+} to Mn^{4+}. Overlap and interaction of Mn^{4+} and Fe^{2+} bands at 16.200cm^{-1} and Mn^{4+} band at 27,200cm^{-1} respectively are the causes of the enhancements of intensities of these bands. These observed bands therefore, are results of combination of bands of both ions and not just bands due to a single ion (Fe^{3+} or Fe^{2+}) as previously interpreted.

Also, the band at 29,200 cm^{-1} is $Fe^{2+} \longrightarrow Fe^{3+}$ intervalence charge transfer band. It will occur only in garnets that contain appreciable amounts of Fe^{3+} content. The crystals are not bleached by heating, X-irradiation or UV light. This indicates that the colour producing ions in garnets are tightly held in their crystal structure and hence cannot change their valences easily. Therefore, in terms of suitability their colour stability recommends them as valuable gemstones. However, they will still be required to satisfy other necessary requirements like crystallinity, size, phase purity and durability.

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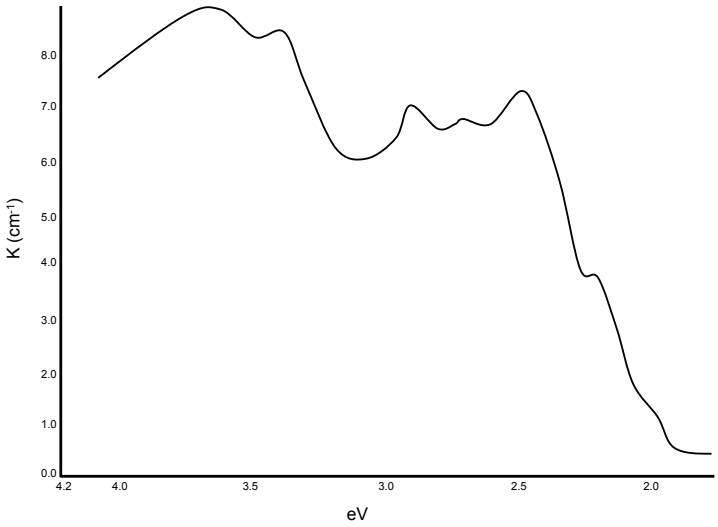


Fig 1: Absorption spectrum of natural almandine garnet single crystal using normal light

Fig 2a

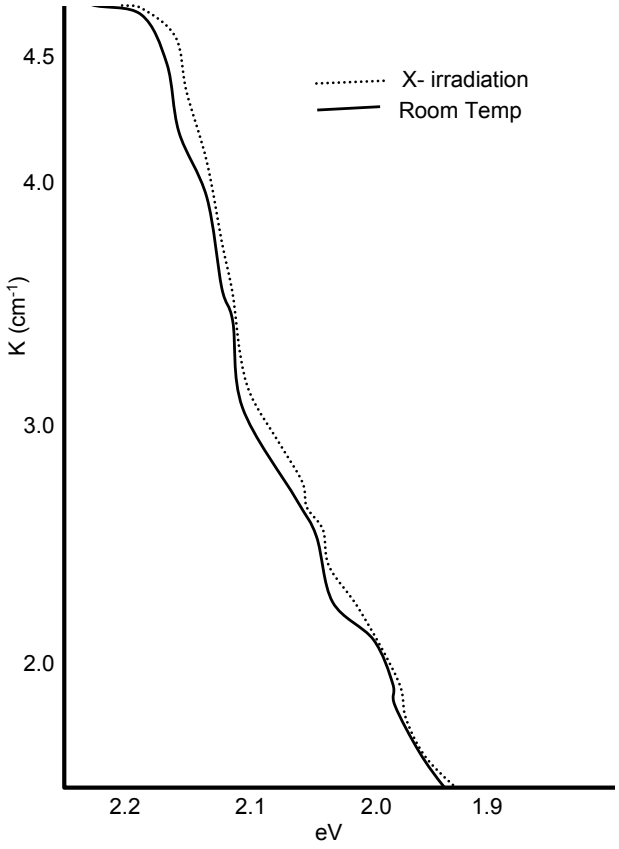
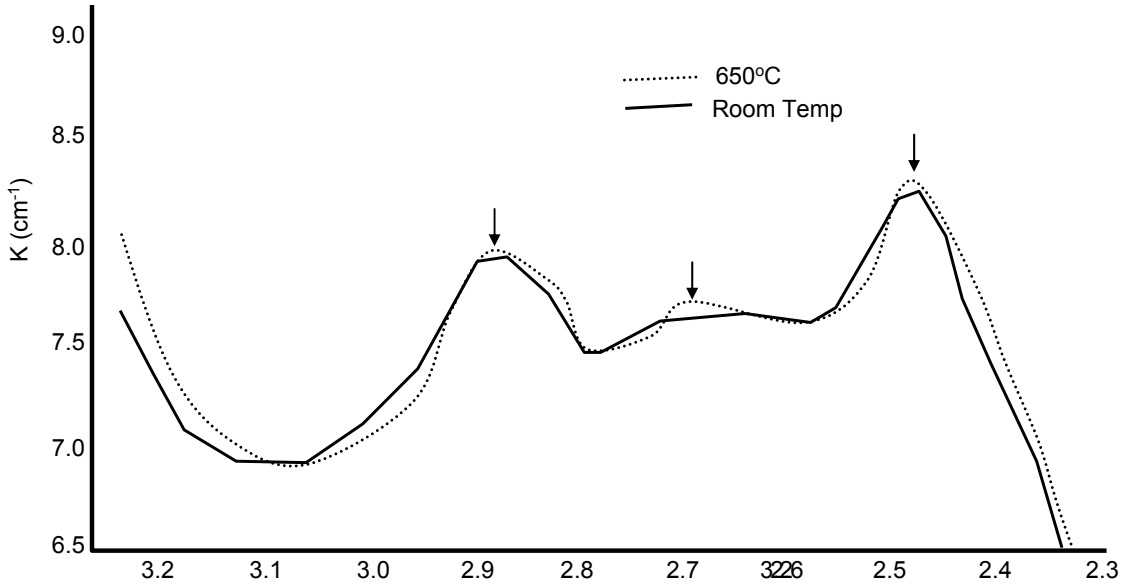


Fig 2b



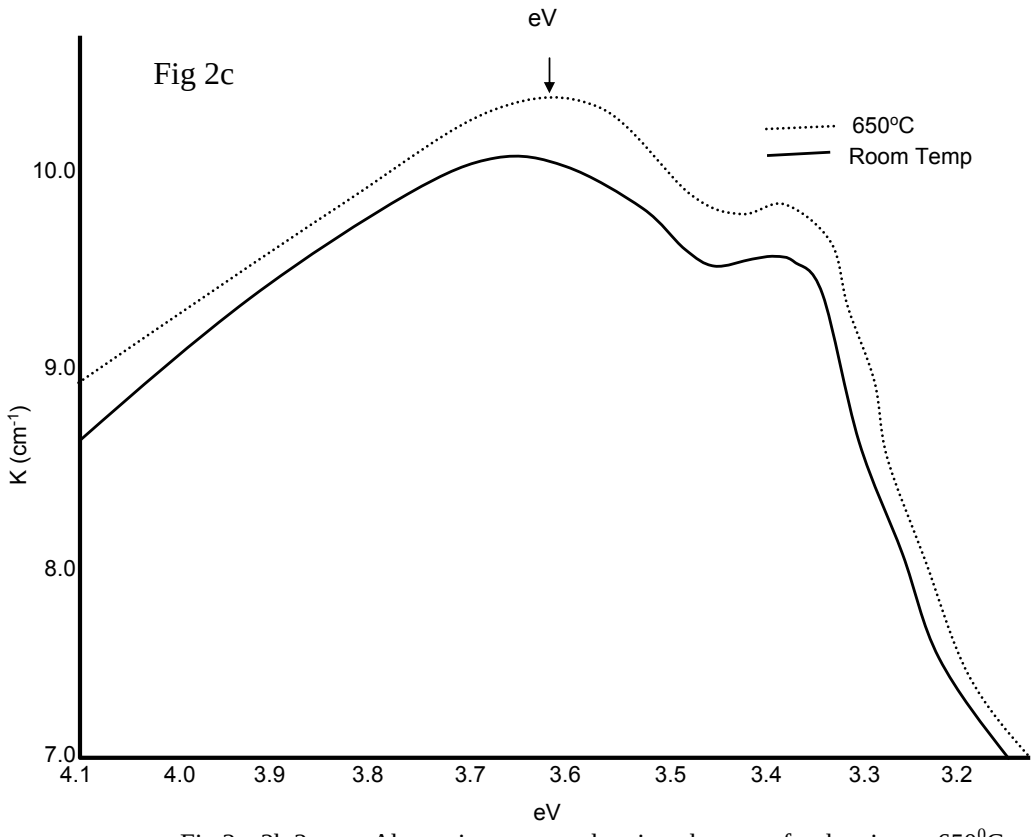
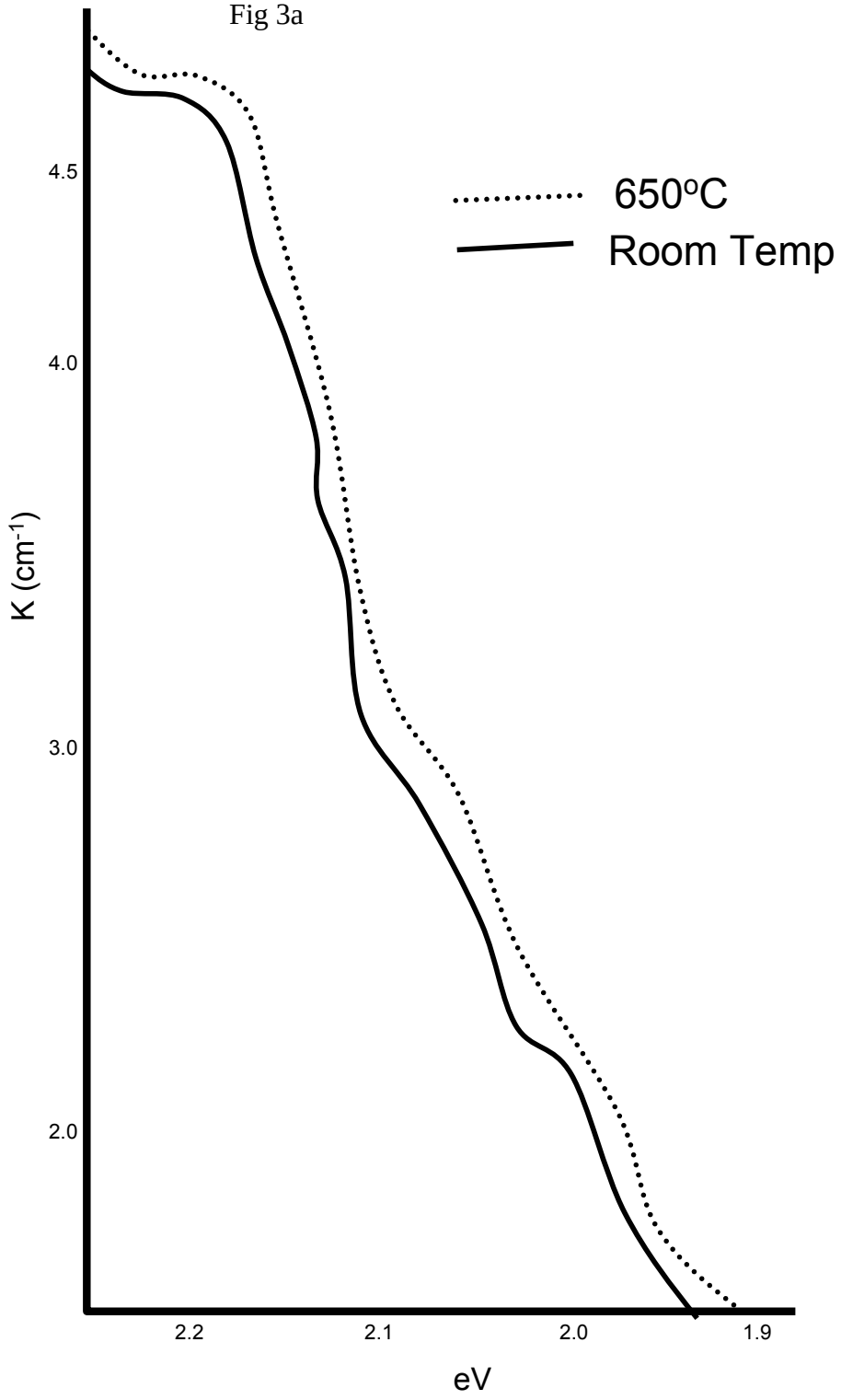


Fig 2a, 2b,2c: Absorption spectra showing changes after heating at 650^0C

Fig 3a



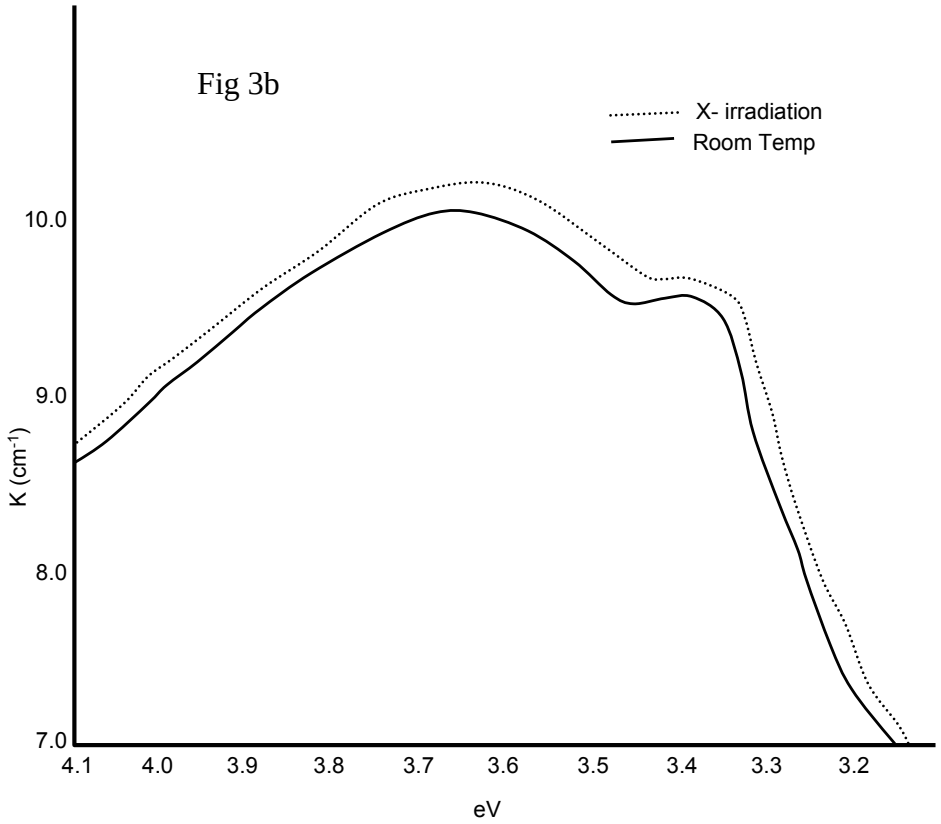


Fig 3a,3b: Absorption spectra showing changes after X- irradiation

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数学归纳法的拓广

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摘要： 本文指明数学归纳法的实质在于递推，将其从正整数集逐步推广至整数集、实数集、有理数集、复数集等集合，从普通加法运算推广至一般抽象运算，给出了一般集合上的数学归纳法，为数学命题的证明开辟了一条新的道路，同时举例说明了其应用。[New York Science Journal. 2009;2(4):74-76]. (ISSN: 1554-0200).

关键词 ：数学归纳法、递推、整数集、实数集、抽象运算。

数学归纳法通常是证明与正整数集有关命题的一种重要的论证方法，许多数学命题利用其它数学方法很难证明或者根本无法证明，但利用数学归纳法很容易解决。数学归纳法的理论根据是正整数集的序数理论，为了证明命题的需要而演变成了多种形式，同时将数学归纳法从正整数集推广至所有良序集。

定义：设 S 是一个集合，≤是 S 中一个二元关系，满足 ① 对任何 x∈S 有 x≤x; ② 对任何 x、y∈S 有 x≤y 且 y≤x 可得 x=y; ③对任何 x、y、z∈S 有 x≤y 且 y≤z 可得 x≤z，④ 对任何 x、y∈S 均有 x≤y 或 y≤x; ⑤若 S 的任何非空子集有最小元。则称 S 是良序集。

超限归纳法原理：设（S，≤ ）是一个良序集，P（x）是与元素 x∈S 有关的一个命题，①如果对于 S 中的最小元 a_0，P（a_0）成立；②假定对于任何 x＜a, P （ x ）成立，可证明 P (a)也成立。则 P(x)对任何 x∈S 都成立。

根据上面的理论，集合M＝｛n_0,n_0+1,n_0+2, ••••••｝，n_0∈ Z, 对于普通数的大小是良序的，因此类似于正整数集也可以列出数学归纳法的各种形式．整数集与实数集对于普通数的大小不是良序的，但可对其重新规定序使其成为良序集，不过有时给证明命题带来很大困难．倘若我们从另一个角度审视数学归纳法会发现数学归纳法的理论根据是正整数集的序数理论，其实质在于递推．

（一）整数集上的数学归纳法原理

定义：任何一个非空集合 Z 的元素叫做整数，如果在这个集合里的所有元素之间有两种基本关系－＂前继＂与＂后继＂满足下面的公理：① 对任何一个数 a，存在着且仅存在者一个后继数 a'与前继数'a；②任何数只能是一个数的后继数与另一个数的前继数；③ 存在 a∈N，且 a∈Z；④（归纳公理）设 Z 有一个子集 M，满足条件

Ⅰ Z_0∈M,且 Z_0∈Z;

Ⅱ 若 a∈M，有'a∈M，a' ∈M.则 M=Z.

1、 第一数学归纳法原理：设有一个关于整数集 Z 的命题 p(Z),①若存在 Z_0∈Z，p（Z_0）成立；②若 p(k)成立，则 p(k+1)与 p(k-1)均成立。那么对于任意整数 Z，p(Z)都成立.

证明：设 M 是使命题 p（Z）成立的整数集合，于是：①因为存在 Z_0∈Z，p（Z_0）成立，故得 Z_0∈M：②因为假定 p(k)成立的条件下，能推出 p(k+1)与 p(k-1)成立，即由 k∈M 能推出'k∈M,k'∈M.

因此集合 M 具有整数定义中归纳公理的条件①②,由归纳公理得 M=Z。故 p(Z)对于任意整数 Z 都成立.

2、 第二数学归纳法原理：设有一个关于整数 Z 命题 p(Z)。①若存在 $Z_0 \in Z$，$p(Z_0)$成立；②设 $Z_0 \leqslant x < k_1$,若 p(x)成立，则 $p(k_1)$成立；③设 $k_2 < x \leqslant Z_0$,若 p(x)成立，则 $p(k_2)$成立。那么 p(Z)对于任意整数 Z 均成立。注：k_1 与 k_2 为整数。

证明：假设 p（Z）不是对于所有整数均成立，根据整数集的序数理论，可以找到一个整数 Z_1，不妨设 $Z_1 \geqslant k_1$(当 $Z_1 \leqslant k_1$ 时，证明类似)，使 $p(Z_1)$不成立，而 $p(Z_1\text{-}1)$成立。根据归纳假设--由 p(x)，$k_1 \leqslant x < Z_1\text{-}1$ 成立，得 $p(Z_1)$成立.这与前面的假设相矛盾。故 p(Z)对于任意整数均成立。

数学归纳法可以应用于整数集的实质在于整数集中相邻两数的差为定值 1，那么它也可以应用于其它公差为定值或公差为统一公式的数集，例如集合 $M=\{n_0, n_0\text{-}1, n_0\text{-}2, \cdots\}$，$n_0 \in Z$。奇数集或偶数集也可以建立其序数理论，方法及证明类似于整数集，只不过将 k±1 变为 k±2 即可。

综上所述，数学归纳法可以应用于整数集及其某些子集，而数论主要是研究整数性质的，所以数学归纳法的拓广可能有助于数论的研究，例如可以把某些关于正整数的命题推广至整数集等。下面举例说明数学归纳法在整数集中的应用。

例 1 求证：对于任意整数 x，$f(x)= 0.2x^5+1/3x^3+ 7/15x$ 是一个整数。

证明：①当 x=0 时，f(x)=0 命题成立。②假定当 x=k 时命题成立，即 $f(k)=0.2k^5+1/3\ k^3+7/15k$ 为整数,

则当 x=k±1 时 $f(k\pm1)=0.2\ (k\pm1)^5+1/3\ (k\pm1)^3+7/15(k\pm1)=(k^5/5+k^3/3+7k/15)\pm k^4+2k^3+3k^2+4k\pm1 \in Z$。

这说明当 x=k±1 时命题成立。由①②可知，对于任意整数 x，原命题均成立。

下面笔者举出几例，作为引玉之砖。

① 当 n 为任何非负偶数时，$x^n\text{-}1$ 都可以被 x+1 整除；当 n 为任何非负偶数时，x^n+1 都可以被 x+1 整除；

② n^3+5n 能被 6 整除（$n \in Z$）。

③ 若 $x \in Z, x^3+2x+3y=0$,则 $y \in Z$.

④ 已知：$x+x^{-1}=2\cos\theta$ 。求证：$x^n+x^{-n}=2\cos n\theta$,$n \in Z$.

㈡实数集上的数学归纳法

在运用数学归纳法证明有关整数集上的命题时，初始值取一个数，若将初始值变为一个区间，则可证明实数集上的某些命题。下面列出实数集上的第一数学归纳法原理，其它形式及证明从略。

第一数学归纳法原理：设 p(R)是一个关于实数集的命题。若存在 R_1，$R_2 \in R$，在［R_1，R_2］上命题 p(R)成立；若假设 p(k)成立，能推出 p(k±L)成立，其中 $0 < L \leqslant R_2\text{-}R_1$,则 p(R)对于所有实数均成立。

［注］ 若将闭区间改为开区间或半开半闭区间，$0 < L < R_2\text{-}R_1$.

例 2 已知：$a \in R^*$，求证：$f(a)=a^8-a^5+a^2-a+1>0$

证明：①若 $a \in [0, 1]$，则 $a^2 \geqslant a^5$,$f(a)==(1-a)+(a^2-a^5)+a^8>0$，命题成立。 ②设 $k \in R^*$，若 $f(k)=k^8-k^5+k^2-k+1>0$，则 $f(k+1)=(k+1)^8-(k+1)^5+(k+1)^2-(k+1)+1=(k^8-k^5+k^2-k+1)+8k^7+28k^6+56k^5+65k^4+56k^3+18k^2+5k>0$

∴对于任意 $a \in R^*$，$f(a)>0$

例 3 运用数学归纳法证明：$2^m>2m+1$,（$m \in R, m \geqslant 3$）。

证明：①当 $m \in [3, 3.5)$ 时，左边=$2^m \geqslant 8$，右边=2m+1<8，命题成立。

②假设当 m=k 是命题成立，即 $2^k>2k+1$,那么当 m=k+0.5 时，$2^{k+0.5}>(2k+1)\ 2^{0.5}=(2k+1)+(2^{0.5}-1)(2k+1)$。

因为（2k+1）＞3，所以（$2^{0.5}$-1）（2k+1）＞1，即 $2^{k+0.5}$＞2（k+0.5）+1。命题成立。由①②可知，2^m＞2m+1,（m∈R,m≥3）。

前面我们所讨论的数集都是对加法或减法构成递推数集，实际上任何一个集合（不一定是数集）通过某种运算，能使该集合的各个元素之间具有递推性，原则上也可以利用数学归纳法原理证明,例如双等差数集与集合 M={2^0,2^1,2^2,…,2^n,…}。因此数论中有些猜想至今没有证明，或许可以构造一种新型运算，使集合中的元素具有递推性，从而得到解决。通过推广数学归纳法还可将某些集合上的命题拓广.下面列出一般集合上的第一数学归纳法原理，其它形式略。

第一数学归纳法原理：设命题 P 是关于集合 M 的命题。通过构造某种运算*，使得集合 M={a_1,a_2,…,a_n,……}中的元素具有如下关系：a_1*q=a_2,a_2*q=a_3,…,a_{n-1}*q=a_n,…….若 P(a_1)成立,在假定 P(a_k)成立的条件下,可以推出成立.那么命题 P 对于集合 M 中的任何元素都成立。

注:1、 运算*可以是代数运算,也可以是超越运算,甚至于可以是一般的抽象运算.

2 、元素可以属于集合 M,也可以不属于 M,譬如正整数集中 1∈N*,奇数集中 2 不属于奇数集.

3、当上述方法还是无法证明时 ,可以考虑数学归纳法的其它形式,也可以分成几个集合,定义不同运算分别进行归纳,也可以各种形式混合使用.另外也可以去掉有限个元素后,使其具有递推性,但去掉的元素应单独证明.

4 、有些集合需要多步证明,例如有理数集可分别归纳分子与分母,复数集可分别归纳实部与虚部，或者分别归纳模与辐角.下面列出有理数集上第一数学归纳法原理,其它形式及证明从略.

第一数学归纳法原理:设有一个关于有理数集 Q 的命题 P(Q),①若存在 Z_0∈Z,命题 P(Z_0)成立;②若 P(k)成立(k∈Z),则 P(k')与 P('k)均成立;③任取 m∈Z,若 P(m/n)成立(n∈N),则 p(m/(n+1))成立,那么对于任意有理数 Q,命题 P(Q)均成立.

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导 数 概 念 的 一 点 儿 扩 充

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摘要：本文从数学美的角度把不定积分定义为一元函数的负一阶导数，将 Jacobi 行列式定义为多元函数组的导数，并指明了雅可比行列式的几何意义，最后举例说明了其应用。[New York Science Journal. 2009;2(4):77-78]. (ISSN: 1554-0200).

关键词：导数、扩充、数学美、Jacobi 行列式、不定积分

美学观念在自然科学的发展中起的作用是不可替代的。早在我国春秋时期，庄子则有“原天地之美，而达万物之理”的言句。而在古代西方，毕达哥拉斯学派则把对自然奥秘的探索与对自然美的追求统一起来；把数的和谐性作为科学解释的最高原则。自那时以来，寻求自然界的美成为了推动自然科学发展的动力。十七世纪以后，近代自然科学中兴起的经验主义思潮，曾一度造成了科学与美学在某种意义上的分离。进入二十世纪以来，以相对论和量子力学为代表的近代物理学革命的兴起却在更大的深度上推动了科学美学的发展。众多的物理学家从各自的科学创造实践中感受到物理理论的审美价值；在美学原则的指引下，他们作出了杰出的工作。美学因素不仅渗透到科学创造的原动力中，而且也渗透到物理理论体系的构建与表述中。美学原则潜在地影响着科学成果的内容与形式；人们甚至把美学价值的大小看做是评价一个科学理论成就大小的重要标准。一元函数的导数反映了函数对自变量的变化率，在数学分析中有一些概念与导数不但存在着密切联系，而且具有许多相似的性质。如果把它们也定义为导数，就可以使数学知识之间具有一种和谐、对称的美感，而且有助于进一步认识导数以及这些概念的本质。

㈠ 不定积分定义为一元函数的负一阶导数

不定积分是求一个函数的原函数，不定积分和导数互为逆运算，Newton——莱布尼兹公式搭起了微分学与积分学之间的一座重要的桥梁。不定积分与导数既然互为逆运算，那么它们能否统一为一种运算呢？数学中许多互逆的运算都可以 统一为一种运算，例如加法与减法、乘法与除法、乘方与开方，因此笔者认为不定积分与导数既然互为逆运算，应当可以统一为一种运算，只需把不定积分定义为负一阶导数。

定义：在区间 X 上给出函数 f(x)，若存在 F（x）使得 F`（x）= f(x)，x∈X，或 dF(x)=f(x)dx，x∈X ，则称 F(x)是 f(x)的一个负一阶导数 ，f(x)的所有负一阶导数，记作 $f^{(-1)}(x)$或 ∫ f(x)dx。

定理：设 F(x)是 f(x)的一个负一阶导数，则 $f^{(-1)}(x)=F(x)+C$。 证明略。

一般情况，函数 f (x)的-n+1 导数存在负一阶导数，称之为函数 f (x)的-n 阶导数，记为 $f^{(-n)}(x)$，即 $〔f^{(-n+1)}(x)〕^{(-1)}=f^{(-n)}(x)$.

根据定义可知，一个函数 f (x)的负一阶导数即为它的不定积分，依然可以用 ∫ f(x)dx 表示，而且还可以表示 n 次不定积分形式。在函数的各阶导数都存在的条件下，导数的所有阶可以进行代数和运算，即

$〔f^{(-1)}(x)〕`=f(x)$, $〔f`(x)〕^{(-1)}=f(x)$，$〔f^{(-n)}(x)〕^{(n)}=f(x)$,、、、、、、。这样定义以后，把导数运算与积分运算统一起来，而且可以看出数学知识之间具有一种和谐、对称和美感，函数的导数的阶数定义

在整数集上。这样定义不仅仅是一种形式改变，而且可以对一些数学知识认识更加深刻，譬如微分方程与积分方程可以统一在一起，因为积分方程可以认为是负一阶微分方程，从而为寻找二者相似性与统一性搭起了一座桥梁。下面推导一下分部积分公式：

证明：∵(uv)`=u`v+v`u,∴uv=$(u`v)^{(-1)}$+$(v`u)^{(-1)}$.

∴（u`v）$^{(-1)}$=uv—（v`u）$^{(-1)}$,即∫vdu=uv-∫udv.

这样计算方法的一切固定的差别都消失了，一切都可以用相反的形式表示出来。

㈡把 Jacobi 行列式定义为函数组的导数

多元函数只有偏导数，但是多元函数的 Jacobi 行列式与一元函数的导数存在着极其相似的特点，因此笔者从数学美的角度尝试着拓广导数概念，将 Jacobi 行列式定义为函数组的导数.这样定义之后，反函数组存在的判定定理与一元函数的反函数存在定理、Jacobi 行列式的锁链法则与一元函数的锁链法则、反函数组的 Jacobi 行列式与一元函数的反函数的求导公式、多重积分的变量替换公式与定积分的变量替换公式便一致起来。

一元函数的导数表示函数对自变量的变化率，可以认为是位移的变化率，可以假设二元函数组的 Jacobi 行列式表示一个坐标系到另一个坐标系的面矢的变化率，三元函数组的 Jacobi 行列式表示一个坐标系到另一个坐标系的体矢的变化率，、、、、、、

为了与一元函数定积分公式统一起来，笔者建议在多重积分的变量替换公式中的 Jacobi 行列式的绝对值符号去掉。至于物理问题与几何问题可以根据其意义决定是否保留绝对值符号，求数量时加绝对值符号，求向量时去掉绝对值符号。

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对于四元数的异议

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摘要 ：本文从数集的扩展原则与扩展的必要性出发，阐明了哈密尔顿的四元数不能作为复数集的拓广，从而将向量乘法与普通乘法区别开来。[New York Science Journal. 2009;2(4):79-80]. (ISSN: 1554-0200).

关键词：四元数、异议、数集的扩展原则、向量乘法、普通乘法

按照现代数学的观点，数集包括狭义数集与广义数集两大类，狭义数集包括复数与超复数，广义数集包括向量、矩阵等集合，其中超复数起源于四元数，在 1828——1843 年，伟大的数学物理学家哈密尔顿为了物理学研究空间的需要，建立了一种对乘法运算不可交换的数集——四元数（又称超复数）,其一般形式为 ai+bj+ck+d,其中 a、b、c、d 为实数,i、j、k 为虚单位,$i^2=j^2=k^2=-1$,$ij=k,jk=i,ki=j,ji=-k,kj=-i,ik=-j$.其乘法规则类似于多项式乘法，但不满足交换律，设 $z_1=a_1i+b_1j+c_1k+d_1$，$z_2=a_2i+b_2j+c_2k+d_2$,则 $z_1z_2=-(a_1a_2+b_1b_2+c_1c_2+d_1d_2)+(b_1c_2+a_1d_2+a_2d_1-b_2c_1)i+(c_1a_1-c_2a_1+b_1d_2+b_2d_1)j+(a_1b_2-a_2b_1+c_1d_2+d_1c_2)k$。对于四元数 ai+bj+ck+d 而言,当 b=c=0 时,四元数便成为复数;当 d=0 时，ai+bj+ck 代表三维向量， a、b、c 分别为其在 x 轴、y 轴、z 轴上的分量，$(a_1i+b_1j+c_1k)(a_2i+b_2j+c_2k)=-(a_1a_2+b_1b_2+c_1c_2)+(b_1c_2-b_2c_1)i+(c_1a_1-c_2a_1)j+(a_1b_2-a_2b_1)k$。后来，人们对其分成两部分，$(a_1a_2+b_1b_2+c_1c_2)$为数量积，$(b_1c_2-b_2c_1)i+(c_1a_1-c_2a_1)j+(a_1b_2-a_2b_1)k$ 为向量积，并分别在物理学中找到了其应用；为了物理学研究空间的需要将其推广为 n 维，并且不满足乘法结合律.。笔者发现把四元数作为复数集的拓广不满足数集的扩展原则与扩展的必要性。

㈠把四元数作为复数集的拓广不满足数集扩展的必要性

数集的每一次扩展，总是由于原来的数集与解决具体问题的矛盾而引起的，这些问题有的是首先从实际中提出 的，有些则是从数学本身首先提出的。为了使除法、减法运算封闭，从正整数集先后扩展到正有理数集合、有理数集合；为了表示无限不循环小数，引进了无理数，从有理数集合扩展到实数集； 为了使开方运算封闭，引进了虚数，从实数集扩展到复数集。在复数集 中，加、减、乘、除、乘方、开方等所有代数运算都已封闭，因此复数集是一个完美的数集，从数学本身来讲没有扩展的必要。退一步讲，假设四元数是复数集的拓广，那么开方运算失去意义，例如∵$i^2=j^2=k^2=-1$，∴-1 的平方根至少有 6 个——$\pm i$、$\pm j$、$\pm k$,其实一个四元数的 n 次方根有无数个解，这样将使开方运算 变为无定解运算。

㈡把四元数作为复数集的拓广不满足数集的扩展原则

①根据数集的扩展原数集作为新数集的特例，原有的运算法则依然成立。

当数集拓广至复数集后，人们迅速发现其在物理学中的应用——可以表示平面向量及其加减运算。但是复数的乘法与向量的乘法有着本质的区别，复数集对于乘法封闭且满足交换律，平面内向量的向量积是一个空间向量，数量积是一个标量。因此为了研究物理学中向量乘法而拓广复数集 是没有必要的，表示向量乘法与普通乘法的符号亦应区别开来，不必定义 $i^2=j^2=k^2=-1$.。向量运算不同于代数运算，没有必要将其纳入代数运算。若将三维向量表示为 a+bi+cj,数量积与向量积分别用“.”与“×”表示，$(a_1+b_1i+c_1j).(a_2+b_2i+c_2j)=a_1a_2+b_1b_2+c_1c_2$,$(a_1+b_1i+c_1j)\times(a_2+b_2i+c_2j)=(b_1c_2-b_2c_1)+(c_1a_2-c_2a_1)i+(a_1b_2-a_2b_1)j$,从而把向量乘法与普通乘法区别开来，又能作为复数集的拓广.其实这样做对表示向量乘法非常妥当，但它会使普通乘法出现矛盾，复数集对于普通乘法已经封闭，乘积中出现的 ij、ji 无论怎样定义都会出现矛盾，而且与普通乘法的符号不加区别会造成混乱。

② 在向量 ai+bj+ck 中 i、j、k 的意义与复数 a+bi 中的 i 意义不同。

在三维向量 ai+bj+ck 中 i、j、k 是为了区分向量在 x 轴、y 轴、z 轴上的分量而作的标记，可以规定 $i^2=j^2=k^2$ 为任何实数，但在复数 a+bi 中的 i 有着特殊的含义：$i^2=-1$。在四元数 ai+bj+ck+d 中，当 d=0 时表示三维向量，a、b、c 分别代表在 x 轴、y 轴、z 轴上的分量，因此当 c=0 时，二维向量

应为 ai+bj，a、b 分别代表在 x 轴、y 轴上的分量，但单位不一致 ，前者为 i、j,后者为 1、i,而 $i^2=j^2=-1\neq1$,因此这本身就具有一种不协调性。

综上所述，复数的乘法与向量的乘法有着本质的区别，哈密尔顿的四元数不能作为复数集的拓广，只不过他找到了向量的乘法法则。为了满足数集的扩展原则，笔者建议取消四元数，直接定义向量乘法。为了与复数乘法相区别，定义 i*i=j*j=k*k=1,这样可以避免运算结果中出现负号，其它的规则不变。设向量 $Z_1=a_1i+b_1j+c_1k$, $Z_2=a_2i+b_2j+c_2k$,$Z_1*Z_2=(a_1a_2+b_1b_2+c_1c_2)+(b_1c_2-b_2c_1)i+(c_1a_2-c_2a_1)j+(a_1b_2-a_2b_1)k$,其中前者 $(a_1a_2+b_1b_2+c_1c_2)$表示数量积，后者$(b_1c_2-b_2c_1)i+(c_1a_2-c_2a_1)j+(a_1b_2-a_2b_1)k$ 表示向量积，不满足交换律。这种运算可以推广至 n 维，推广后不满足结合律。一句话，狭义数集只包含复数集。数学之所以完美是因为数学有一个完备的复数系统；复数系统之所以完备是因为它的元素数不仅仅是一个记号，而且源于人类对自然界的抽象，带有宇宙的最基本信息。可见，数学美不是人类构造出来的，而是完美宇宙的真实映象。寻找宇宙的最基本信息是重要的，因为它有助于我们发现表达“适用于一切事物的理论”的数学形式，反过来，我们也可以从宇宙的最基本信息出发去思考宇宙的造化。

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Seed Age Effect on Germinability in Seeds of *Rheum emodi* Wall. ex Meissn: An Endangered Medicinal Plant of Garhwal Himalaya

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Abstract: *Rheum emodi* Wall. ex Meissn is a perennial stout herb, distributed in the temperate and subtropical regions of Himalaya from Kashmir to Sikkim, between an elevation of 2800 and 3800 m. In Garhwal Himalaya it is generally found between 2800 and 3600 m in an alpine zone on rocky soil, between boulders and near streams. For the present study seeds of the years 2005, 2006 and 2007 were used, to evaluate the effect of age on germination and infection occurrence. Very poor germination was found in the present study because, age of seeds. Only 25% seeds of the year 2007 were germinate in T4 treatment and 15% in T1 treatment. No germination was recorded in all other presowing treatments. Infection percent was also evaluated and it was observed that as old as seed was showed higher infection percent. The result revolved that age of the seeds of *Rheum emodi* were directly effect the viability and vigour, even one year old seeds was also showed very poor germination and infection. [New York Science Journal. 2009;2(4):81-84]. (ISSN: 1554-0200).

Keywords: Seed; Age; Germinability; *Rheum emodi*; Plant; Garhwal Himalaya

Introduction:

In the Garhwal Himalayas *Rheum emodi* is generally found between 2800-4500 m on rocky soil surfaces, between boulders and near streams. Population density is between 0.5-1.5 plant m-2 in very restricted localities, and is designated rare in status. The plant is a perennial stout herb, 1.0-3.0 m in height, distributed in the temperate and subtropical regions of the world between 2800-3600 m altitudes. Rhubarb, however, may exert an astringent action after purging. It is used as an astringent tonic; it's stimulating effect combined with aperingent tonic; its stimulating effect combined with aperient properties render it especially useful in atonic dyspepsia (Chopra, 1958; Chopra *et al.*, 1986). The essential oil content is 0.05% in the root, and its characteristic odor is due to the presence of eugenol (Chopra, 1958). The total oxalic acid contents of the leaves and stems are reported to be 0.65 and 0.81 respectively. The drug contains a number of anthraquinone derivatives based on emodin, emodin-3-monomethyl ether, chrysophanol, aloe emodin, and rhein. In the wild population of Garhwal, emodin percent ranges between 0.81-1.88, rutin 0.24-0.93, chrysophenol 2.51-2.82 and chrysophenic acid between 0.35-1.08% (Maithani, 2001).

Material and Method:

For the present study seeds of *Rheum emodi* were collected from the forest of Tungnath (3600 m) in Uttarakhand Garhwal Himalya. The seeds of the years 2005, 2006 and 2007 were used for the study to evaluate the effect of age on germination. The seeds were properly dried and stored in plastic containers under ambient condition. The stored conditions for all the seeds were same. For investigation the seeds were subjected to following presowing treatments (24 hours) to study their effect on germination period and germination percentage:

T_1 : Cold water
T_2 : Luke warm water
T_3 : Boiling water
T_4 : GA_3- 50 ppm
T_5 : GA_3- 100 ppm
T_6 : IAA- 50 ppm
T_7 : IAA- 100 ppm

Table-1: Seed Age effect on germination of *Rheum emodi:*

	GERMINATION START (DAYS)			GERMINATION CEASE (DAYS)			GERMINATION PERIOD (DAYS)			GERMINATION %		
	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
T1	0	0	4	0	0	7	0	0	4	0	0	15
T2	0	0	0	0	0	0	0	0	0	0	0	0
T3	0	0	0	0	0	0	0	0	0	0	0	0
T4	0	0	6	0	0	12	0	0	4	0	0	25
T5	0	0	0	0	0	0	0	0	0	0	0	0
T6	0	0	0	0	0	0	0	0	0	0	0	0
T7	0	0	0	0	0	0	0	0	0	0	0	0

For germination test (McDonald and Copeland, 1999) seeds were sown on moist filter paper in petridishes with three replicates of each treatment. Watering was done daily or as required. The seeds were allowed to germinate at 30 ^{0}C with 16 hr light and 8 hr dark condition. Germination was noticed when redical emerged. Germination count was taken daily until it was over and constant. Data were analyzed using mean and standard deviation. For viability test 1% TDZ (Tretazolium solution) was prepared and seeds of three years were incubated at 35 ^{0}C in continuous dark condition for 24 hr (Agrawal, 1995) The infection on the seeds were also evaluated and calculated as infection percentage and days of infection.

Result and Discussion:

Rheum emodi Wall. ex Meissn. is a perennial stout herb, distributed in the temperate and subtropical regions of Himalaya from Kashmir to Sikkim, between an elevation of 2800 and 3800 m. In Garhwal Himalaya it is generally found between 2800 and 3600 m in an alpine zone on rocky soil, between boulders and near streams (Nautiyal *et al.*, 2002). Current estimates by the Threatened Plants Species Committee of the Survival (TPSSC) of IUCN indicate that 1 in 10 species of vascular plants on earth is endangered or threatened due to commercial exploitation and international trade. It has been pointed out that nearly 60,000 plant species may be in danger of extinction leading to gene erosion during the next 30–40 years1. *Rheum emodi* is among the top of that list, particularly for Garhwal Himalaya; it has been identified as a top-priority species for conservation and cultivation.

The data presented in table-1 indicate that the seeds of year 2005 and 2006 have no germination even in any presowing treatments. Germination was found only in the seeds of year 2007 on T1 and T4 treatments. Higher percentage (25%) of germination was recorded in T4 treatment. T1 treatment also showed 15% germination. The viability test indicates only 30% viability in the seeds of year 2007. Infection on seeds was evaluated daily and found that the seeds of year 2007 showed very low infection while the old one seed of year 2005 showed higher percentage of infection (Table- 2). In the seeds of year 2005 infection was start very quickly i.e. from 2nd days of the experiment. 2006's seeds were also showed higher percentage of infection. Germination behavior and seed dormancy of alpine plants from different alpine populations of world have been studied by several workers (Bliss, 1958; Amen, 1964; Semwal and Purohit, 1980; Rawat, 1989). Seeds of alpine plants are well known for high temperature requirements (Bliss, 1971). Billings and Mooney (1968) described 25 ^{0}C optimum germination temperature as measured by speed and completeness of germination percentage in many Himalayan alpine species. Amen (1966) did not found any evidence where an alpine seed can germinate at temperature below 10^{0}C. Present study showed that as old as seeds of *Rheum emodi* were reduced their viability, that's why seeds were not germinated even in the presowing treatments of growth regulators and the rate of infection, is also increase.

Table-2: Seed age effect on infection occurrence:

Infection %																								
Days	2nd			3rd			4th			5th			6th			7th			8th			9th		
	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
T1	0	0	0	45	0	0	0	0	0	20	55	0	0	0	15	15	30	0	60	75	0	0	0	5
T2	45	0	0	0	50	0	25	0	0	0	20	0	60	0	5	0	10	0	0	80	0	75	0	10
T3	0	0	0	0	0	0	35	0	0	0	0	0	30	10	0	0	0	0	0	0	0	25	25	0
T4	60	0	0	0	65	0	30	0	0	0	30	5	10	0	0	0	15	5	0	25	15	0	0	0
T5	0	0	0	75	55	0	0	0	0	30	0	5	0	35	0	25	0	0	15	0	10	0	5	0
T6	35	0	0	0	0	0	20	0	0	0	5	0	65	0	0	0	5	0	0	5	5	90	0	0
T7	0	0	0	85	60	0	0	0	0	0	0	10	90	55	0	0	0	5	0	0	0	75	30	0

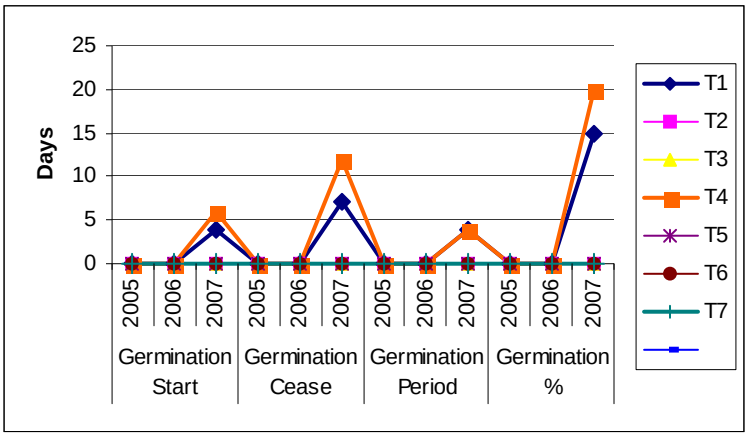

Fig.1: Germination study on Seeds of *Rheum emodi*

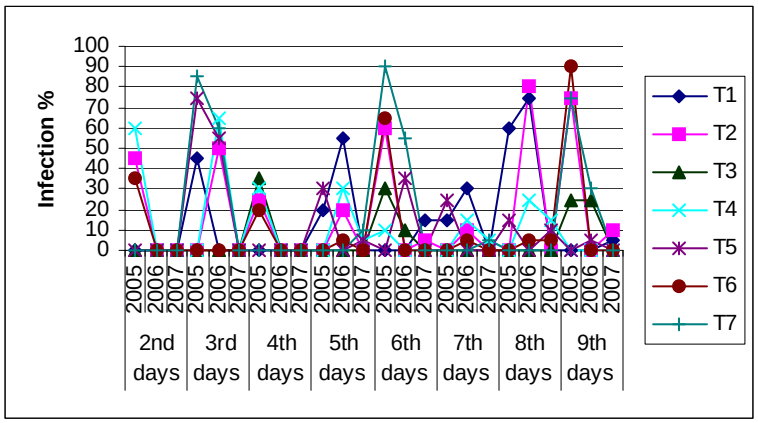

Fig.2: Infection percent on seeds of *Rheum emodi*

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