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INSTRUCTIONS TO AUTHORS

Manuscripts should be submitted in triplicate, typed double spaced on one side of the paper (A4 bond) with 3 cms. margin on all sides. The arrangement of the manuscript should be as follows : Title page, Abstract, Key words, Introduction, Methods, Results, Discussion, Acknowledgements, References, Tables, Figures, Legends, and Figures. Full length of paper should not exceed 10 printed pages.

Title Page : It should contain the following information :

(i) The title of the paper which should be concise but informative, (ii) a short running head of not more than 10 words placed at the foot of the title page, (iii) first name, middle initial and last name of each author, (iv) name of department(s) and institution(s) to which the work should be attributed, (v) name and address of author for correspondence.

Abstract : The second page should carry an abstract of not more than 200 words. The abstract should state the purpose of the study, basic procedure, main findings and principal conclusions. Abstract should be followed by relevant Key Words.

Introduction : This should contain a concise statement of the purpose of the article. Only pertinent references should be given.

Methods : The methodology, apparatus and procedure in sufficient detail should be identified to allow other workers to repeat the experiments. Standard methods can, however, be identified by proper references. The new or substantially modified methods should be described giving reasons for using them.

Results : Results should be quoted in SI units. The results should be presented in logical sequence in the text, tables and illustrations. Unnecessary repetition should be avoided. Only important observations may be emphasized in the text.

Discussion : This should precisely deal with interpretation of results. Emphasis should be given on the new and important aspects of the study and conclusions that follow from them. Recommendations, when appropriate, may be included.

References : Consecutive numbers in parentheses should be used to indicate the reference in the text. The full reference should be cited at the end of the manuscript. The following forms of citations should be used :

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Tables : Tables should be typed on separate sheets using double space. Each table should be numbered (Roman numerals) consecutively with a brief caption on the top of the table.

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Photographs must be in black and white. A clear print in glossy paper, large enough to be legible after 25% reduction, is necessary for reproduction. These should be submitted unmounted.

EDITORIAL NOTE

During the year we have lost two eminent scholars and academicians who were actively associated with VUJBS, though in different capacities. Professor Ashok Kumar Ghosh, who was an External Member in the Editorial Board of VUJBS, was a palaeo-anthropologist of international repute. He was Professor of Anthropology, University of Calcutta, but more than that, he was known in the academic circle, both at the national and international level, for his insight and scholastic interest in diverse fields. Probably a day before his death in a letter addressed to the undersigned, which may very well be his last letter, Late Prof. Ghosh wanted an article to be published in VUJBS which would be of benefit to the students of biological sciences. The Editorial Board of VUJBS may take it up later.

Professor Subhas Chandra Datta, Professor of Botany, University of Calcutta, took upon himself the role of contributing almost regularly to VUJBS. Before his tragic death he did not forget to send his joint paper for publication in our journal. We are glad that the paper has appeared in the current issue. Prof. Datta was a source of encouragement to us. In his death we have lost a genuine well wisher, a patron of our Journal. As it turned out, 1997 contribution was a swansong for the late Professor Subhas Chandra Datta.

RAJAT KANTI DAS
Editor-in-Chief
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A Study of Certain Crops and Non-Crop Plants in Relation to Salinity : Interaction between Growth Regulators and Salinity

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Abstract

In this study the effects of five different growth regulators GA_3 , 9AA, Kinetin, B-995 and urea - on the germination pattern of rice seeds were examined. The seeds were first of all pre-soaked in these substances and were subsequently transferred to saline solutions of various salts. When the seeds of four species were pre-soaked in growth regulator and subsequently transferred to various salinities, each species indicated a particular trend. Thus, treatment with growth regulators made the satika cultivars (cv) tolerant towards O.I.M. carbonates and 0.3M chlorides, sulphates as well as nitrates. Neither Ratna nor Dular followed it. In the case of *Acanthur ilicijolins*, germination stimulation was obtained even with 0.5M, NaCl and KCl. In the case of *Hygrophila salicifolia*, previous treatments with growth regulator could not overcome the toxic effects of Na_2CO_3 and K_2CO_3 for small seeds. Only the action of K_2CO_3 for large seeds (at the level of 0.2M) could be overcome. The black and red seeds *Suaeda Maritima* responded differently when the seeds were pre-treated with all concentrations of $MgSO_4$ and $NaNO_3$ after pre-soaking them in growth regulators. Pre-treatment of rice seeds of these cultivars with GA_3 stimulated germination after being subsequently exposed to low salinity. Exceptions occurred in Satika and Ratna where there was recovery of 3% and 13% respectively at the level of 0.7M $MgSO_4$.

Key words : Salinity, growth regulators, germination.

Introduction

The hormonal balance of seeds may be a critical factor in determining the germinability of seeds exposed to salt-stress induced dormancies (1). This line of experimentation, initiated by Boucaud and Ungar (2, 3) should yield some very basic information regarding salinity-hormonal interaction. As a matter of fact, interrelationships between growth regulator treatments and alleviation of dormancy produced by high salinity has been demonstrated by several researchers. But how cytokinins and gibberellins interact to reduce the influence of salt stress or to overcome salt stress is not precisely understood.

In this study, we have sought to determine the effects of five different growth regulators — GA_3 , IAA, Kinetin, B-995 and Urea — on the germination pattern of seeds which were presoaked in these substances and subsequently transferred to saline solutions arising from various salts. An attempt has been made to show whether or not exogenously applied growth regulators have pronounced impact on the responses of both crop and non-crop species.

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Material and Methods

The seeds were first soaked in growth regulators and then shifted to saline solutions. The soaking period was not uniform : 12 hr. for *Suaeda maritima*, 24 hr. each for *Acanthus ilicifolius* as well as *Hygrophila salicifolia* and 48 hr. for rice cultivars; these durations were found ideal after a preliminary experiment. While the concentrations of urea was 10–3M, four growth regulators — GA₃ (gibberellic acid), IAA (indole–3–acetic acid), Kinetin and B-995 (succinic acid) — were of the same level, i.e. 10–4M. After transfer to saline solutions, seeds were held there for additional 7 days and the percentages were scored. In all cases, water controls were maintained.

Results and Discussion

Treatment of Satika cultivar (cv) of rice seeds with various growth regulators stimulated germination after being exposed to low salinities and not high salinities (except MgSO₄). Germination recovery was possible when post-treated with a salinity level of 0.1M for carbonates and 0.3M for chlorides, sulphates and nitrates. Pretreatments with GA₃ induced maximum germination recovery when seeds were post-treated with NaCl, KCl, Na₂CO₃, Na₂SO₄, NaNO₃ and Ca(NO₃)₂. Germination recovery from the toxic effects of CaCl₂, MgCl₂, and K₂SO₄ could be obtained with the previous use of IAA, urea and B-995 respectively. At all concentrations of MgSO₄, seed germination could recover when growth regulators other than B-995 were utilised. Pretreatment with IAA caused minimum recovery if the seeds were subsequently treated with NaCl, CaCl₂ and K₂SO₄. There was minimum recovery when GA₃ was used in conjunction with CaCl₂ and MgCl₂; B-995 with KCl; kinetin with Na₂SO₄ and NaNO₃.

Treatment of Ratna cultivars of rice with various growth regulators stimulated germination after being exposed to low salinities and not high salinities. While there was no germination recovery with even 0.1M Ca(NO₃)₂, it was possible with 0.1M Na₂CO₃ and up to 0.3M of the remaining salt solutions (except MgSO₄). Pre-treatment with GA₃ induced maximum recovery when seeds were post-treated with NaCl, CaCl₂, Na₂CO₃ and Na₂SO₄. Germination recovery from the effect of KCl, K₂SO₄ and NaNO₃ could be obtained with the previous use of urea, kinetin and B-995 respectively. At all concentration of MgSO₄, seed germination could recover and B-995 served well at any salinity level. Pre-treatment with IAA caused minimum recovery with the seeds being subsequently treated with NaCl, CaCl₂ and K₂SO₄. Likewise, kinetin acted in conjunction with KCl, Na₂SO₄ as well as NaNO₃ and B-995 with Na₂CO₃.

Treatment of Dular cultivars of rice with various growth regulators stimulated germination after being exposed to low salinities and not high salinities (except MgSO₄). Germination recovery was possible when seeds were post-treated with a salinity level of 0.1M MgCl₂, Na₂CO₃ and K₂CO₃. While the level was 0.5M for MgSO₄, it was 0.3M for the remaining salts. Pretreatment with GA₃ induced maximum recovery when seeds were post-treated with CaCl₂, K₂CO₃, K₂SO₄ and MgSO₄. Likewise, B-995 acted in concert with NaCl, KCl and NaNO₃. There was minimum recovery when IAA was used in conjunction with NaCl, CaCl₂, K₂O₃ and MgSO₄; urea with KCl and B-995 with K₂SO₄.

Treatment of seeds of *Acanthus ilicifolius* with various growth regulators stimulated germination after being exposed to low salinities and not high salinities (except NaCl and KCl). Germination recovery was possible when post-treated with a salinity level of 0.1M for CaCl₂, MgCl₂, Na₂CO₃, K₂CO₃, Na₂SO₄ and Ca(NO₃)₂; 0.3M for MgSO₄ and NaNO₃ and 0.5M for NaCl and KCl. Pre-treatment with GA₃ induced maximum recovery if the seeds were post-treated with NaCl, KCl, MgCl₂, Na₂SO₄ and NaNO₃. Germination recovery from the toxic effect of K₂CO₃ and MgSO₄ could be obtained with the previous use of IAA. There was minimum recovery when B-995 was used in

conjunction with NaCl, CaCl₂ and MgSO₄; GA₃ with Na₂CO₃, K₂SO₄ and Ca(NO₃)₂; kinetin with MgCl₂, K₂CO₃ and Na₂SO₄. When a concentration of 0.3M used alone in solutions of MgCl₂, Na₂CO₃, K₂CO₃, Na₂SO₄ and Ca(NO₃)₂ at could not ensure germination, Germination took place when the seeds interacted with various growth regulators. The same was true for 0.5M MgSO₄ and NaNO₃.

Treating small seeds of **Hygrophila salicifolia** with growth regulators improved germination after being exposed to very low salinity. While no seeds could germinate at any concentration of Na₂CO₃ and K₂CO₃, certain amount of recovery could be attained by GA₃ (maximum) and B-995 (mimimum) when the seeds were post-treated with 0.3M MgSO₄. Pretreatment with urea induced maximum recovery if the seeds were post-treated with NaCl, KCl, Na₂SO₄, K₂SO₄ and Ca(NO₃)₂. In th same way, the toxic effect of CaCl₂ and MgCl₂ could be relieved by GA₃ and of MgSO₄, NaNO₃ and Ca(NO₃)₂ by B-995. Thre was mimimum recovery when kinetin was used in conjunction with NaCl, KCl, Na₂SO₄ and NaNO₃; IAA with CaCl₂, MgCl₂ and MgSO₄. In case of post-treatment with CaCl₂ and MgCl₂, kinetin-treated and corrsponding control seeds failed to germinate.

As to the interaction of salinity and growth regulators, large seeds of **H. Salicifolia** followed the same pattern as with the smaller seeds. With one exception, germination recovery was possible when 0.1M level of salinity was used in conjunction with various growth reguators. Whereas no seeds germinated at any concerntration of Na₂CO₃, both control and kinetin-treated seeds germinated in the case of 0.1M K₂CO₃. In case of large seeds, certain amount of recovery was observed at 0.3M MgSO₄, when B-995 produced maximum recovery and kinetin minimum recovery. Post-treatments with MgSO₄ and NaNO₃ resulted in slight recovery of large seeds by all growth regulators in contrast to considerable recovery by the same growth regulators when smaller seeds were post-treated with these salts. While post-treatments of large seeds with NaCl and KCl followed the trend of smaller seeds by producing maximum recovery on the part of urea pretreatment, minimum recovery of small seeds by kinetin was shared by KCl post-treatment and not by IAA pretreatment where large seeds germinated minimally. Regarding other salts, large seeds responded to the pretreatments with various growth regulators in a way which were quite different from those of smaller seeds.

Treatment of black seeds of **Suaeda maritima** with various growth regulators did not stimulate germination after being exposed to various lvlsl of Na₂SO₄ salinity. Post-treatments with even 0.1M KCl, MgCl₂, Na₂CO₃ and K₂SO₄ did not stimulate germination with the growth regulators. Pre-treatments with growth regulators stimulated germination if the seeds were post-treated with all concentrations of MgSO₄ and NaNO₃. While IAA was inhibitory at all concentrations of NaCl and K₂SO₄, both GA₃ and IAA inhibited seed germination for all concentrations of K₂CO₃. B-995 ensured germination recovery in all salts where there was a stimulation. There was minimum recovery when IAA was used in conjunction with 0.5M MgCl₂, as well as 0.1–0.3M MgSO₄ and Ca(NO₃)₂. Urea overcome the toxic effect of 0.7M NaCl, 0.5–0.7M Kcl, 0.1M CaCl₂, 0.3–0.5M MgCl₂, o.5M Na₂CO₃, 0.5M K₂CO₃ and 0.3–0.5M K₂SO₄. Kinetin interacted positively with 0.5M KCl, 0.1M CaCl₂, 0.3 and 0.7M Na₂CO₃, 0.5M K₂CO₃, 0.7M K₂SO₄, 0.3M MgSO₄ and 0.3M Ca(NO₃)₂.

Treatment of red seeds of **S. maritima** with various growth regulators did not stimulate germination after being exposed to all levels of NaCl, CaCl₂ and MgCl₂ salnity. With the use of growth regulators, there was no stimulation at 0.3M for KCl and Na₂CO₃-treated seeds; no stimulation at 0.1M, 0.3 and 0.7M for Na₂SO₄ and K₂SO₄-treated seeds; no stimulation at 0.1 and 0.7M for K₂CO₃-treated seeds; no stimulation at 0.5 and 0.7M for Ca(NO₃)₂-treated seeds; no stimulation at 0.7M for NaNO₃-treated seeds. Pre-treatment with growth regulators stimulated germination if the seeds were post-treated with all concentrations of MgSO₄. There was germination recovery when B-995 was used in conjunction with 0.5M KCl, 0.3M K₂CO₃, 0.7M MgSO₄, 0.3M NaNO₃ and 0.3M Ca(NO₃)₂; GA₃ with

0.5M Na₂CO₃, 0.3M K₂CO₃, 0.5M MgSO₄, 0.1–0.5 NaNO₃ and 0.1–0.3M Ca(NO₃)₂; urea with 0.5M Na₂SO₄.

The above results are indicative of the fact that probably more than one mechanism was included in overcoming inhibition of germination caused by salinity. While halophytic species (**S. martima**) responded to treatments with various growth regulators when the salinity stress was high (0.5-0.7), glycophytes as like rice (**O. sativa**) could do so when there was low salinity. **A. ilicifolius** and **H. salicifolia** could not be placed in either category.

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A Novel Chemical for Long-Term Storage of Crop Seeds

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Abstract

Imposition of accelerated ageing (95% relative humidity, RH) for 60 days augmented the leaching of sugar and amino acids in sunflower and safflower seeds. On the other hand, protein, RNA and insoluble carbohydrate contents, percentage TTC (tetrazolium chloride) - stained seeds and activity of total dehydrogenase enzyme were drastically reduced. Soluble carbohydrate level of the seed kernel, however, remained high after the forced ageing period of 60 days in both the seed species.

Pretreatment of the seeds with sodium-dikegulac (Na-DK) for 3 x 6h remarkably reduced the leaching of sugar and amino acids in comparison with control seeds. Ageing-induced loss of protein, RNA and insoluble carbohydrate contents as well as percentage TTC-stained seeds and total dehydrogenase activity were substantially ameliorated by Na-DK treatment when observation was made after 60 days of accelerated ageing. Concomitantly, ageing-induced vigorous rise of soluble carbohydrate in seed kernels was considerably checked in all Na-DK-treated seed lots. The promising role of Na-DK on enhancement of storage potential of seeds is highlighted.

Key words : Accelerated ageing, sodium-dikegulac, seed viability, seed leaching, TTC staining, biochemical changes.

Introduction

Maintenance of vigour and viability of seeds is a problem in agriculture and horticulture. Due to prevalence of high temperature and high RH, storage deterioration of seeds under ambient condition is accelerated in tropical countries like India causing serious concern to the crop growers.

In recent years, some physical and chemical manipulative techniques have been developed by seed researchers to get rid of various biotic and climatic hazards which are conducive to earlier deterioration of stored seeds. There are reports that hydration-dehydration treatment as well as treatment of seeds with chemicals of diverse nature (salts, phenols, organic acids etc.) can favourably influence the viability status of seeds (2, 18, 22). Recently, the possibility of prolongation of seed vigour and viability under storage condition by seed pretreatment with some growth retarding chemicals and volatile compounds, has been explored by Bhattacharjee and his coworkers (3, 4, 5, 6, 8, 20).

In this investigation, using two low-vigour seed species of sunflower and safflower the present author reports the efficacy of Na-DK on enhancement of seed longevity even under adverse storage condition. This result is a part of our comprehensive work undertaken, using a wide range of seed species, to establish the effect of Na-DK as a potent seed invigorating agent.

Materials and Methods

Experiments of the present investigation were performed using certified seeds of sunflower (*Helianthus annuus* L. cv Morden) and safflower (*Carthamus tinctorius* L. cv. JLA-900), procured from Oil Seeds and Pulses Research Station, Govt. of West Bengal. After surface sterilization with 0.1% HgCl_2 for 90 sec. seed lots (200 g each) of the two cultivars were separately presoaked in the aqueous solutions of 1000, 2000 and 4000 $\mu\text{g/ml}$ sodium dikegulac (Na-DK, 2, 3 : 4-6 – di-O-isopropylidene – ∞ – L – xylo – 2 – hexalofuranosate) or distilled water for 6 h and then dried back to their normal moisture contents ranging from 6.45 to 6.98%. At an interval of 48 h, such soaking-drying treatments were repeated thrice to make the total duration of pretreatment 18 h. This mode of pretreatment enabled maximum penetration of the chemical while avoiding the commencement of germination (6). The pretreated seed lots were taken in separate cloth bags and thus stored in a desiccator in which an environment of 95% RH was maintained by keeping 250 ml 12.64% H_2SO_4 (v/v) within it. This experimental set-up was kept at $30 \pm 1^\circ\text{C}$ and H_2SO_4 was replaced periodically to maintain the desired RH.

Soluble carbohydrate levels from the seed leachates were analysed after immersing 1g sunflower and safflower seeds in 20 ml distilled water for 16h. This was determined following the method of McCready et al (15). Sampling procedure of free amino acids was the same as was done in the case of soluble carbohydrates, and from the same leachate stock free amino acid level was quantified following the method of Moore and Stein (16).

Samples for protein, RNA, soluble and insoluble fractions of carbohydrate were taken from 100 mg seed kernels of each treatment. Extraction of protein was done as per the method of Kar and Mishra (12) and estimation was done following the method of Lowry et al (13). RNA was extracted following Cherry's (7) method and it was quantified as per the method described by Markham (14), modified by Chowdhuri and Chatterjee (9).

Extraction of soluble carbohydrate from seed kernel was done with 80% boiling ethanol followed by centrifugation of the extracts at 6000 g for 10 min. This was repeated thrice and from the pooled supernatant (10 ml) soluble carbohydrate level was analysed. For the analysis of insoluble carbohydrate, the residue after centrifugation of the sample was digested with 5 ml 25% H_2SO_4 at 80°C in a water bath for 30 min. The extracted material was taken as a source of insoluble carbohydrate. Quantitative measurement of both the carbohydrate fractions was done using anthrone reagent (15).

To determine TTC stainability of seeds, dehusked seeds in 4 groups of 40 seeds of each sample were allowed to imbibe 1% TTC (2, 3, 5 – triphenyl tetrazolium chloride) solution (w/v) in separate beakers and incubated in dark conditions for 12 h. Subsequently, percentage TTC-stained (red – coloured) seeds was calculated. This method was adopted after Halder (11). The activity of total dehydrogenases of intact seeds was analysed by measuring the red-coloured formazan, produced in seeds after incubation, according to the method of Rudrapal and Basu (21).

The data were statistically analysed at the treatment and replication levels, and the least significant difference (LSD) values were calculated at 95% confidence limits (17).

Results

Leaching of soluble carbohydrates and amino acids (Table 1) from both sunflower and safflower seeds increased to a great extent when data were recorded after 60 days of accelerated ageing. However, this increase was remarkably arrested in seed lots which underwent presoaking with all the three concentrations of Na-DK.

On the contrary, the levels of protein and RNA (Table 2) and also that of insoluble carbohydrate (Table 3) in the seed kernels of the two cultivars remarkably declined in control seed lots after 60 days of forced ageing treatment. The magnitude of decline was, however, substantially arrested in the chemical-pretreated seed samples, although at the initial period of analysis, the chemical effect was found inhibitory. Internal soluble carbohydrate level (Table 3) in seed kernels was greatly augmented after 60 days of accelerated ageing. Na-DK at all its concentrations efficiently retarded the rapid rise of soluble carbohydrate.

Percentage TTC-stained seeds sharply declined after 60 days of seed ageing with concomitant decrease of the activity of total dehydrogenase enzyme (Table 4). However, the magnitude of fall of both the parameters was found to be much less in Na-DK pretreated seed lots.

Discussion

Accelerated ageing-induced deterioration of sunflower and safflower seeds was evidenced by profuse leakage of sugar and amino acids (Table 1). Considerable alleviation of this deleterious effect by Na-DK indicates its role in retention of membrane integrity. The membrane is the most important site of a seed which is prone to attack first by any accelerated ageing treatment (10) and arguably any chemical purported to have an effect on seed viability must influence membrane integrity. The proposal that decreased membrane integrity and occurrence of membrane lesions might play significant role in the deterioration of seeds has been supported by work on solute leaching accompanying a fall in germinability and viability (12, 19). Profuse leakage of sugars and amino acids, as observed in the present investigation, thus seems to be the result of damage of cell membrane leading to loss of viability, whereas Na-DK-induced lowering of the speed of leaching indicates retention of seed viability by maintaining membrane integrity.

Solute leaching in seeds was associated with a proportional shift in metabolism within seed kernels as evidenced from remarkable decrease in protein and RNA (Table 2) as well as insoluble carbohydrate (Table 3) after 60 days of seed ageing. Here also, Na-DK significantly relieved the deleterious effect of forced ageing treatment. The chemical also slowed down the drastic rise of internal soluble carbohydrate level. Results, therefore, point out that although deterioration occurs both in treated and control seed lots, the catabolic processes within the treated seeds remained somewhat subdued, thereby rendering them tolerant against unfavourable storage environment.

Beneficial effect of Na-DK on maintenance of viability and storage potential of seeds can also be evidenced from TTC stainability and total dehydrogenase activity (Table 4). Both the parameters were found high in Na-DK-treated seed lots. Dehydrogenase activity is considered a reliable index for evaluation of seed viability (1). There are also reports that as seeds age, they lose vigour which is evaluated by counting percentage TTC-stained seeds and/or by observing the pattern of TTC staining which appears as deep red colour or as irregular red patches on the seeds depending on their viability status (11). Data, thus, point out that in spite of experiencing accelerated ageing treatment, Na-DK pretreated seeds got hardened and retained higher vigour than the control ones.

Thus, from a number of reliable viability indices using Na-DK as a test chemical on two low-vigour seed species, it can be concluded that Na-DK may be used as a potent seed invigourating agent to enhance the storage life of seeds.

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TABLE – 1. Effect of accelerated ageing and seed pretreatment with different concentrations of Nadikegulac (DK) on leaching of soluble carbohydrates (mg/g/20 ml) and free amino acids (mg/g/20 ml) from seeds of two cultivars

Cultivars	Pretreatments ($\mu\text{g/ml}$)	Soluble carbohydrates		Amino acids	
		Days after accelerated ageing			
		0	60	0	60
Sunflower	DK 0	2.50	10.55	0.80	9.85
	DK 1000	2.65	6.45	1.18	6.50
	DK 2000	2.90	5.90	1.36	6.42
	DK 4000	2.92	5.72	1.30	6.30
	LSD (P=0.05)	0.21	0.70	0.09	0.62
Safflower	DK 0	2.0	10.05	0.25	2.87
	DK 1000	2.30	6.60	0.32	2.05
	DK 2000	2.35	6.95	0.42	2.20
	DK 4000	2.80	7.02	0.40	2.48
	LSD (P=0.05)	0.19	0.68	0.03	0.19

TABLE – 2. Effect of accelerated ageing and seed pretreatment with different concentrations of Nadikegulac (DK) on protein (mg/g wet weight) and RNA ($\mu\text{g/g}$ wet weight) contents of the seeds of two cultivars

Cultivars	Pretreatments ($\mu\text{g/ml}$)	Protein		RNA	
		Days after accelerated ageing			
		0	60	0	60
Sunflower	DK 0	88.50	62.01	935.8	560.4
	DK 1000	84.68	70.50	902.7	690.5
	DK 2000	78.82	72.02	887.6	705.0
	DK 4000	78.05	73.80	875.5	710.8
	LSD (P=0.05)	7.80	6.80	NS	52.55
Safflower	DK 0	83.31	40.59	833.5	485.6
	DK 1000	78.50	58.90	810.0	580.4
	DK 2000	76.69	60.85	786.8	590.6
	DK 4000	76.24	61.05	773.9	598.2
	LSD (P=0.05)	NS	5.50	NS	42.8

NS = Not Significant

TABLE – 3. Effect of accelerated ageing and seed pretreatment with different concentrations of Nadikegulac (DK) on soluble - and insoluble carbohydrate (mg/g wet weight) contents of the seeds of two cultivars

Cultivars	Pretreatments ($\mu\text{g/ml}$)	Soluble carbohydrate		Insoluble carbohydrate	
		Days after accelerated ageing			
		0	60	0	60
Sunflower	DK 0	24.8	50.0	28.7	16.8
	DK 1000	26.2	35.6	20.5	19.0
	DK 2000	29.0	32.9	20.6	18.7
	DK 4000	29.5	32.0	19.4	17.2
	LSD (P=0.05)	2.03	3.01	2.02	1.50
Safflower	DK 0	21.5	38.5	24.4	14.0
	DK 1000	25.6	33.6	22.5	17.5
	DK 2000	27.3	32.8	21.0	18.0
	DK 4000	27.9	32.0	17.2	15.8
	LSD (P=0.05)	1.98	2.80	2.01	1.40

TABLE – 4. Effect of accelerated ageing and seed pretreatment with different concentrations of Nadikegulac (DK) on percentage TTC-stained seeds and total dehydrogenase ($\Delta\text{OD/g/ml}$) activity of the seeds of two cultivars

Cultivars	Pretreatments ($\mu\text{g/ml}$)	% seed staining		Dehydrogenase	
		Days after accelerated ageing			
		0	60	0	60
Sunflower	DK 0	80	18	0.54	0.23
	DK 1000	80	45	0.56	0.40
	DK 2000	80	48	0.56	0.42
	DK 4000	80	44	0.54	0.41
	LSD (P=0.05)	NC	2.50	NS	0.03
Safflower	DK 0	85	17	0.55	0.26
	DK 1000	85	35	0.55	0.35
	DK 2000	85	38	0.53	0.37
	DK 4000	85	38	0.54	0.38
	LSD (P=0.05)	NC	2.44	NS	0.03

NC = Not Calculated; NS = Not Significant

Effect of Various Starchy Raw Substrates on α -Amylase Production by *Bacillus megaterium* VUMB109

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Abstract

To economise the production of the enzyme amylase, fermentation of different starchy materials available locally by a bacterial strain, *Bacillus megaterium* VUMB-109 previously isolated in our laboratory, has been investigated. Among twelve different starchy materials which are potato, black gram, oat, lathyrus, green gram, rice, rice hull, wheat, sweet potato, soyabean, lentil and beet, the first five had resulted in the highest level of enzyme production. Starch hydrolysing efficiency of the enzyme was found to be the maximum when lathyrus, arum, lentil, barley, potato and oat were used.

Key words : Thermostable amylase, starch digesting enzymes.

Introduction

Thermostable amylases have found many commercial applications during the last several decades. The utilisation of these enzymes in the textiles, brewing and dextrose making industries is of special interest. As such, information on ideal cultural and nutritional conditions (1,2) for increased production of the enzymes has become necessary. Several carbohydrate sources have been used for this purpose (3,4). It is reported that higher yield of amylase is obtained in media containing complex raw materials, such as maize, barley, wheat or malt as compared to that in defined media (5,6).

The availability of cheap raw substrates plays an important role in industrial production of the enzyme. Percentage conversion to reducing sugar, such as glucose, maltose or higher oligosaccharides after enzymatic degradation remains the deciding factor.

In the present study the effect of various raw substrates, such as potato, arum, pulses, wheat, cereals etc. which are cheaply available in the District of Midnapore, West Bengal, India, were studied for the production of amylase by *Bacillus megaterium* VUMB 109. The hydrolytic efficiency of the enzyme produced by the isolate in converting the raw substrates was also investigated.

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Materials and Methods

A previously isolated bacteria *Bacillus megaterium* VUMB 109 was used (7).

Culture Method : The strain was grown in a medium (50 ml, pH 8.2) containing (g/L) starch, 1; bacto-peptone, 5; beef extract, 3; $(\text{NH}_4)_2\text{HPO}_4$, 4; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.5; KCl, 1; in a 250 ml Erlenmeyer flask for 32 hrs. at 43°C on a rotary shaker at 200 rpm. The cells were then removed by centrifugation (10,000 xg, 4°C) and the resultant supernatant was used as a source of the crude enzyme. The effect of various raw substrates on the enzyme production was studied in media where starch was replaced by a raw substrate.

Preparation of substrate from Raw Materials : Freshly collected raw materials to be used as substrates were first peeled off and dried in an oven at 60°C for 48 hrs. The dried materials were then crushed in a mortar by a pestle to make a fine powder. These powdered materials were used as substrate for the production of an amylase in the fermentation medium. For the determination of enzymatic action on various substrates the dried powder materials (at 5% concentration) were boiled in boiling water bath for 15 mins. The viscous semisolid liquid thus formed, was filtered through clean fine cloth, to remove the undesired particles. The filtrate thus obtained was used as substrate for enzymatic action. The amount of starch present in each 5 ml substrate was estimated using analytical grade starch (Diffco) as a standard.

Assay of Amylase : The dextrinizing activity was determined by the starch iodine method as described by Smith and Roe (8). One dextrinizing unit was defined as the amount of enzyme which caused a decrease in optical density by 0.05 of starch iodine colour under the assay conditions. Saccharolytic amylase activity was determined according to Bernfeld (9). Saccharolytic unit was defined as the amount of enzyme which produced 1 μ mol glucose equivalent of reducing sugar. The reaction mixture in both the assays consisted of 0.5 ml 1% starch solution in 10mM phosphate buffer (pH 7.75), 0.4 ml 10mM phosphate buffer (pH 7.75) and 0.1 ml enzyme solution. After incubation for 5 mins. at 93°C, reaction was stopped by the addition of 0.5 ml of 1 (N) HCl for assay of dextrinizing activity and 1 ml of 3, 5 dinitrosalicylate reagent for the assay of saccharolytic activity. For determination of dextrinizing activity, 0.1 ml iodine solution was added and the mixture was diluted to 15 ml. Readings were taken in Erma colorimeter using red filter for the iodine method and a green filter for the dinitrosalicylate method.

For determination of hydrolytic capability of amylase on various substrates, the modified method of Smith and Roe (8) was followed. The reaction mixture consisted of 5 ml substrate (5%), 1 ml 10mM phosphate buffer (pH 7.75) and 1 ml of crude enzyme solution. The mixture was incubated for 20 minutes at 93°C when 3.0 ml 1 (N) HCl was added to stop the reaction. Finally iodine solution was added for development of colour.

Measurement of Biomass : In liquid media biomass was measured in absorbance units at 620 nm using a Klett-Summerson colorimeter.

Results

Table I shows the various substrates and their respective concentration used in the medium for the production of α -amylase by *Bacillus megaterium*. It was noticed that certain substrates such as oat,

rice, wheat favoured production of dextrinizing activity than the others including starch. Highest yield of the enzyme was obtained using the seeds of black gram, lathyrus, lentil, green gram, oat and potato tubers. The production rate was found to be in the following order : oat > Black gram > lathyrus > potato > green gram > lentil. While the growth was less in oat containing medium than starch, the total yield of the enzyme was almost 1.8 fold higher with oat than with starch. The remaining starchy materials except soyabean, beet, sweet potato did not encourage the enzyme production. The optimum concentration of the powder raw substrate for high yield of the enzyme was as follows : 1% oat lathyrus and lentil, 0.5% green gram, potato and black gram.

Table II shows the starch content of various raw substrates and hydrolytic capacity of the enzyme of different kinds of starchy materials. Starch content of various raw substrates have been measured. The amount of starch was found to be higher in oat, wheat, pearl millet, lentil and lathyrus compared to maize, gram, arum barley and fresh potato. Starchy materials derived from arum, potato, lentil, oat, lathyrus, barley were well hydrolysed by the amylase produced by *Bacillus megaterium*. The hydrolysis of starch of lathyrus, arum, lentil, barley, oat and potato were 92%, 85%, 85%, 82%, 80% and 80% respectively.

Discussion

It is well known that complex media are more suitable for enzyme production than the synthetic ones (1, 10). However, research in this direction is only fragmentary. Cheaper sources of substrates are needed for economisation and as such need to be searched continuously. Many cheaply available materials are able to elevate the enzyme production. Keeping this in mind, the present investigation was carried out to find out the potentiality of some inexpensive easily available substrates to increase amylase production by *B. megaterium* VUMB – 109.

Results showed that certain substrates (e.g. oat, black gram, green gram, lathyrus, lentil and potato) are able to increase α -amylase production by *B. megaterium* relative to commercial starch. The increase in enzyme production, however, is not concomitant to increase in growth as evident from a comparison of growth of the strain and its corresponding α -amylase production. It is presumed that the different natural substrates which brought about high enzyme production, in addition to serving as substrates, provided several necessary nutrients (viz. amino acids and vitamins) to the growth medium. There is reason to believe that the presence of certain free amino acids in these substrates helped in enhancing the production of α -amylase by *B. megaterium* VUMB 109.

It is also known that specific enzyme acts on specific substrate and the efficiency of enzymes and the products formed depend primarily both on the nature of the enzyme and the substrate. Blom et al (II) used potato starch as raw substrate for the production of many industrially important substances, e.g., syrups, sugars etc. by the action of α -amylase.

It was noted that at least six substrates, potato, arum, barley, lentil, oat and lathyrus, were very effectively hydrolysed by α -amylase produced by *B. megaterium* VUMB 109.

The hydrolysing efficiency of α -amylase in transforming natural substrates to simple sugars may lead to a wider application of the enzyme in food and pharmaceutical industries.

Acknowledgement

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TABLE – I
Effect of various plant materials on α -amylase formation by *Bacillus megaterium* VUMB 109.

Substrates		Concentration (%W / V)	Cell biomass OD at 620 nm	Dextrinizing activity (Unit/ml)	Saccharoly activity (Unit/ml)
English name	Scientific name				
Oat	<i>Avena sativa</i>	0.5	1.40	28	17
		1.0	1.50	25	20
Rice	<i>Oryza sativa</i>	0.5	1.50	16	13
		1.0	1.70	18	14
Rice hull	<i>Oryza sativa</i>	0.5	1.20	16	13
		1.0	1.20	18	14
Wheat	<i>Triticum aestivum</i>	0.5	0.95	18	15
		1.0	1.20	19	13
Beet	<i>Beta vulgaris</i>	0.5	1.50	23	18
		1.0	1.25	12	11
Black gram	<i>Phaseolus mungo</i>	0.5	1.50	23	18
		1.0	1.60	14	10
Green gram	<i>Phaseolus aureus</i>	0.5	1.10	24	17
		1.0	1.30	15	12
Lathyrus	<i>Lathyrus sativus</i>	0.5	1.20	21	15
		1.0	1.20	23	17
Lentil	<i>Lens culinaris</i>	0.5	1.75	15	13
		1.0	1.50	20	16
Potato	<i>Solanum tuberosum</i>	0.5	0.90	21	17
		1.0	1.30	18	15
Sweet Potato	<i>Batatus edulis</i>	0.5	0.90	9	9
		1.0	1.10	10	9
Soyabean	<i>Glycine max</i>	0.5	0.93	13	10
		1.0	1.75	8	6
Starch (Commercial)		0.5	1.40	15	12
		1.0	2.00	10	7

TABLE – II
Hydrolysis of various substrates by *Bacillus megaterium* VUMB 109 α -amylase in 20 minutes

Substrates		Concentration of substrates used (%W/V)	Initial Starch present in 5 ml of substrates (mg)	Amount of starch hydrolysed in 5ml substrates/ml enzyme (mg)	% of starch hydrolysed/ml enzyme/ 20 min
English name	Scientific name				
Maize	<i>Zea maize</i>	5	190.0	65.0	34
Oat	<i>Avena sativa</i>	5	212.5	170.0	80
Wheat	<i>Triticum aestivum</i>	5	237.5	172.5	72
Pearl millet	<i>Sorghum vulgare</i>	5	235.0	164.5	70
Gram	<i>Cicer arietinum</i>	5	190.0	140.0	73
Lentil	<i>Lens culinaris</i>	5	200.0	170.0	85
Lathyrus	<i>Lathyrus sativus</i>	5	212.5	195.5	92
Arum	<i>Colocasia esculenta</i>	5	187.5	159.3	85
Potato (Fresh)	<i>Solanum tuberosum</i>	5	175.0	122.5	70
Potato (Dried)	<i>Solanum tuberosum</i>	5	240.0	192.0	80
Barley	<i>Hordeum vulgare</i>	5	180.0	147.6	82
Starch (Diffco)		5	250.0	200.0	80

Effect of Ascorbic Acid Supplementation on Chromium-induced Tissue Toxicity in Experimental Rats

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Abstract

The impact of Ascorbic Acid (AA) treatment on Chromium (Cr) toxicity in relation to changes in certain marker enzymes of cellular toxicity was studied. Intraperitoneal administration of Cr (VI) for 28 days causes decrease of phosphatase activities in all the tissues examined. AA treatment along with Cr reversed the Cr-induced changes of phosphatases. It is suggested that reversal of Cr-induced changes in the activities of marker enzymes of cellular toxicity may be affected by AA in most of the cases through cellular reduction of Cr.

Key words : Chromium Toxicity, ALP, ACP.

Introduction :

Chromium, like many transition metal elements, is essentially to be taken at low concentrations and may prove toxic to many systems at higher concentrations. In addition to the overt symptoms of acute chromium toxicity, delayed manifestations of chromium exposure become apparent by subsequent increases in the incidence of various human cancers. Chromium is widely used in numerous industrial operations including welding, grinding, soldering, painting, smelting and storage battery manufacturing, and as a result is a contaminant of many environmental systems. Chromium, in its myriad chemical forms and oxidation states, has been well studied in terms of its general chemistry and its interactions with biological molecules. However, the precise mechanisms by which chromium is both an essential metal and a carcinogen are not yet clearly known (1). Accordingly, there have been approaches to study the toxicity of metals in terms of dose response relationship focussing on connection between the intake of metal and its accumulation in the body and especially in the target organs and the development of particular symptoms of toxicosis. Such studies on toxicity of metals like lead, cadmium, zinc etc. which have extensive industrial use, revealed that these metals do have significant impact on different systems of living. Reactions appear in human from exposure to the metal from various sources, such as manufacturing of chrome nickel, steel, electroplating catalyst, mordant leather tanning, green varnishes, paints, inks and glazes for porcelain (3).

Chromium occurs naturally in various crustal materials and is discharged to the environment as an industrial waste. Although it can occur in a number of oxidation states, only trivalence and hexavalence are available in the environment. Hexavalent chromium compounds are considered toxic to a variety of terrestrial and aquatic organisms and are mobile in soil/water systems much more than trivalent chromium compounds (4).

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The present investigation is intended to study some of the marker enzymes of cellular toxicity caused due to chromium and to see whether ascorbic acid treatment could reverse some of the changes, if any, in the activities of marker enzymes affected by chromium.

Materials and Methods

Male albino rats weighing 80-100 gm were used for this investigation. These were divided into four groups, each containing six animals. One of the groups received hexavalent chromium at a dose of 0.8 mg/100 gm body weight per day. The second group was treated with ascorbic acid at a dose of 0.5 mg/100 gm body weight per day. Another group was administered both chromium and ascorbic acid at the aforesaid doses. The last group received normal saline. All the animals were injected i.p. for a period of 4 weeks and then sacrificed by cervical dislocation. The tissues were collected immediately and kept frozen.

With the above groups of rats, Alkaline Phosphatase and Acid Phosphatase of tissues were assayed using P-Nitrophenyl Phosphate as substrate (5).

All the results are expressed as means and standard error from the six rats. Comparisons between the mean values of the control and treated rats were made by student's t-test at $P < 0.05$ as a level of significance.

Results and Discussion

Chromium (hexavalent) treatment at the present dose decreased the activities of Acid Phosphatase (ACP) and Alkaline Phosphatase (ALP) in all the tissues studied, such as liver, kidney, testis, spleen, cerebrum and cerebellum (Table-1 & 2). Among the tissues, spleen, cerebrum, cerebellum and testis showed a marked depression in the activities of ACP and ALP. Ascorbic acid treatment reversed the activities of ACP and ALP in all the tissues studied in chromium-administered rats except for the activity of ACP in spleen (Table-I).

Studies reported by others (6,7) demonstrate that chromium causes altered liver and kidney functions and changes in glycogen and aminonitrogen metabolism. It was reported that chromium toxicity induces depressed mitochondrial respiration resulting from NADH depletion as well as due to specific enzyme inhibition (8). There were also reports indicating induction of cellular injury and lipid peroxidation by hexavalent chromium (9). It was further reported that cellular pretreatment with ascorbic acid reduced the level of chromium (pentavalent) intermediate and increased the level of trivalent chromium complex suggesting cellular reduction of hexavalent/pentavalent chromium to trivalent chromium by ascorbic acid (10).

The present investigation revealed that ascorbic acid treatment could reverse some of the changes in the activities of marker cellular enzymes of chromium toxicity. This reversal of enzyme activities might be caused either by the cellular reduction of chromium by ascorbic acid or by direct action of ascorbic acid. This can be ascertained by further studies.

TABLE - I

Effect of chromium treatment and ascorbic acid supplementation on Acid Phosphatase (ACP) activity of different organs

ACID PHOSPHATASE ACTIVITY (μ mole PNP produced/hr/mg of fresh tissue)				
ORGANS	GROUPS OF ANIMALS			
	CONTROL	CHROMIUM TREATED	ASCORBIC ACID SUPPLEMENTED	ASCORBIC ACID SUPPLEMENTED ALONG WITH CHROMIUM TREATMENT
	(6)	(6)	(6)	(6)
LIVER	0.67 \pm 0.03	0.53 \pm 0.07	0.75 \pm 0.11	1.06 \pm 0.025
KIDNEY	9.62 \pm 0.58	6.12 * \pm 0.32	9.08 \pm 0.72	9.38 \pm 0.85
TESTIS	4.12 \pm 0.38	1.25 * \pm 0.33	3.87 \pm 0.41	2.62 \pm 0.57
SPLEEN	3.75 \pm 0.43	1.66 * \pm 0.27	3.54 \pm 0.52	1.63 * \pm 0.14
CEREBRUM	0.75 \pm 0.08	0.25 * \pm 0.02	0.69 \pm 0.05	0.75 \pm 0.07
CEREBELLUM	0.57 \pm 0.02	0.12 * \pm 0.04	0.51 \pm 0.04	0.32 \pm 0.05

(Data are mean \pm S.E.M.

Numbers within parenthesis indicate the number of observation)

* = P < 0.05.

TABLE – 2

Effect of chromium treatment and ascorbic acid supplementation on Acid Phosphatase (ACP) activity of different organs

ALKALINE PHOSPHATASE ACTIVITY (μ mole PNP produced/hr/mg of fresh tissue)				
ORGANS	GROUPS OF ANIMALS			
	CONTROL	CHROMIUM TREATED	ASCORBIC ACID SUPPLEMENTED	ASCORBIC ACID SUPPLEMENTED ALONG WITH CHROMIUM TREATMENT
	(6)	(6)	(6)	(6)
LIVER	32.51 \pm 3.31	25.55 * \pm 4.38	33.53 \pm 4.57	32.06 \pm 4.61
KIDNEY	33.59 \pm 3.72	23.09 * \pm 2.77	33.45 \pm 2.86	32.53 \pm 3.22
TESTIS	15.74 \pm 2.38	7.50 * \pm 2.26	16.43 \pm 2.11	15.68 \pm 3.02
SPLEEN	35.57 \pm 4.17	25.75 * \pm 3.13	36.18 \pm 3.79	36.25 \pm 2.14
CEREBRUM	14.28 \pm 0.91	6.17 * \pm 1.05	21.24 \pm 1.13	19.83 \pm 1.22
CEREBELLUM	17.42 \pm 1.13	6.75 * \pm 1.16	15.54 \pm 1.72	16.25 \pm 2.26

(Data are mean \pm S.E.M.

Numbers within parenthesis indicate the number of observation)

* = P < 0.05.

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Effect of Migration on Demographic Structure of the Oraon of Sundarban, South 24-Parganas, West Bengal

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Abstract

Migration, an important variable of demography, has exposed the human species to a wide range of physical, biological and social-cultural environment. The present study attempts to see the changes, if any, in demographic composition among some Oraons who have migrated from Chota Nagpur area of Bihar and settled down in a village of South 24-Parganas in West Bengal. For this purpose comparison had been made between the present study and the study made earlier on the Oraons residing in Gumla and Jalpaiguri districts respectively. The present study shows that the three populations are growing and the lowest fertility among them is found among the Oraons of Sundarbans. It also shows that the highest infant mortality among the three groups of Oraons is found among the Oraons of Sundarbans. But the adolescent mortality is the highest among the sedent Oraons of Gumla District in Bihar. The selection potentiality is the highest among the Oraons of Sundarbans.

Key words : Demographic structure, migration, age-group specific fertility.

Introduction

Demographically, a population shares a pattern of fertility, mortality, migration, age-sex composition etc. Human populations have been constantly moving since prehistoric times into different corners of the world. Therefore migration has profound effect(s) on the biological and social-cultural traits of the human species. The study of population movement has long been a subject of fascination to human biologists whether in the form of large scale migration or local mobility. The demographic changes following migration seems to be related to sociocultural and biological factors. Fertility and mortality may change following migration and associated changes in sociocultural and biological characteristics.

This is because members of a human population share a specific patterns of fertility, mortality, migration, age-sex composition and geographical distribution. These patterns together form the demographic dimension of the structure of a population and, in other words, form or what is now called demographic structure (Mukherjee, 1997). The demographic structure itself is multidimensional. The effect of the change in one aspect of demography, that is migration, may influence other elements of demography.

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Goldstein (1943) found that both fertility and mortality among the Mexican migrants were lower than among the sedents and age at menarche and age at marriage were both earlier among the migrants. Myers and Morris (1966) also found reduced fertility, accelerated geographical mobility, relatively stable marital pattern, changing family size and so forth with urbanization in Puerto Rico. Harbison and Baker (1981) again confirmed lower fertility among the Samoans who migrated from the traditional to the modern urbanized environment. Hoff (1968) found fertility of the migrants to decrease with increasing urbanization. Berry (1983) has also reaffirmed that the migrants had lower fertility and higher education, occupation and age remaining unchanged. Fertility has generally been found to decrease with increase in altitude migration (Abelson et. al 1974; Abelson, 1976; Gupta; 1980; Beall 1982 and others).

The mortality rate has been found to be relatively higher at high altitude by Harrison et.al, (1969) but about equal between high and low altitudes (Gupta, 1980). Both physical environmental and sociocultural factors have been considered as possible determinants of altitudinal differences in demographic traits. But Gupta et.al (1989) have suggested that while fertility might be sensitive to both physical environmental and sociocultural factors, mortality seems to be more affected by the latter.

The objective of the present study is to examine the trends of changes in the demographic profile of the same ethnic population, i.e. the Oraon tribe and the influence of migration to a new rural habitat comparing three isolated divisions of the Oraon population. For this purpose, the data on fertility and mortality were collected within a small space of time from (i) the sedent Oraons of Chota Nagpur plateau of Gumla district in Bihar, (2) the migrant Oraons of Dooars of Jalpaiguri district in West Bengal and (3) the migrant Oraons of Sundarban of South 24 Parganas district in West Bengal.

Materials and Methods

The Oraons of Chota Nagpur plateau, due to hard economic pressure in their original homeland, migrated to different adjacent States such as West Bengal, Orissa, Assam, Madhya Pradesh as tea-garden labourers, colliery labourers, indigo-plantation labourers and ordinary labourers during the turn of the present century. Das and Raha (1963) observed the change in social-cultural life and activities of the migrant Oraons of Sundarban who came from Gumla district for reclamation of land in that area. The district 24-parganas is the third in the order of concentration of the Oraon population among the districts of West Bengal according to 1961 census.

The study conducted by Mahinder on the Oraons of North Bengal tea-gardens is worth mentioning here. Mahinder (1988) studied demography of the migrant Oraons of Birpara-Lankapara-Tulsipara tea-gardens of Dooars area of Jalpaiguri district in West Bengal. The Oraons are the third largest group in Jalpaiguri district, preceded by the Rajbanshi and the Mahammedan populations (Grunings, 1911). They came mainly as tea-garden labourers from Gumla district. She also observed the demographic aspects of the sedent Oraons of Chota Nagpur area and compared them with the Oraons of Dooars area.

To fulfill these needs, the Sundarban area of South 24-Parganas has been selected for the present study of the effect(s) of migration on the demographic structure for a comparative analysis. The ethnic background of the three groups of population as well as the factor of temporal change has been thus possible to contribute to a large extent for focussing attention to the effect(s) of migration alone in this study.

The Canning Police Station of South 24-Parganas was selected for a good concentration of the Oraons. The Dabu mouja was selected which is within Canning Police Station, where a sizeable population is scheduled tribes (243 males and 223 females according to 1981 census), of which the bulk are the Oraons, available for study. Joyramkhali village of that mouja, which has 55 households of the Oraon tribe and also three households of the members of the Munda tribe, has been chosen for this investigation. Thus the data can be considered as a selective sample of the migrant Oraons. The three groups studied are of the same ethnic origin but inhabiting different regions for which they can be controlled following the suggestions of Baker and Dutt (1972) to study how human adapted to new environments after migration from a native habitat.

All members of the Oraon households of the village are included in the sample. A questionnaire schedule was used to collect data on age, sex, place of birth, marital status, marriage, divorce, remarriage, number of surviving and living children, miscarriage, still birth, age at death and birth order.

Percent of male proportion at birth, child : women ratio, net-reproductive index, total fertility rate infant mortality and adolescent mortality, Crow's (1958) index of opportunity of selection have been calculated from the collected data and age-group specific fertility rate has been graphically represented.

Results and Discussions

The analysis reveals that 35.93, 46.10 and 17.96 percent of 295 migrant Oraons of Sundarban are demographically classified (Sandberg's classification cited by J.M. Datta in 1962) in the pre-reproductive age group of 0-14 years, reproductive age group of 15 - 49 years and post-reproductive age group of 50 + years respectively. This indicates a trend of population growth through time among the Oraons of Sundarban as in the other two groups of Oraon population (Mahinder, 1988). However the Oraons of Sundarban can be considered to approach the characteristics of a stationary population with 35.93 percent of the population representing the pre-reproductive age group and 17.96 percent of the population representing the post-reproductive age group. (Sandberg's classification cited by J.M. Datta in 1962).

The proportion of male births among the Oraons of Sundarban is 57.47 ± 3.89 . But the overall value of this proportion is 50.17 ± 2.89 indicating sex differential mortality favouring the women. The overall male proportions are 48.27 ± 1.57 and 50.71 ± 1.33 among the sedent Oraons of Gumla and the migrant Oraons of Dooars of Jalpaiguri respectively, which has been shown in the following Table

No. 1. This indicates lower proportions of females among the migrant section of Oraons than among the sedent Oraons.

Table—1 : Comparison of percent of male proportion at birth, child : Women ratio, net-reproductive index and total fertility rate between the sedent and two migrant groups.

Population	Percent of male proportion at birth	Child : Women ratio	Net-reproductive index	Total fertility rate	Source
Oraon Migrant (Sundarban)	50.17 ± 2.89	47.69	2.00	4.71	Present Study
Oraon Sedent	48.27 ± 1.57	59.45	2.89	5.57	Mahinder, 1988
Oraon Migrant (Dooars)	50.71 ± 1.33	58.67	3.30	5.68	Mahinder, 1988

The decline of the proportion of females in live births appears consistent in two different migrant sections of Oraons and a situation conducive to relatively high fertility among the sedent Oraons of Gumla compared to the migrant Oraons of Sundarban and Dooars area.

By surveying the total population of the households at Joyramkhali, it has been observed that the unmarried females were aged below 25 years among the Oraons of Sundarban. But 4.56 percent and 2.09 percent of the unmarried females among the migrants of Jalpaiguri and the sedents of Gumla are older than 24 years. This would indicate a decline of age at marriage among the Oraons of Sundarban in contrast to the other two sections and especially, the migrant Oraons of Jalpaiguri. Thus the migrational effect on change in the marriage age of women does not appear to be consistent in the two areas of the Oraon migration considered here. It can be suggested that the ecological factors of the place of migration might also have some role in this biocultural change in a population.

The child : women ratio among the migrant Oraons of Sundarban indicates moderate rate of fertility among them. But the child : women ratio among the migrant Oraons of Jalpaiguri and the sedent Oraons of Gumla indicate relatively higher fertility in the latter (Table – 1). This suggests a decline in fertility specially during the last half of a decade, before the present field investigation among the Oraon of Sundarban. But such a decline, obviously due to conscious family limitation, if at all, is not appreciable in the case of the migrant Oraons of Dooars of Jalpaiguri district. In this case, there is a question on the relative roles of migration and ecological factors on the secular fertility decline, assuming the time factor being nearly constant.

The percentage of childless women is 11.01 among the migrant Oraons of Jalpaiguri and 8.73 among the sedent Oraons of Gumla. In both the groups, the nulliparous married women are mainly concentrated in the age group of 15 - 19 years (Mahinder, 1988). But the present study shows that the percentage of childless women is 7.93 among the migrant Oraons of Sundarban and the nulliparous married women are almost equally distributed in both less than 25 years and 25 - 34 years of age groups. It should be mentioned that the relative infertility in teen agers does not indicate either sterility or voluntary birth control in any case. Adolescent infertility is a very common anthropological phenomenon, which would easily explain Mahinder's findings. But that can hardly explain the absence of fertility in the older married women among the migrant Oraons of Sundarban. This is more indicative of voluntary adoption of family limitation and deferment of pregnancy in the light of a rather low child : women ratio among the Oraons of Sundarban.

The net-reproductive index is also the smallest in the migrant Oraon sample of Sundarban and the largest in the migrant Oraons sample of Jalpaiguri (Table – 1). This confirms a relatively lower potential for fertility in the former and a relatively higher potential for fertility in the latter migrants.

That fertility is also markedly smaller among the migrant Oraons of Sundarban than among the other two groups of Oraons is apparent from values of the total fertility rate in the populations (Table – 1).

The values of age-group specific fertility among the three groups of Oraons under study are graphically compared and the same has been represented in the following figure No. 1.

Insert Fig. 1 (Age Group Specific Fertility Rates)

It appears that the rate of infant mortality has however increased in both the migrant groups of Oraons and the same has been shown in the following Table No. 3.

Table—2 : Comparison of surviving children and live births between the sedent and two migrant groups.

Population	Total No. of married women	No. of surviving children/woman X ± S.D.	No. of live births/woman X ± S.D.	Source
Oraon Migrant (Sundarban)	63	2.38 ± 1.78	3.39 ± 2.67	Present Study
Oraon Sedent	252	2.72 ± 1.83	4.00 ± 2.70	Mahinder, 1988
Oraon Migrant (Dooars)	318	2.77 ± 2.15	3.69 ± 2.79	Mahinder, 1988

T test	Surviving Children	Live Birth
t (Oraon Sedent, Oraon Migrant — D)	0.31, df 568	1,34, df 568
t (Oraon Sedent, oraon Migrant — S)	1,41 df 313	1,64 df 313
t (Oraon Migrant — D, Oraon Migrant — S)	1,56, df 379	0.83 df 379

D = Doors S = Sundarban

Table—3 : Infant mortality and adolescent mortality among the sedent and two migrant groups.

Population	Total No. of births	Infant mortality		Adolescent mortality		Source
		No.	%	No.	%	
Oraon Migrant (Sundarban)	214	42	19.62	62	28.97	Present Study
Oraon Sedent	1007	130	12.91	301	29.89	Mahinder, 1988
Oraon Migrant (Dooars)	1174	171	14.57	277	23.59	Mahinder, 1988

Binomial tests for equality of proportions :

(1) Infant mortality :

Between Oraon sedent and Oraon migrant (D) : — 0.0165595 ± 0.0148142

Between Oraon sedent and Oraon migrant (S) : — 0.0671653 ± 0.0261860*

Between Oraon migrant (D) and Oraon migrant (S) : — 0.0506058 ± 0.0267897

(2) Adolescent mortality :

Between Oraon sedent and Oraon migrant (D) : — 0.0629622 ± 0.0189561*

Between Oraon sedent and Oraon migrant (S) : — 0.0091880 ± 0.0344034

Between Oraon migrant (D) and Oraon migrant (S) : — 0.5377420 ± 0.0319336

D = Dooars

S = Sundarban

* = Significant

But this increase as projected in the above Table No. 3 is significant as revealed by the binomial test of equality of proportions only in the case of migrant sample of Sundarban. No such significant increase of mortality in the migrant Oraons has been obtained in the adolescent age-group. If anything, there is a slight decrease of adolescent mortality among the migrants, especially in the Dooars sample. But the size of the sample is not adequate for finding a significance in that trend.

The Crow's (1958) index of opportunity of selection appears to increase among the migrant Oraon population of Sundarban and rather decline among the migrant Oraons of Jalpaiguri, compared to that estimated for the sedent Oraons by Mahinder (1988). This is apparently due to the increased rate of variability in fertility and fertility component of selection intensity in the sample of Sundarban, although the mortality component among them slightly declines and a decline in both the fertility and mortality components in the sample of Dooars from the values among the sedent group of Oraons at Gumla as shown in the following Table No. 4.

Table—4 : Index of opportunity of selection among the sedent and two migrant groups.

Populations	\bar{X}	V_I	P_d	P_s	I_f	I_m	I	Source
Oraon Migrant (Sundarban)	4.65	7.52	0.289	0.711	0.348	0.406	0.895	Present Study
Oraon Sedent	6.02	5.66	0.298	0.702	0.156	0.424	0.646	Mahinder, 1988
Oraon Migrant (Dooars)	6.98	4.93	0.235	0.765	0.101	0.308	0.441	Mahinder, 1988

The average number of live births per woman with completed fertility shows the same trend of lowered fertility in the Sundarban and slightly increased fertility in the Dooars from that in the Gumla.

Summary and Conclusions

Thus the effect(s) of migration on fertility rate does not seem to be exactly alike in the two migrant Oraon populations inhabiting the tea-gardens of the Dooars and the agricultural ecology of the Sundarban areas. Any generalization about such effect(s) can not yet be done and would await further microlevel study for understanding the adaptive strategies and environmental and cultural niches of the migrated populations inhabiting different ecosystems. This increasing trend of mortality especially in infants is, however, a common feature among the migrant groups. This is also a reflection of adaptation to new environment.

The proportions of the Oraon population in Sundarban in the pre-reproductive and the post-reproductive age-groups suggest that although yet a growing population like other two groups of

Oraons, the migrant Oraons of Sundarban tend to approach the characteristics of a stationary population.

The analysis of sex ratio among the three Oraon populations reveals a decreasing proportion of female individuals among the migrants compared to the sedents, and the decline of female proportion with age among the Oraons of Sundarban.

The marriage age of females tend to decline among the Oraons of Sundarban. A recent decline of fertility and increase of nulliparous women among the women of the most fertile ages suggest the adoption of birth control measures among the migrant Oraons of Sundarban, but not in those at Dooars, due to eco-cultural backgrounds of the respective areas. The decline of the female proportion among the offspring in the sample of Sundarban in contrast to the Dooars indicate a lower potential for fertility in the former.

In fact, various measures of fertility suggest a decline of fertility among the Oraons of Sundarban, but rather a recent increase in fertility in the other sample of migrant Oraons at Dooars.

There is also a trend of increasing infant mortality among the migrants, which is significant for the Oraons of Sundarban. The adolescent mortality shows a rather declining trend with migration especially in the sample of Sundarban although the data are not adequate for finding any significant change.

The selection potential due to variability tends to increase among the Oraons of Sundarban due to increase in its fertility component alone. But the opportunity of selection tends to decline among the other migrant Oraons at Dooars due to the change in its fertility and mortality components.

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Postural Variations and Body Pain Experienced by Indian Women While Basket Making

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Abstract

A study was done on Indian women basket makers as regards the postural variations and associated body pain experienced by them. Incidence of musculoskeletal problems (N=27) and work pause cycle (N=7) were recorded. It was found that continuous squatting posture was adopted by these women which might have resulted in high incidence of musculoskeletal pains. Among the body ache, back pain was found to be the highest amongst the women basket makers. Variations in the squatting postures were also observed. Posture like sitting with left knee raised and right knee laid outside (Posture #7) was the most adopted posture during basket making. Out of the total work period 7.05% was the period of pause and major portion of this pause was taken while working in standing posture. The study suggests that improvisation of the work posture is necessary for better long term productivity by redesigning the workstation and working tools which will help to reduce the musculoskeletal problems.

Introduction

The small scale industries and the unorganised traditional industries known as Village and Small Industries (VSI) are an important part of Indian economy which provided wage employment to 413.39 lakhs in the year 1989-1990 and accounted for 54% of the total exports of the country. Small Scale Industry is known to manufacture a wide range of over 7400 products and accounts for about 70% of the gross output of the VSI sector (4).

The present study is a part of study on the ergonomic aspects of workstation design for women adopting squatting posture engaged in Small Scale Industries and Cottage (at home) Industries. Basket making is an important area where a significant number of women workers, mainly from the lower income group are employed.

Perhaps, one of the oldest of man's creation is basket making done with the help of minimum number of tools where bamboo is used as a raw material. This is essentially a rural craft intimately connected with the every day life of the people to meet their common needs. In India, the technology related to these crafts have changed a little while in Japan and other South East Asian countries the techniques have greatly improved. In India basket making activity is usually tradition bound, where women workers are engaged since childhood and continue this occupation for a whole lifetime. The

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posture adopted by these basket makers is squatting on floor. The squatting on floor posture is not only adopted by the Indian women but also by the women engaged in similar types of activities in the neighbouring countries.

ILO (2) reported that women employed in these small scale Industries are likely to suffer from discomfort and postural defect. As in certain Asiatic countries it is customary to sit on the floor, and persons may have complaints of backache probably caused by faulty posture adopted for a prolonged period.

The present study has been done to understand the degree of postural variations occurring during the performance of basket making activities with an ultimate objective of designing an ergonomic workstation and tools for these basket makers or workers engaged in bamboo crafts, which will not only accommodate the variations of working postures but will also help to adopt better work posture. An attempt has also been made to establish a linkage between the sociomedical issues and work related postures. With the progress of the study, some recommendations will be proposed which will improve the personal health of the worker and bring easiness in the work style leading to long term benefit to the women work force. The objectives of the present study were to understand the variations in squatting posture, the work pause period and incidence of body pain among the women basket makers.

Subjects and Methods :

Study on Basket Making : Activities / Job Description :

Work pattern was recorded through observation. The steps included in the process of basket making were cleaning of bamboo, cutting of bamboo, slicing of bamboo, making strips for base weaving, making strips for side weaving, weaving of base, bending to give shape, weaving of sides and finishing the basket.

Selection of Basket Makers :

Women basket makers (N=27) with mean age 34 years ± 9.66 were selected for the study of musculoskeletal problems and 7 women from the same group were randomly selected for the study of the work pause cycle from Wadala area of Mumbai (Bombay), India. All those women had migrated from the State of Karnataka and most of them were illiterate. Most of the women belonged to the low income strata of the society. The basket making was considered as the main means of earning livelihood for them. Since the occupation was tradition bound, the average years of experience was as high as 20.37 years (± 10.28 years). It is to be noted that these women spend their whole life time in this occupation where continuous squatting posture is adopted. They start this work from the age as early as 10 years. It is thereby highly probable that the squatting posture as adopted by the basket makers for a continuous and long period might lead to high degree of musculoskeletal problems for different body joints.

Study on Musculoskeletal Problems :

The survey on musculoskeletal problems was conducted by means of a prepared questionnaire and each subject was asked to indicate their pain locations. It was seen that it was difficult to confirm the musculoskeletal problems through the medical reports as the workers had no records with them nor the hospitals kept track of those issues.

Work Pause Cycle :

Generally, the basket making activity starts around 8.30 A. M. and ends around 7.00-8.00 P.M. In

the present study, activity analysis was done between 9.00 A.M. to 6.00 P.M. The work period included the period where basket making activity was performed. The pause taken up by the basket makers can be divided into two types ; disguised pause and prescribed pause. Disguised pauses were the pauses when the worker occupied herself with some easier routine task in order to relax from concentrating on the main job, e.g. cleaning the workplace, sitting down more comfortably etc. such disguised pauses are justified from a physiological point of view, since nobody can do continuous manual or mental work without interruption (Grandjean 1988). Prescribed pauses in this case were the breaks in the work that were laid down by the worker herself, e.g. tea break. Work pause cycle was recorded by noting the activity being performed through observation and the time taken to perform this activity was recorded through stopwatch.

Results and Discussion :

The musculoskeletal problems were studied through the questionnaire and have been detailed in the Table 1.

Table 1 : Percentage of body ache as reported by the workers through questionnaire.

S. No.	Region	Percent	Rank
1.	Back Lumbar	66.6	1
2.	Back Scapular	62.9	2
3.	Shoulder	48.1	3
4.	Thigh (Front Side)	44.4	4
5.	Thigh (Back Side)	40.7	5
6.	Neck	37.6	6
7.	Hip Joint	29.6	7
8.	Knee	29.6	7
9.	Thigh (Whole)	27.0	8
10.	Eye	25.9	9
11.	Forearm	25.9	9
12.	Wrist	25.9	9
13.	Palms and fngers	22.2	10
14.	Head (Back)s	22.2	10
15.	Upper arm	22.2	10
16.	Ankle	18.5	11
17.	Calf	14.8	12
18.	Elbow	14.8	12
19.	Foot	11.1	13
20.	Head (Forehead)	11.1	13
21.	Waist	11.1	13
22.	Head (Whole)	7.4	14
23.	Stomach	7.4	14
24.	Chest	7.4	14

From the Table 1, it can be observed that the prevalence of musculoskeletal problem (body ache) was rank wise highest in the lumbar region and second in the scapular region. The high incidence of back, shoulder, thigh, neck, hip and knee joint pain is most likely due to the continuous squatting posture adopted by the women basket makers. It was observed that due to the squatting work posture the lower portion of the body (below the naval region) remained more in the static condition than the upper part. The sustained static muscular contraction specially for the back muscles and thigh muscles and other lower leg muscles may be the cause of musculoskeletal problems as observed in the study.

Work Period and Pause :

Work period and the pause period was calculated for the working hours. The total time (in seconds) attributed to a particular activity and pause was seperately calculated. It was found that out of the total period 92.95% was the work period and only 7.05% was the period of pause which should be a minimum 15% in general as expressed by Grandjean (1). The various postures adopted by the women basket makers are detailed in Table 2. The analysis of the variations in the posture revealed that posture like sitting with left knee raised and right knee laid outside (Posture # 7) was the most adopted posture by the women basket makers during the working hours. Imanura (3) studied the postural patterns of the Japanese farmers in the RyuKyu Islands. Based on Imanura's description, it was observed that posture # 8 of this study was also adopted by those Japanese farmers while basket making, but it can not be concluded whether this posture was also the highest adopted posture by Japanese farmers, as no such study on postural variations was reported by Imanura. However, it is very much possible that there are differences in postures adopted between different communities because of socio-cultural differences.

The study suggests that improvisation of the work posture is necessary for better long term productivity by redesigning the workstation and working tools which will help to reduce musculo-skeletal problems. Some particular postures like P2, P5, P6 and P7 are demanded by the type of job which can be eliminated by proper workstation and tool design. Introduction of jigs and fixtures in the workstation also may resolve this issue. Utmost care has to be taken for these particular postures before changing the workstation and tool design.

Table 2 : Different postures adopted by women workers while basket making.

	Posture	Description
P1		Standing.
P2		Sitting with right knee raised and left knee laid outside.
P3		Sitting cross legged.
P4		Sitting with right leg stretched in the front or in the side and left knee laid side ways on the floor.
P5		Sitting with folded upright legs and knees close to the chest.
P6		Sitting with folded legs and knees away from the body.
P7		Sitting with left knee raised and right knee laid outside.
P8		Sitting with left leg stretched in the front or in the side and right knee laid side ways on the floor.

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Differential Acceptance of Family Planning Methods in India: A Quantitative Analysis

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Abstract

Acceptance of family planning methods may be viewed as a function of complex interaction amongst many variables, viz., couple's socio-demographic characteristics together with knowledge, availability and attitude toward family planning methods as well as various psychological factors. In the present paper, an attempt has been made to understand contraceptive use differentials in India by exploring National Family Health Survey (NFHS) data using logistic regression in conjunction with Multiple Classification Analysis technique. For the current analysis such variables as residence, caste, religion, education of couples, number and sex composition of the living children, interspouse communication, exposure to mass media, and family planning messages have been considered to throw some light on the contraceptive use in the country.

It is observed that a large number of couples are not using any method due to lack of knowledge or distorted knowledge, fear of side effects and owing to poor availability of the proper methods or restricted contraceptive choice.

Key words : Sociodemographic factors, contraceptive use, predictor variable, regression.

Background

Among the proximate determinants of fertility as suggested by Bongaart (1978), contraception is perhaps the most crucial one. Contraception also becomes important in the context of the prevention of teenage and unwanted pregnancies, longer birth spacing and reduction in reproductive and other health morbidities. It has been observed that most of the countries where family planning acceptance was high had a low fertility (World Population Data Sheet 1997). However, it is important to mention here that the use-effectiveness of the different family planning methods varies considerably and on many occasions improper use of contraception fails to protect the eligible women from getting pregnant. Understanding the role of contraception in the reduction of fertility, emphasis has been given more on contraception rather than other variables to reduce birth rate in almost all the countries as a part of their antinatalist policy. Recently, China, Sri Lanka and Vietnam have been able to reduce

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the birth rate mainly by increasing contraceptive prevalence rate (CPR). In India, during a span of 50 years from the day of Independence, the population has more than doubled, though family planning programme has been officially incorporated, in the first Five Year Plan in 1952. The 1991 Census records the annual growth rate at 2.14 percent with a total fertility rate of 3.6. The rapidly increasing population poses a serious threat to our Nation and as it has been stressed time and again, if it is not controlled immediately, India is going to face a severe socio-economic crisis in the near future. At present in India CPR is 41 per cent and the target by 2000 A.D. is 60 per cent to achieve NRR of unity (which has been shifted to 2011-2016 A.D. according to the Eighth Five Year Plan document).

Now a critical question may be posed : why is family planning not successful inspite of its early introduction into the National Policy ? At this point it may be worth while to analyse contraceptive use differentials as well as the factors that prevent the couples from adopting any method.

Some studies reveal that acceptance of family planning methods depends on couples's sociodemographic characteristics as well as some psychological factors. According to Kanitkar and Sinha (1994), four development related variables viz., infrastructural facilities, education, health and mass media and communication facilities have a significant correlation with contraceptive use. Acceptance increases with the frequent interspouse communication (De Silva 1994, Khan 1979; Mukherjee 1967; Bhatia and Newmann 1980).. Age of women, number and sex combination of children are also related to contraceptive acceptance. Cultural preference of a son acts as a hindrance to contraceptive use (Raju *et al*, 1994). Lack of initiation, lack of awareness, non availability of the method of choice, fear psychosis etc. also inhibit the couples to go for any method (Khan and Prasad 1983 ; Kumar A. 1983).

With this background, an attempt has been made in this paper to understand contraceptive use differentials with possible hindrances in the context of Indian population.

Methods and Materials

The data from the National Family Health Survey, which is a national-wide survey conducted in 26 states by the International Institute for Population Sciences, Mumbai during 1992-93, have been used for this study. The survey generates data from 89777 ever-married women in the age group of 13-49. For the present study analysis has been restricted to 84,680 currently married women in the reproductive age group. Data pertaining to socio-demographic characteristics and family planning have been explored. Besides cross tabulation, multivariate techniques such as logistic regression in conjunction with multiple classification analysis (refer appendix) have been used to analyse the data. The logistic coefficients are transferred into simple percentages (adjusted) by using MCA format for a better understanding. While doing this, the predictor variables such as education and residence are controlled for all cases by setting them equal to their national means. By fixing the means we neutralise the interaction effects of residence and education for studying the individual effects of each predictor variable on contraceptive use. The reason for selection of residence and education as controlled variables lies in the fact that a sizeable proportion of interaction effects of each predictor variable with respect to response variable (i.e., contraceptive use) can be explained by these two variables. It is possible to include interaction term for all the predictor variables while regressing each sociodemographic variable with respect to contraceptive use. In that case the model would cumbersome. So we avoid it in the present analysis. Unadjusted percentages against different socio-demographic variables refer to the simple percentage distribution of the contraceptive users. The multivariate analysis is conducted among the 16350 currently married, non-pregnant women with three living children. The reason for limiting attention to this group

is that, for a great many Indian women, the transition from three to four children is a critical point for deciding whether to stop child bearing at that stage.

Results

In this section an analysis of the relationship between the various sociodemographic factors and acceptance of contraceptives have been presented.

i) Residence : It is observed that most of the couples, both in urban as well as in rural areas, have the knowledge of at least one modern contraceptive method. Female and male sterilizations are commonly known methods followed by contraceptive Bills and IUD. A higher percentage of couples from urban areas have the knowledge of contraceptives by each single method than the couples in rural areas. Prevalence of contraceptives is also higher in urban areas and for every method except male sterilization, users are more in urban areas (Table 1). Multivariate analysis as presented in Table 4 suggests that urban rural differences in contraceptive prevalence rate reduces from an unadjusted 12 percentage points to an adjusted 5 percentage points when women's education is controlled.

ii) Education : Contraceptive prevalence rate increases with the increasing education level of women. But the acceptance of permanent method decreases from 'literate' category to higher literate levels (Table 2). Controlling residence for women's education, it is found that there is a big difference in prevalence between the 'reference' category (illiterates) and literate category. But within the literate category itself, increase in education makes little difference. The rate also increases sharply with the increasing level of education of husband. But a reverse trend is observed in the case of the literate husband when wife's education and residence are controlled (Table 4).

iii) Sex combination and number of children : A small percentage (4.20) of the newly married couples of 'Zero' parity use contraceptives. Among the couples who have only daughters, 24.08 percent have accepted family planning methods, Whereas 50.54 percent of those having of best one son are using contraceptives, (Table 3). This clearly indicates a strong preference for sons in India. It has also been observed that prevalence rate increases sharply upto two living sons and then level off. And the unadjusted and adjusted rates show little difference when residence and women's education are controlled (Table 4).

(iv) Religion and caste : There is a difference in acceptance of contraception according to religion and cast in India. A higher rate is observed among the Hindus and other religious groups compared to the Muslims. Controlling residence and education in the regression analysis makes hardly any difference. The rate is the highest among the general castes and it is the lowest among the scheduled tribes. The observed differences get reduced when residence and women's education are controlled.

v) Age of women : Table 4 reveals that contraceptive prevalence rate is the highest among the women in 30-39 years age group. When residence and women's education are controlled, it makes little difference in the result.

vi) Inter-spouse communication : Use of contraceptives increases sharply with the increasing interspouse discussions on family planning. The rate is very low among those who have not discussed with their spouses. Controlling residence and education reduces the difference by 29 to 20 percentage points between the reference category (never discussed) and those who had discussed more often.

vii) Exposure to electronic media and Family Planning messages : Regular exposure to electronic media enhances the acceptance of family planning methods. The rate is higher among those who

were exposed to family planning messages through television than those who were in the habit of listening to radios. Controlling wife's education and residence creates little difference.

viii) *Antenatal care services and place of delivery* : Women who utilized the antenatal care services (ANC), tends to use contraceptives more than among those at home deliveries who have never utilized ANC. Controlling residence and education reduces the gap between these two classes of women by 7 percentage points in the prevalence rate. It is also observed that prevalence rate is higher in those cases where the last delivery occurred at private or public institutions than among those where the deliveries took place at home. Controlling residence and education has narrowed the gap between unadjusted percentages of these two classes of women by 8 percentage points (Table 4).

Some other barriers : Table 5 reveals that 49 percent of the couples in urban areas and 63.1 per cent in rural areas are not using any method. It is important to unearth the reason for non-use of contraceptives to formulate effective intervention programmes. The table further shows that a large percentage of couples are not using any method as they want children. Fear of side effects, improper knowledge and non-availability factors constitute a large percentage of non-users in rural areas compared to urban sectors. In general, more than 15 per cent of the couples are not using any method due to the above reasons. Health problems occur more in urban areas (26.90%) than rural areas (18.64%) leading to non-use of contraceptives.

CONCLUSION

In India, as procreation is primary to the newly married couples, they do not like to use any methods before the first child birth. That is why, the prevalence rate of contraceptives in younger age groups is lower than that in the higher age groups. There is a positive relation between education and contraceptive use and the differences are very clear between illiterate and literate categories. The prevalence rate is also higher in urban areas than in rural areas due to easy availability, exposure to mass media and other modernising factors. Religion still acts as a determining factor of contraceptive acceptance. The rate is the lowest among the Muslims compared to other religious groups even when residence and education are controlled. Exposure to electronic media and family planning messages, regular husband-wife communication etc. always enhance the acceptance. Utilization of antenatal care services and use of public or private institutions during delivery have a positive relation with contraceptive use. Traditional son preference still plays a crucial role in determining the use of contraception. Furthermore, couples may not use any method due to lack of knowledge, lack of initiation, fear of side effects etc. Emphasis should be given to remove these barriers together with MCH and ANC services to achieve the target of NRR unity by 2011 - 2016 AD. In spite of the limitation of this study, as it has dealt only with the macrolevel data, one may get some interesting hints from it for undertaking microlevel in-depth and qualitative enquiries regarding the contraceptive use differentials among the various Indian populations.

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APPENDIX

Logistic regression, more commonly called logit regression, is used when the response variable is dichotomous (i.e., binary or 0-1). The predictor variable may be quantitative, categorical, or a mixture of the two. In the logistic regressions presented here, the input values of contraceptive use (the observed data) are 1 if using and 0 if not using. The value of contraceptive use predicted from the logistic regression equation, on the other hand, can assume anything between zero and one and may be interpreted as the probability of using contraception. The basic form of the logistic function is,

$$P = \frac{1}{1+e^{-Z}} \quad \dots(1.1)$$

Where, P is the probability of happening of an incidence, Z is the predictor variable and e is the base of the natural logarithm equal to 2,71828...

From logit of P is derived from the logistic function in (1.1), it follows that

$$1-P = 1 - \frac{1}{1+e^{-Z}} = \frac{e^{-Z}}{1+e^{-Z}} \quad \dots (1.2)$$

Dividing (1.1) by (1.2) one gets

$$\frac{P}{1-P} = e^{-Z} \quad \dots (1.3)$$

Taking the natural logarithm (base e) of both sides of (1.3).

we get,

$$\log \frac{P}{1-P} = Z \quad \dots (1.4)$$

where Z can take the form of $b_0 + b_1 X_1 + b_2 X_2 + \dots + b_k X_k$. The quantity $P/(1-P)$ is called the odds ratio, and $\log [P/1-P]$ is called the log odds or the logit of P.

The definition of the odds in (1.3) corresponds to everyday usage. For example, one speaks of the

odds of using a contraceptive in a population, say, 75:25, meaning, $75/(1-.25)$. Alternatively, one speaks of "three-to-one" odds, which is the same as 75:25. That is three part of the population is using contraceptives against one part which is not using.

In this paper underlying logit regression results are not shown. Instead, we use multiple classification analysis (MCA) format to transform regression results (i.e., odds ratios) into simple cross-tabulations to show how contraceptive use varies with different socio-demographic variables, residence and women's education being controlled.

METHODS	URBAN		RURAL	
	KNOWLEDGE	USERS	KNOWLEDGE	USERS
ANY	98.4	59.7	94.7	42.5
ANY MODERN METHOD	98.6	53.9	94.5	37.1
PILL	85.5	8.7	59.4	4.1
IUD	83.1	10.5	52.9	3.2
INJECTION	25.2	0.3	17.2	0.2
CONDOM	80.2	14.3	50.2	4.6
FEMALE STERILIZATION	97.7	30.4	93.5	26.3
MALE STERILIZATION	91.1	3.3	82.1	3.5
ANY TRADITIONAL METHOD	48.8	14.6	36.0	10.4
RHYTHM/PERIODIC ABSTINENCE	44.0	10.6	31.7	8.0
WITHDRAWAL	26.4	7.0	17.8	4.8
OTHER METHODS	3.8	1.0	3.5	0.7
NUMBER OF WOMEN	22077	22077	62601	62601

TABLE 2 : CURRENT USE OF CONTRACEPTIVES BY EDUCATION.

METHOD	ILLITERATE	LIT. <MIDDLE	MIDDLE SCHOOL COMPLETED	HIGH SCHOOL ABOVE
ANY METHOD	33.9	50.4	50.8	54.7
ANY MODERN METHOD	31.5	44.8	42.4	45.0
PILL	0.6	1.7	2.3	2.8
IUD	0.6	2.2	3.3	7.3
INJECTION	-	-	-	-
CONDOM	0.8	2.2	3.8	10.7
FEMALE STERILIZATION	25.7	35.1	30.1	22.0
MALE STERILIZATION	3.7	3.7	2.8	2.1
ANY TRADITIONAL METHOD	2.4	5.5	8.5	9.7
PERIODIC ABSTINENCE	1.6	3.2	4.6	5.6
WITHDRAWAL	0.6	2.1	3.4	3.4
OTHER METHOD	0.2	0.2	0.1	0.3
NOT USING ANY METHOD	66.1	49.6	49.2	45.3
NO. OF WOMEN	53045	15476	6280	9879

TABLE 3 : CURRENT USE OF CONTRACEPTIVES ACCORDING TO SEX COMBINATION OF CHILDREN.

SEX OF LIVING CHILDREN	USERS	NON-USERS	TOTAL
NO CHILD	473(4.20)	10793 (95.80)	11265[13.30]
ONLY FEMALE CHILD	2918(24.08)	9198(75.92)	12116[14.31]
AT LEAST ONE SON	30979(50.54)	30320(49.46)	61299(72.39)
TOTAL	34370(40.59)	50310(59.41)	84680[100.00]

Source : NFSH India (1992-93)

χ^2 value is highly significant for 2 d.f. at $\alpha = 0.01$ level of significance (calculated value is 10070.976)

TABLE 4 : ADJUSTED PERCENTAGES OF CONTRACEPTIVE PREVALENCE BY BACKGROUND CHARACTERISTICS IN INDIA AS PREDICTED BY LOGIT REGRESSION IN CONJUNCTION WITH MULTIPLE CLASSIFICATION ANALYSIS.

Background variable	Control variable	Unadjusted	Adjusted [§]
Age			
13-29 ^R	Residence and education	51	53
30-39		73	73*
40-49		62	63*
No. of living sons	Residence education		
None ^R		36	34
1		55	54*
2		70	72*
3		67	70*
Residence	Education		
Rural		59	62*
Urban		71	67*
Women's education	Residence		
Illiterate		553	54
Lit. <middle Comp.		75	74*
Middle Complete		78	78*
High School Comp.		78	77*
Husband's education	Residence and education		
Illiterate ^R		50	58
Lit. <middle Comp.		66	69*
Middle Comp.		67	65*
High School Comp.		70	62*
Religion	Residence and education		
Hindu ^R		64	65
Muslim		39	39*
Others		73	70*
Caste/tribe	Residence and education		
Non-SC/ST ^R		64	64
Sch. Caste		55	60*
Sch. Tribe		52	59*
Exposure to electronic media	Residence and education		
Not regularly ^R		49	53
Regularly		73	71*
Exposure to F.P. messages on electronic media	Residence and education		
Nither		53	57
Radio only		65	65*
Television only		75	71*
Both		77	73*
Discussion of F.P. with husband (past year) [*]	Residence and education		
Never		9	9
Once or twice		24	19*
More often		38	29*
Utilization of ANC for last birth	Residence and education		
Did not have ANC ^R		25	29
Had ANC		52	49*
Place of last delivery	Residence and education		
Home ^R		34	36
Public or private institution		67	61*

Source : NFHS, 1992-93.

§ : Adjusted for the control variable.

TABLE 5 : REASONS FOR NON-USE OF CONTRACEPTIVES BY CURRENTLY MARRIED WOMEN NOT USING ANY METHOD AND NOT INTENDING TO USE IN FUTURE.			
REASONS	URBAN	RURAL	TOTAL
WANTS CHILD	2770(45.91)	12433(53.91)	15203(52.25)
MISCONCEPTION, DISTORTED KNOWLEDGE, FEAR PSYCHOSIS	543(9.00)	2219(9.62)	2762(9.49)
LACK OF KNOWLEDGE NON AVAILABILITY, INCONVENIENT etc.	272(4.51)	1385(6.01)	1657(5.70)
CULTURAL PROHIBITION AGAINST RELIGION, FAMILY MEMBERS DOES NOT PERMIT	524(8.68)	1963(8.51)	2487(8.55)
HEALTH REASON, DIFFICULT TO GET PREGNANT, MENOPAUSE	1623(26.90)	4298(18.64)	5921(20.35)
OTHERS	302(5.00)	763(3.31)	1065(3.66)
TOTAL	6034(100.00)	23061(100.00)	29095(100.00)

Aquatic Insects of Midnapore District - I (Insecta, Coleoptera, Dytiscidae)

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Abstract

13 species of Dytiscidae has been reported in this paper, of which 7 are newly recorded from Midnapore District.

Key words : Dytiscidae, elytra, pronotum.

Introduction

Dytiscidae are commonly known as 'predaceous diving beetless'. These are one of the commonest constituents of aquatic insect fauna which are perfectly adapted to the aquatic life. They are active swimmers. Both larvae and adults prey on various kinds of aquatic biota. These serve as food for carnivorous fish, feed on small fish and compete with them for food. As such these are of immense value from the point of view of fishery. Vazirani (1977) has published a catalogue of oriental Dytiscidae. Of the approximate 4000 species of Dytiscidae, 223 have been recorded from India of which only 69 species are found in West Bengal. Very little is known about this beetle from Midnapore District wherefrom only 6 species have previously been recorded by Biswas, Mukhopadhyay & Saha (1995). The present paper is based on a survey of wetland in 1995 and it includes 7 species recorded for the first time from Midnapore District along with 2 previously known species. A key for identification has been included for these 9 species and other 4 species which could not be collected in the present study.

Insects : Coleoptera : Adephaga :

1. FAMILY : DYTISCIDAE

Characters : Convex form, stream lined body and paddle like hind legs, hind coxae fused with metasternum, ventrite I divided and maxillary palpi short.

Key to the subfamilies of Dytiscidae known from Midnapore District :

1 (6) Scutellum not visible.

2 (5) Fourth segment of prosternal mesotarsi not reduced and subequal to the 3rd segment, prosternal process straight. occasionally with a little depressed

3 (4) Posterior legs with two tarsal claws of equal length, sides of the pronotum rebordered.....
Noterinae

4 (3) Posterior legs with a single tarsal claw ; side of the pronotum not rebordered.....
Laccophilinae.

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5 (2) Fourth segment of the pro and mesotarsi much reduced, hardly visible, prosternal process arched and oblique..... Hydroporinae

6 (1) Scutellum visible, anterior border of the eyes not excised, three basal segments of the protarsi enlarged into rounded. oval or sub-triangular pallet.....Dytiscinae

1. Sub family : NOTERINAE

Key to the Genera of subfamily Noterinae :

1 (2) Curved spurs not present on the apex of fore tibiaeHydrocoptus
Miotrchutasky

2 (1) Curved spurs present on the apex of four tibiae.....Canthydrus
Sharp

1. Genus : *Hydrocoptus* Motschulsky, 1859.

1859. *Hydrocoptus* Motschulsky. *Etudes Entomologiques*, 8 : 43,364.

1977, *Hydrocoptus*, Vazirani. *Cat. Orient. Dytiscidae* 2

Only one species, *Hydrocoptus* (*s. str.*) *subvittulus* Motschulsky (1860) is found in Midnapore.

1 *Hydrocoptus* (*s. str.*) *subvittulus* Motschulsky, 1860.

1860. *Hydrocoptus subvittulus* Motschulsky. *Etud. Ent.*, 8 : 53 (1859).

1877, *Hydrocoptus* (*s. str.*) *subvittulus*. Vazirani, *Cat. Orient. Dytiscidae*, pp. 4.

Material examined : 3 exs. from Pirrakata, 16.5.95, 1 ex. from Gangadharpur, 16.5.95, 1 ex. from Midnapore, 17.5.95. P.R. Pahari.

Distribution : India : West Bengal (Calcutta, North 24 Parganas, South 24 Parganas, Midnapore) Assam, Bihar, Orrissa, Tamil Nadu. Maharastra, Gujrat.

Elsewhere : Burma (Myanmar) Sri Lanka, China and Indonesia.

Remark : Reported here for the first time from Midnapore District.

2. Genus : *Canthydrus* Sharp, 1882

1882. *Canthydrus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 269, 838

1977. *Canthydrus vazirani*, *Cat. Orient. Dytiscidae* : 5

Key to the species of the genus *Canthydrus* sharp known from Midnapore District.

1 (2) Elytra testaceous, length 2.5–3.0 mm. antennae testaceous with apical segments a little darker
..... *C. flavus*

2 (1) Elytra brownish black, with testaceous/yellow spots.

3 (4) Length 2.25 – 2.7 mm. pronotum testaceous.....*C. lactabilis*

4 (3) Length 2.9–3.5 mm. pronotum largely black at least on the disc. elytra black, with three orange spots as under : 1, outer basal in the form of an elongated streak, 2, small, inner, basal, 3, small post median.....*C. luctuosus*

2 *Canthydrus flavus* (Motschulsky), 1855.

1855. *Hydrocanthus flavus* Motschulsky, *Etudes Entomologique*, 4 : 83.

1977. *Canthydrus flavus*, Vazirani, *Cat. Orient., Dytiscidae* : 5

Material studied : 2 exs from Pirrakata. 1 ex. from Gangadharpur 1 ex. from Midnapore, 16.5.95, P. R. Pahari.

Distribution : India : West Bengal (North 24 Parganas, Midnapore) Midnapore.

Elsewhere : Thailand, Vietnam, Indonesia, China and Formosa,

Remark : Recorded here for the first time from Midnapore District.

3 *Canthydrus laetabilis* (Walker), 1858.

1858. *Hydroporus lactabilis* Walker, *Ann. Mag. Nat. Hist.*, 3 (2) : 205.

1977. *Canthydrus lactabilis*, Vazirani. *Cat. Orient. Dytiscidae*. pp. 6.

1995. *Canthydrus lactabilis*. Biswas et al. *Zool. Surv. India. State fauna series – 3, Fauna of W. B. Part 6 (A)* 85.

Material studied : 1 ex. from Pirrakata, 1 ex. from Gangadharpur 6.5.95 P.R. Pahari.

Distribution : **India** : West Bengal (Calcutta, Midnapore, Murshidabad, South 24 Parganas) Assam, Bihar, Orissa, Gujrat, Kerala, Rajasthan, Uttar Pradesh.

Elsewhere : Burma, Bangladesh, Sri Lanka, Pakistan & Nepal,

Remark : In Midnapore the species was known previously from Kharagpur (Biswas et al. 1995).

4 *Canthydrus luctuosus* (Aube), 1838.

1838. *Hydrocanthus luctuosus* Aube, in Dejean's species Coleopteres, 6 : 408.

1977. *Canthydrus luctuosus* Vazirani. *Cat. Orient. Dytiscidae*. pp. 6.

Material studied : 3 exs. from Pirrakata 16.6.95, 3 exs. from Gangadharpur 16.6.95, 2 exs. from Midnapore town 17.7.95, P.R. Pahari.

Distribution : **India** : West Bengal (Darjeeling, Midnapore), Bihar, Orissa. Andhra Pradesh, Tamil Nadu, Maharastra, Karnataka and Kerala.

Else where : Iran and Sri Lanka.

Remark : Reported here for the first time from Midnapore District.

2. Sub family : LACCOPHILINAE

Only a single genus, *Laccophilus* Leach recorded from Midnapore District.

3. Genus : *Laccophilus* Leach, 1817.

1817. *Laccophilus* Leach, *Zool. Misc.*, 3 : 69.

1977. *Laccophilus*, Vazirani, *Cat. Orient. Dytiscidae.*, pp. 9.

Key to the species of the genus *Laccophilus*
known from Midnapore.

- 1 (2) Elytra unicolorous, without any distinct markings, punctation on elytra in the posterior half larger, closer and more distinct..... *L. rufulus*
- 2 (1) Elytra testaceous with undulating single or double lines.
- 3 (4) Elytra markings flexuous, excessively irregular and covering the entire surface excepting the lateral margins..... *L. flexuosus*
- 4 (3) Elytra markings consisting of double zig - zag lines, sometimes the lines, becoming thick and coalscnt, pronotum without any black markings along the anterior and posterior margins
L. parvulus

5 *Laccophilus rufulus* Regimbert. 1888.

1888. *Laccophilus rufulus* Regimbert, *Ann. Mus. Stor. nat. Genova*.

1977. *Laccophilus rufulus*, Vazirani. *Cat. Orient. Dytiscidae*. pp. 14-15.

Material examined : 2 exs. from Pirrakata. 16.6.95. P.R. Pahari

Distribution : India : West Bengal (Calcutta, Darjeeling. Midnapore) ; Assam, Manipur, Bihar and Madhya Pradesh.

Remark : The species is found only in India. Previously it was recorded from only Kharagpur in Midnapore District. (Biswas et al. 1995).

6 *Laccophilus flexuosus* Aube, 1838.

1838. *Laccophilus flexuosus* Aube. in Dejean's species Coleopteres, 6 : 430.

1977. *Laccophilus flexuosus*. Vazirani, *Cat. Orient. Dytiscidae*, pp. 11-12.

1995. *Laccophilus flexuosus* Biswas et al., *Zool. Surv. Ind. State fauna series 3, Fauna of West Bengal*. Part 6 (A), 88.

Material examined : 1 ex. from Pirrakata 16.6.95

Distribution : India : West Bengal (Calcutta, Midnapore Dist., Bihar, Orissa, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Tamil Nadu, Karnataka, Gujrat and Rajasthan.

Elsewhere : Burma, Sri Lanka, Pakistan, Iraq, Iran, Japan & Indonesia.

Remark : In Midnapore District it has been previously collected from Kharagpur & Abhaipur (Biswas et al. 1995).

7 *Laccophilus parvulus* Aube, 1838

1838. *Laccophilus parvulus* Aube, in Dejean's species

1977. *Laccophilus parvulus*. Vazirani. *Cat. Orient. Dytiscidae*. 13-14

Material examined : NIL

Distribution : India : West Bengal (Midnapore. North 24 parganas) : Assam : Manipur; Bihar, Orissa; Madhya Pradesh; Andhra Pradesh; Maharashtra. Tamil Nadu; Goa; Gujrat and Rajasthan.

Elsewhere : Burma, Sri Lanka, Pakistan, Malaysia, Indonesia, Phillipines.

Remarks : This species has previously been recorded from Kharagpur (Biswas et al 1995).

3. Sub family : HYDROPORINAE

Key to the genera of subfamily Hydroporinae known from Midnapore

- 1(2) Claws of the hind tarsi mostly unequal, the external claw nearly invisible. Posternal process oblong, size more than 2 mm. **Hyphydrus.**
- 2(1) Claws of the hind tarsi equal.
- 3(4) Prosternal process broadened at the apex, sutural angle of the elytra acuminate **Hydrovatus**
- 4(3) Prosternal process not broadened at the apex, pronotum marked with striae on both the sides, pronotal striae generally continued on the elytra.
- 5(6) Clypeus distinctly thickened, semicircular in outline with a transverse striae between the eyes **Clypeodytes**
- 6(5) Clypeus not thickened almost cut straight, elytra with a sutural striae **Guignotus**

4. Genus : Hyphydrus Illiger, 1807

1870. Hyphydrus Illiger, *Mag. Ins.* 6 : 349.

1977. Hyphydrus. Vazirani, *Cat, Orient. Dytiscidae* : 20

Only one species Hyphydrus (*Apriophorus*) *renardi* Severin, 1890. was recorded from Belpahari by Biswas et al. (1995).

8. Hyphydrus (Apriophorus) renardi Severin, 1890

1890. *Hyphydrus renardi severin*, *Ann. Soc. ent. Belg.* 34.

1977. *Hyphydrus (Apriophorus) renardi*. Vazirani, *Cat. Orient. Dytiscidae* : 23.

Material Examined : 2 exs. from Pirakata 15.6.95. P. R. Pahari.

Distribution : India : West Bengal (Midnapore); Bihar; Orissa; Uttar Pradesh; Madhya Pradesh, Tamil Nadu and Rajasthan.

Elsewhere : Burma.

Remark : Previously reported from Belpahari in Midnapore District by Biswas et al. 1995.

5. Genus : Hydrovatus Motschulsky 1855

1855. *Hydrovatus Motschulsky*, *Etud., Ent.* 5 : 82

1882. *Hydrovatus Sharp*, *Sci. trans. R. dublin Soc.*, 2 : 321, 848

Only two species of the genus **Hydrovatus** found in Midnapore.

- 1 (2) Length not more than 2.5 mm. elytra less densely puncted than pronotum. punctures separated by at least their own diameter **H. acuminiatus**

Motschulsky

2 (1) Elytra more densely punctate than pronotum, puncture almost coealescent, clypeus very narrowly rebordered; from more oval, side of pronotum arched, pronotoelytral angle not distinct, elytra concolorous with head and pronotum.....

H. confertus Sharp.

9. *Hydrovatus acuminatus* Motschulsky, 1859.

1859. *Hydrovatus acuminatus* Motschulsky, *Etude Entomogiques*, 8 : 42.

1977. *Hydrovatus acuminatus* Vazirani. *Cat. Orient. Dytiscidae* : 25.

Material Examined : 2 exs. from Pirrakata, 17.6.95. P.R. Pahari.

Distribution : **India** : West Bengal (Calcutta, Midnapore, Hooghly, Murshidabad), Bihar, Orissa, Kerala.

Elsewhere : Burma, China, Indonesia, Malacca. Celebes and Madagascar.

Remark : Reported for the first time from Midnapore District.

10. *Hydrovatus confertus* Sharp, 1882

1882. *Hydrovatus confertus* Sharp. *Sci. Trans. R. Dublin. Soc.*, 2 : 329.

1977. *Hydrovatus confertus* Vazirani, *Cat. Orient. Dytiscidae* : 27.

Material Examined : 1 ex. from Pirakata, 17.6.95. P. R. Pahari.

Distribution : **India** : West Bengal (Calcutta, Howrah, Midnapore) Bihar, Uttar Pradesh; Punjab; Tamil Nadu; Kerala and Rajasthan.

Elsewhere : Sri Lanka, Burma, Thailand, Vuetnam, China and Indonesia.

Remark : Previously known from only Kharagpur in Midnapore District (Biswas et al. 1995).

6. Genus : *Guignotus* Houlbert, 1934

1934. *Bidessus* (*Guignotus*) Houlbert, *Fauna Ent. Arm.*, Hydrocanthres : 54

1977. *Guignotus* Vazirani, *Cat. Orient. Dytiscidae* : 31

Only one species of *Guignotus fulvescens* (Zimmerman) 1923 is recorded from the Midnapore District.

11 *Guignotus fulvescens* (Zimmerman) 1923

1923. *Bidessus fulvescens* Zimmermann, *Ent. Blatt.*, 19 : 34

1970. *Guignotus fulvescens*, Vazirani, *Orient. Ins.*, 4 : 181

Characters : Latero-basal plica on pronotum distinctly continued on elytra, length 2.00 mm. elytra grey, with pale yellow marking.

Material examined : 2 exs. from Pirakata, 17.6.95, P.R. Pahari.

Distribution : **India** : West Bengal (Calcutta, Midnapore) Andaman & Nicobar Islands.

Remark : Restricted to India. Recorded here for the first time from Midnapore District.

7. Genus : *Clypeodytes* Regimbart, 1894

1894. *Clypeodytes* Regimbart, *Ann. Sec. ent. Fr.*, 63 : 230.

1977. *Clypeodytes* Vazirani, *Cat. Orient. Dytiscidae* : 37

Only one species, *C. bufo* (Sharp) 1890 found in Midnapore District.

Characters : Elytra feably elevated in the position of the sublateral carina. Length 2.00 mm.

12 *Clypeodytes bufo* (Sharp), 1890.

1890. *Bidessus bufo* Sharp. *Trans. ent. Soc. Lond.* : 344

1971. *Clypeodytes bufo*, Vazirani, *Orient. Ins.*, 4 : 444

Material Examined : 2 exs from Pirakata. 17.6.95 P.R. Pahari.

Distribution : India : West Bengal (Calcutta), Bihar, Orissa, Maharastra and Goa.

Remark : Reported here for the first time from Midnapore District. Restricted to India in distribution.

4. Subfamily : DYTISCINAE

Only one genus *Cybister* of the sub family DYTISCINAE known from Midnapore.

8 Genus : *Cybister* Curtis, 1827

1827. *Cybister* Curtis, *Brit. Ent.*, 4 : 151

1977. *Cybister*, Vazirani, *Cat. Orient. Dytiscidae* : 85.

Characters : Hind margins of the four basal metatarsal segments not fringed with any ciliae.

Only one species known from Midnapore *Cybister (Melanectes) Convexus* Sharp, 1882

Characters : Female with a rudimentary second claw on hind tarsi, pronotum with lateral reddish margin, tibial spurs of the hind leg reaching the two basal tarsal segments combined.

13 *Cybister (Melanectes) convexus* Sharp, 1882

1882. *Cybister convexus* Sharp, *Sci. Trans. R. Dublin. Soc.*, 2 : 718.

1977. *Cybister (Melanectes) Convexus*, Vazirani, *Cat. Orient. Dytiscidae* : 87

Material studied : 1 ex. from Pirrakata, 17.6.95. P.R. Pahari.

Distribution : India : West Bengal (Darjeeling, Midnapore), Assam, Manipur.

Elsewhere : China.

Remark : Recorded here for the first time from Midnapore District.

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