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# F O R E W O R D

The Specialized Bibliography is one of the important and widely known information services. This facilitates awareness and accessibility to references in the particular field of interest. In view of the significant contribution of such bibliographic tools and their usefulness to the researchers and other users the National Agricultural Library and Documentation Centre (NALDOC) of Bangladesh Agricultural Research Council (BARC) initiated publishing a series of Specialized Bibliographies.

The present volume of this specialized bibliography services is devoted to the literature on Khesari (Lathyrus sativus); a widely grown pulse crop in Bangladesh, produced both for human consumption and animal fodder. This crop is grown in about 100,000 hectare of land and contributed to about one third of total pulse (70,259 tons) production in Bangladesh.

Subject coverage of this bibliography includes; economics, production, breeding, diseases, soil biology and food, nutrition and toxicology.

The volume contains 99 citations and abstracts from serials, monographs, conference papers, research reports, pamphlets etc. produced in Bangladesh. Entries are arranged alphabetically by authors under each subject and are numbered consecutively. Author and subject indexes are also appended.

I hope the researchers and other users will be benefited by this specialized bibliography. I also hope this will generate greater interest and awareness in this field and will facilitate user's access to the existing knowledge. All items listed in this bibliography are available in the NALDOC.

We appreciate the role of the International Development Research Centre (IDRC), Ottawa, Canada in providing financial assistance and advisory services in the production of this specialized bibliography.

Ekramul Ahsan
Chairman
BARC

## CONTENTS

ECONOMICS

001 Tareque, Md. Basic economics of declining pulse (includes Lathyrus sativus) production: a micro level study. COTA Bulletin. 1981, 4(2). p. 62-71.

This report is the outcome of a field survey carried out in Hosenabad of Kushtia. The objective of this study was to find out basic economic factors responsible for declining pulse production over time in Bangladesh, both in terms of acreage and productivity. Another corollary objective was to suggest feasible measures by which production could be augmented, as emphasized in the draft Second Five Year Plan to increase pulse production of Bangladesh from 2.36 lakh tons to 4.72 lakh tons. On the basis of information collected from 23 randomly selected pulse producers of Hosenabad, it is evident that Aus is the main crop, occupying 49% of total cultivated land followed by pulses, which are cultivated in about 35% of the area. Then comes Broadcast Aman, followed by wheat, sugarcane, tobacco and jute occupying about 30%, 21%, 15%, 11% and 10% of cultivated land respectively. Of the total area devoted to pulses in the year 1979-80, 25% of the land was devoted to Masur, 43% to Chhola and only 7.8% to Khesari (Lathyrus). Pulse, therefore, is still occupying an important position in terms of acreage under cultivation and continues to be more important than wheat and tobacco. This may be because in Hosenabad invariably Chhola and wheat are mix cropped. Although tobacco is profitable, the researcher has seen apathy among old farmers towards tobacco due to its harmful effects on soil. Masur (Lentil), Chhola (Chickpea) and Khesari are the main varieties of pulses in Hosenabad. From 1965 to 1980, acreage under pulses of all varieties has progressively decreased, rather dramatically for Khesari and Masur. In case of Masur, the acreage has fallen from 119 bighas in 1965 to 100 bighas in 1970, then to 89 bighas and finally to 53 bighas. Khesari acreage has fallen from 109 bighas to 16 bighas, in the same time span. And for Chhola the corresponding figures are 126, 109, 103 and 88 acres. Acreage trend between 1970 and 1980 in percentage terms shows that the rate of decline of acreage under Khesari is 83.67% and for Masur it is 47%. In Hosenabad, acreage under different varieties of pulses has sharply fallen and is probably still falling, due to three reasons, (i) introduction of profitable tobacco cultivation in 1967 and introduction of HYV wheat in 1976-77. Net returns from both tobacco and wheat are greater than that of pulses, (ii) the outbreak of "Lathyrism", which was allegedly caused through consumption of Khesari. It occured between 1971 and 1974 and (iii) gradual decline of productivity of pulses which in turn accounts for declining net returns from pulses cultivation.

PLANT PRODUCTION

002 Ahmed, Noazesh. Lathyrus; guide book of pulses in Bangladesh. Dhaka, FAO/UNDP, 1985. 183 p.

It includes economic importance; relevant botanical features, important varieties; climate and soil; crop production technology; land preparation, time of planting, method and depth of planting; cropping system; fertilizer application response to irrigation; harvesting and storage; yield; detoxification of lathyrus pulses, nitrogen fixation, pest & diseases limitation and need for improvement.

003 Bangladesh Agricultural Research Council. Proceedings of the First National Workshop on Oilseeds and Pulses, Dhaka, 11-13 October,1976. Dhaka, BARC, 1976. 318 p.

This report includes 36 papers, discussions and recommendations of first national workshop on oilseeds and pulses.

004 Bangladesh Agricultural Research Institute. Legume Post harvest Technology; Annual Report 1982-83. Joydebpur, BARI, 1983. 44 p.

This annual report incorporates the results of the activities of the year 1982-83. Studies initiated before June, 1983 but completed after this period have not been included in this report. Studies centred around (a) analysis of pulses seed samples for insects, pathogens and viability, (b) socio-economic survey of farmers growing pulses in some selected areas and (c) evaluation of driers and improvement of some traditional storage containers. As in the year 1981-82, five divisions such as Entomology, Plant Pathology, Agronomy (Plant Physiology), Agric.Economics and Agric. Engineering participated in implementing these experiments.

005 Bangladesh Agricultural Research Institute. Legume Post harvest Technology; Annual Report 1983-84. Joydebpur, BARI, 1984. 36 p.

Survey of different pulses stored at farmer's level for the incidence of insect pests and fungi and seed viability continued in 1983-84. The study was conducted in 4 selected districts with new set of containers traditionally used by the local farmers. The new studies included for the year under report were identification of sources of Bruchid infestation, evaluation of the mechanical drier and marketing costs and margins of different pulses.

006 Bangladesh Agricultural Research Institute. Proceedings of the National Workshop on Pulses, August 1981, Sponsored by Bangladesh Agricultural Research Institute and International Development Research Centre and edited by A.K. Kaul. Joydebpur, BARI, 1982. 311 p.

This report includes 36 papers, discussion and recommendations of BARI and IDRC sponsored workshop on pulses.

007 Begum, K.; Islam, M.Q.; Wahhab, M.A.; Shaha, S.K. Status of Research on Khesari (Lathyrus sativus L.) at Bangladesh Agricultural Research Institute (BARI) under Bangladesh Agricultural Research Council (BARC) Programme. Proceedings of the National Workshop on Pulses, Joydebpur, 18-19 August 1981. Joydebpur, Bangladesh Agricultural Research Institute, 1982. p. 71-82.

Khesari is the most widely grown pulse crop in Bangladesh; produced both for human consumption and animal fodder. According to available statistics, Khesari is the most important pulse crop in Bangladesh, both in terms of total area under cultivation and total production. It occupies about 2,44,000 acres of land and contributes about one third of the total pulse (70,259 tons) production. Depending on variety, the grain contains varying amounts of toxic factor (ODAP), causing a condition known as Lathyrism. It is the most hardy pulse and will germinate and grow in land too dry for other crops. It will also withstand water logging. Following are the merits of Khesari crop: most suitable for dryland cultivation; requires least inputs to give reasonable yield; adds nitrogen to the soil; has least pest and disease problem; is least labour intensive; excellent source of fodder; contains over 25% protein in the grain. For evaluation of germplasm of Khesari (work done in 1979-80) 127 germplasm lines, collected from different districts of Bangladesh were put into a nonreplicated performance trial at Joydebpur and sixty three strains at Jamalpur. Considerable variability for yield has been recorded. Also,it seems that the no. of pods/plant is contributing more than the number of seeds/pod and 100 seed weight. There does not seem to be much variation for day's to maturity. From the correlation data it is evident that while 100 seed weight is positively correlated with yield; seeds/pod is negatively correlated. Pods/plant and days to maturity are negatively correlated. Pods/plant and number of branches/plant are highly positively correlated. Plant height is highly correlated with pods/plant at Joydebpur while at Jamalpur there is insignificant correlation between these two characters. At Joydebpur, highest yield was obtained for strains no. 3968 follow-

ed by 3970 and 6130, all local strains. None of the three Indian varieties showed much promise. It is of interest to note that the highest yielding strain no. 3968, was also earliest in maturity, being more than 10 days earlier than the rest. Also it is noteworthy that the 3 Indian strains were having higher green matter and were bolder seeded than the local. At Jamalpur, the highest yield was obtained for the strain "Jamalpur" followed by the strain Charbadna and "Pahartali". However, it appears that higher yield was obtained due to higher plant population caused by lower seed weight. Once again this strain was earliest in maturity. Based on the data obtained, 8 varieties were selected for multilocation trails: 3968, Jamalpur, Pahartali, Charbadna, 6118, 6139, 3970 and Barisal. For evaluation of germplasm (work done in 1980-81) an experiment was conducted with 108 materials at Joydebpur and 89 materials at Jamalpur in replicated trails. At Joydebpur, on 23rd March '81 crop was partly destroyed by hail-storm and data was collected on 54 materials. There was severe attack of aphids; insecticide was applied twice at both stations. From 108 materials of Joydebpur and Jamalpur, strains 3607, 3710, 3713, 3716, 3719/1 and 3950 were found early by 5 days at Joydebpur and by 10 days at Jamalpur. 10 plants yield of the above early materials varied from 10 to 6 gm. at Joydebpur and 16 to 19 gm. at Jamalpur. At Joydebpur strains 3653/4 (22.5 gm) gave highest yield followed by 3648/1, 3645, 3653/6, 2923, 3868/16, 3668/25 and 3668/27 in that order. At Jamalpur, highest yield was obtained from the strain 3653/6 (38.3 gm) followed by 3668/12, Jamalpur/13, 2936, Jamalpur/12, 3942, 3941. The result shows that there was considerably less variability for all characters except for yield and pods/plant. Regional yield trail (Large) of Khesari involving 8 strains selected from previous year, were conducted at Joydebpur, Jamalpur, Pabna, Feni, Bogra and Dinajpur. Though sowing was delayed, the performance was not much affected. Infestation of aphids occured and the experiment received insecticide application. Ten plants were randomly selected from each plot (10 x 6m plot) for data collection. At Joydebpur, highest yield was obtained for strains 'Pahartali' followed by "Barisal" 3968 and "Jamalpur". The result showed low variability for seeds/pod and 1000 seed weight while medium for pods/plant. Branches/plant and days to maturity showed medium variability at Jamalpur but low variability at Joydebpur while plant height and 10 plants yield had medium variability. These indicated that there was greater scope of selection for most of the characters except seeds/pod and 1000 seed weight.

008 Gowda, C.L.T.; Kaul, A.K. Pulses in Bangladesh. Dhaka, Bangladesh Agricultural Research Institute, 1982, 472 p.

This technical manual contains 13 chapters of which 2 deals with Lathyrus. Under Lathyrus the following headings are illustrated: introduction, origin and distribution, botany, climate and soil, agronomy, physiology, pests, diseases, harvest and post-harvest practices, uses, lathyrism, breeding and references.

009 Karim, M. Mahbubul. Cultivation of pulse crops. Proceedings of the First National Workshop on Oilseeds and Pulses, Dhaka, 11-13 October, 1976. Dhaka, Bangladesh Agricultural Research Council, 1976. p. 117-134.

Pulses are the plant species belonging to the family Leguminosae which are cultivated for food and feed. Their seeds are rich in protein content, ranging from 17 to 28 per cent and are used by the people in their daily diet in the form of 'dal' (vegetable soup) or vegetable. The total area, production and yield of pulse crops of the world in 1974 were 69,287 thousand hectares, 44, 134 thousand metric tons and 666 kg per hectare respectively. India tops the list both in area (22,016 thousand hectare) and in production (9,286 metric tonnes). Next to India other leading pulse growing countries were China, USSR, Nigeria and Brazil whereas the leading producing countries were USSR, China, Brazil, Mexico, and USA.But the average yield was the maximum in Ireland about 3, 750 kg per hectare. The yields in U.K., The Netherlands and East Germany were also much higher above 3000 kg per hectare as against that of 701 kg in Bangladesh. In Bangladesh the total area pulse crops is about 307 thousand hectares that produced about 230 thousand metric tonnes of different kinds if pulses. Khesari grows in cool and dry climate on clay soil, usually as mixed crop with deep water aman or transplant aman rice with a seed rate of 10 to 12 seers per acre but in pure crop 15 to 18 seers per acre. The large seeded varieties in USA however, require 30 to 40 seers. Seeds are sown broadcast after 2 to 3 ploughing as pure crop in October-November. No intercultural operation is done except nipping the shoot in certain areas. Higher seed yield resulted with higher dose of 62.2 kg $P_2O_5$ per hectare.

010 Kaul, A.K.; Islam, Md. Quamrul. Khesari (Lathyrus sativus) cultivation in Bangladesh and lathyrism. Proceedings of the National Workshop on pulses, Joydebpur, 18-19 August, 1981. Joydebpur, Bangladesh Agricultural Research Institute, 1982. p. 208-217.

A paralytic disease associated with the consumption of seeds of Khesari plant has been recorded in India in the Vedic times (Bhavaprakasa), Hippocrates described similar symptoms in the bean consuming population of Greece. Since then the disease has been reported from Europe, Asia, Africa and the Mediterranean region. From Europe it has been reported in cattle and horses. The disease is characterized by specific paralysis of legs as a result of neurological legions of spinal cord, in populations that may have consumed 'Khesari' as a staple food continuously for some months. The following four species of Lathyrus (Grasspea, Chickling pea) have been associated with the disease: L. sativus; L. cicera; L. clymenus and L. odoratus. L. Sativus has habitually been used as human food in some provinces of India, in Bangladesh and Algeria, and to a small extent, upto 19th century in France, Spain and Italy, The term Lathyrism was coined by Cantani in 1973. The first ever survey on this disease was conducted in India, in 1833, to be followed by an in-depth survey only as recently as 1958. Based on the sympotomology and causal amino-acid molecules, Selye (1957) has differentiated between two types of Lathyrism. Though relatively more information is available on the odoratism (because disease can be easily induced in experimental animals). It is only recently that the role of N-oxalyl-L-x, diamino propionic acid as a causal molecule has been established in Khesari. Other explanations put forward in the past were : excess of phytates; presence of some alkaloids; deficiency of vitamins A,B,C; virus infection; under and malnutrition; high selenium content in diet; low tryptophan and methionine content; manganese deficiency; contamination with aflotoxins; phenols in the husk etc. Based on the latest information the following generalization could be made about lathyrism: Lathyrism disease may occur in the younger (usually male) members of very poor communities who may be consuming unprocessed or nonboiled Khesari as a source of one third to one half of their protein - calorie needs, continuously for 3-6 months. Incidence generally follows famine conditions in semi-arid or arid areas where, under severe drought conditions, Lathyrus may be the only surviving grain crop. In Bangladesh, a detailed survey was made in the Rajshahi and Kushtia districts, after the 1974 famine, jointly by Shaw Unnayan Sangstha and the Department of Sociology of the Rajshahi University. The following

observations were made: there are 10796 patients suffering from lathyrism in Rajshahi and Kushtia. 44% of affected people are landless and 7% homeless as well. The average annual income of these people is between 100-300 Taka. Besides, lathyrism, the affected population suffers from protein and vitamin deficiency as well. The incidence of disease was highest in 1973-74. 404 affected families, closely studied, were all below poverty line. Incidence was more in villages around two sides of Padma. Mostly young people, males in particular, were affected. Highest incidence of disease was recorded in Daulatpur, Kushtia (1951 patients) followed by Shibganj, Rajshahi (1024) and Charghat thana (844) of the same district. As already mentioned lathyrism is a disease associated with poverty of people living on poor agricultural land, solution lies in (a) improving the irrigational facilities of arid land where Lathyrus is is cultivated and gradually replace this crop with something more productive and harmless for health, (b) increasing the purchasing power and general well being of the population so that they can afford more balanced food and be less dependent on Khesari, Simple legislation to ban the cultivation of Khesari is not practical since besides our inability at this stage to provide alternative crops one must be aware of various merits of Khesari, namely high fodder potential, suitability of its cultivation in low lying areas, relative freedom from diseases and pests absolutely low cost of production and its contribution to soil in various ways. Most urgent thing to do is to popularise various low cost alternatives of detoxifying khesari. These are: boiling draining away of the 1st wash, overnight soaking and draining away of excess water, steeping in hot water after dehusking, soaking and steaming for 30 minutes followed by sun drying, roasting at 150°C for 20 minutes, parboiling, exactly as rice.

011 Kaul, A.K.; Wahhab, M.A. Problems and prospects of the production and productivity of pulses (includes Khesari) in Bangladesh. Proceedings of the First North-West Regional Workshop on Research and Extension Approaches to Agricultural Production, 25-27 May,1982. Ishurdi, BARI, Extension and Research Project, 1982, p. 77-86.

Discusses areas and production of Khesari in Bangladesh. Describes nutritional consideration, human, soil, economic, introduction, selection and breeding of the crop, present status of research and strategy, protein content and quality.

012 Kumar, Jagdish. Pulse improvement at the Bangladesh Agricultural Research Institute; Present status and projections for future work. Dhaka, Bangladesh Agricultural Research Council, International Agricultural Development Service, 1985. 32 p.

The main achievements of the pulses improvement programme were: the collection both locally and internationally, of about 4000 germplasm accessions of six pulse crops (Khesari, Lentil, Chickpea, Mashkalai, Mungbean and Pigeonpea) and the evaluation of some of these, release of one variety of mung bean (Mubarik) and identification of one of maskhalai (Baromashi), establishment of pulses quality and breeding laboratories and some facilities for research at Joydebpur, identification of eight low neurotoxin strains of Khesari and determination of training needs. At the end of 1984-85 season four new varieties of pulses (BARI mung 1-3 and BARI sola-1 (chickpea) were submitted to the National Seed Board of Bangladesh. Enough breeders' seed of each of the strains was multiplied for the BADC to take up the foundation seed programme in the next season if these were released. There were nearly perfect plant stands in pulses experiments conducted in 1984-85 at the RARS Ishurdi. The highest yields obtained with minimum inputs were; 2500 kg/ha for Khesari, 2250 kg/ha for lentils and 3500 kg/ha for chickpeas. Some promising results include; identification of promising strains of chickpea (10), Khesari (9), Lentil (9), Mash (4) and Mung (4) for their final evaluation in 1985-86 before the best ones are promoted to the farmers' field tests.

013 Mannan, M.A. A study on the effect of irrigation and fertilizer on the yield of Khesari (Lathyrus sativus L.) and Chhola (Cicer arietinum L). Mymensingh, Bangladesh Agricultural University, Deptt. of Agronomy, 31 p.

014 Massem, S.B. Study on the effect of weeding and date of planting on the yield of khesari (Lathyrus sativus L.). Mymensingh, Bangladesh Agricultural University, Deptt. of Agronomy, 21 p.

015 Shires, P.; Godshalk, B. Pulse research in Noakhali. Proceedings of the National Workshop on Pulses, Joydebpur, 18-19 August, 1981. Joydebpur. Bangladesh Agricultural Research Institute, 1982. p. 117-126.

Pulses are an important crop in meeting nutritional needs in Bangladesh. Cropping systems observations in Noakhali have shown pulses to be a good low input crop, giving favourable benefit/cost ratios, especially for mungbean and Khesari in the Char and lentil at Gunabuti.

Station research has shown that improved varieties yield significantly higher than the local for most pulse crops. Because the climate of Noakhali is wetter than the rest of the country, summer pulse cultivation is feasible on a limited scale, utilizing well drained high-land. New varieties grown in the winter season on normally fallow land will help increase pulse production in Noakhali.

PLANT DISEASES

016 Bangladesh Agricultural University. Department of Plant Pathology. Effect of different organic soil amendments on foot and root rot disease development in Khesari. Three Years Progress Report (1980-81 to 1982-83): Bangladesh Co-ordinated Mashkalai and Khesari Research Project, USAID Phase I: Disease Section. 1984. p. 24-26.

For this study two experiments at two different dates were conducted in the Bangladesh Agricultural University (BAU) farm. The 1st experiment was set on 21st November, 1980 when soil moisture was quite high; while the 2nd experiment was set on 6th January, 1981, when the soil was relatively dry. From the study it appears that three organic soil amendments used in two studies had no influence on foot and root rot disease development in khesari. However, there was significant difference in foot and root rot disease development between October sowing and January sowing. This was probably due to moisture content of the soil or sowing time. Organic soil amendments have no effect on foot and root rot disease development in khesari.

017 Bangladesh Agricultural University. Department of Plant Pathology. Reaction of different strains/lines of khesari and mashkalai to various diseases under observational trials at the Regional Agricultural Research Station, Jamalpur and Bangladesh Agricultural University Farm, Mymensingh. Three Years Progress Report (1980-81 to 1982-83); Bangladesh Coordinated Mashkalai and Khesari Project, USAID Phase I, Disease Section. 1984. p. 73-79.

Off all 69 strains/lines of Khesari tested, 64 were common for the two stations. Among the diseases recorded on the test strains/lines at the two stations, three disease namely, foot & root rot, leaf spot and blight were common. The observational trial with 69 stains/lines of Khesari tried at RARS, Jamalpur in 1982-83 was also conducted in 1981-82 at the same station. Among

the 69 strains/lines tested at RARS, Jamalpur in 1981-82 and 1982-83, 60 strains/lines were common. The reaction of the test strains/lines to different diseases under natural field conditions varied greatly with respect to location and year of testing. At the two stations among all the strains/lines tested in 1982-83, only four lines (3940, 3944, 3951 and 3977) and a single line (3977) were found to be resistant to leaf spot and foot rot respectively. Of all the strains/lines tested for two consecutive years (1981-82 and 1982-83), each of the four lines (3944, 3951, 3967 and 3984) were found to be resistant to foot and root rot and seedling blight. Powdery mildew was recorded in trace on some strains/lines of Khesari at RARS, Jamalpur; while no strains/lines were found affected by downy mildew at Bangladesh Agricultural University (BAU) farm. This difference might be due to a number of reasons including effect of location.

018 Bangladesh Agricultural University, Department of Plant Pathology. Reaction of five advanced mutant lines of Khesari to three major diseases under natural field conditions at Ishurdi and Jamalpur. Annual Progress Report 1983-84: Bangladesh Coordinated Mashkalai and Khesari Research Project BARC/USAID, Phase II, First Year : Disease Section. 1985, p. 17.

Among of the five lines, three lines L-11, L-10 and L-6 were found as resistant to leptosphaerulina blight and two were intermediate to the disease at Ishurdi, At Jamalpur all the test lines were grouped as intermediate to leptosphacrulina blight and downy mildew. All the five lines also showed intermediate reaction to downy mildew at Ishurdi. In case of foot and root rot, L-10 and L-11, and L-11 and 14 were found as resistant at Ishurdi and Jamalpur, respectively. The rest three lines at each stations were classified as intermediate to the disease.

019 Bangladesh Agricultural University. Department of Plant Pathology. Reaction of eight advanced lines of Khesari to three major under natural field conditions at Ishurdi, Jamalpur and Jessore. Annual Progress Report 1983-84 : Bangladesh Coordinated Mashkalai and Khesari Research Project BARC/USAID. Phase II, First Year : Disease Section. 1985, p. 12.

All the eight advanced lines, except 6118 and Barisal were found to be intermediate to leptosphaerulina blight at all the three stations. These two lines showed resistant reaction to the disease only at Ishurdi. All the test lines showed intermediate reaction to downy mildew at Ishurdi and Jessore. At Jamalpur six lines

were found to susceptable and two lines intermediate to the disease. In case of foot and root rot, all the lines were graded as resistant at Jamalpur, seven lines as resistant and one as intermediate at Ishurdi and five lines as resistant and three as intermediate at Jessore.

020 Bangladesh Agricultural University. Department of Plant Pathology. Reaction of eight low-neurotoxin lines of Khesari to three major disease under natural field conditions at Ishurdi. Annual Progress Report 1983-84: Bangladesh Coordinated Mashkalai and Khesari Research Project BARC/USAID : Phase II, First Year : Disease Section. 1985. p. 13.

All the low-neurotoxin lines were found as susceptible to leptospha. erulina blight and downy mildew. As regard to foot and rot, four lines were grouped as resistant and four as intermediate.

021 Bangladesh Agricultural University. Department of Plant Pathology. Reaction of 20 promising lines of Khesari to the major diseases under natural field conditions at Ishurdi. Annual Progress Report 1983-84 : Bangladesh Coordinated Mashkalai and Khesari Research Project BARC/ USAID Phase II, First Year : Disease Section. 1985, p.14.

Out of 20 lines tested against leptospha. erulina blight, five were found as resistant, 11 as intermediate and four as susceptible. In case of downy mildew, 48 lines were graded as intermediate and one as susceptible and one as resistant. All the test lines were found to be resistant against foot and root rot disease.

022 Bangladesh Agricultural University. Department of Plant Pathology. Reaction of 24 germplasm lines of Khesari to two major diseases under natural field conditions at Jamalpur. Annual Progress Report 1983-84: Bangladesh Coordinated Mashkalai and Khesari Research Project BARC/ USAID. Phase II, First Year: Disease Section. 1985, p.18.

Among 24 lines, 19 were classified as intermediate and five as susceptible to leptosphaerulina blight. In case of downy mildew, four lines were found as intermediate and 20 as susceptible.

023 Bangladesh Agricultural University. Department of Plant Pathology. Reaction of 100 germplasm lines of Khesari to three major diseases under natural field conditions at Ishurdi. Annual Progress Report 1983-84: Bangladesh Co-ordinated Mashkalai and Khesari Research Project BARC/ USAID. Phase II, First Year: Disease Section, 1985 p. 15.

Among 100 germplasm lines, 28 were classified as resistant, six as intermediate and 66 as susceptible to leptosphaerulina blight. All the lines were found as resistant to foot and root rot except four lines which were grouped as intermediate. As regard to downy mildew, 57 and 43 lines showed intermediate and susceptible reaction respectively.

024 Bangladesh Agricultural University. Department of Plant Pathology. Reaction of oilfree strains/lines of Khesari and Mashkalai to foot and root rot disease under artificial epiphytotic condition. Three Years Progress Report (1980-81 to 1982-83): Bangladesh Coordinated Mashkalai a and Khesari Project, USAID Phase I, Disease Section. 1984. p. 81.

A total of 30 isolates of Fusarium oxysporum were isolated from the foot and root rot infected mashkalai and khesari plants. The isolates were purified and its growth and morphological characters have been studied in details. Based on the growth and morphological characters, two distinct strains of F. oxysporum have been identified. Reaction of promising cultivars/lines of the two crops will be tested against these two strains of the pathogen under artificial epiphytotic condition in 1983-84.

025 Bangladesh Agricultural University. Department of Plant Pathology. Study on the prevalence of seed-borne fungi in mashkalai and khesari. Three Years Progress Report 1980-81 to 1982-83). Bangladesh Co-ordinated Mashkalai and Khesari Research Project. USAID Phase I: Disease Section. 1984. p. 13-19.

Analysing 16 seed samples of khesari, only two genera of fungi Aspergillus and Fusarium were detected in majority of the samples. Among the species of Aspergillus-A. Flavus, A. Niger and A. ochraceous were predominant. Fusarium spp. were more prevalent on improved cultivars/ lines compared to local ones. In an average 7.0% seed-borne infection of Fusarium sp. were recorded on improved cultivars/lines; while only 3.0% of the fungus could be detected on the local cultivar. It may be concluded that the fungus Macrophomina phaseolina was highly pathogenic and prevalent in mashkalai seeds particularly with the improved cultivars/lines. Among the improved

cultivars/lines, Baromashi (Urd) variety was found more susceptible not only to this pathogen but also to colletotrichum graminicola. M. phaseolina was responsible for germination failure as well as for seedling infection in the wet blotter. Fusarium sp. was the next important pathogen which also decreased the germination of seeds. In seed health analysis of khesari, Fusarium spp. were found most prevalent which caused germination failure and seedling infection on wet blotter to a considerable extent.

026 Bangladesh Agricultural University. Department of Plant Pathology. Study on the reaction of different cultivars/strains of mashkalai and khesari to foot and root rot disease under natural field conditions. Three Years Progress Report (1980-81 to 1982-83); Bangladesh Coordinated Mashkalai and Khesari Research Project, USAID Phase I: Disease Section. 1984. p. 27-29.

Twelve cultivars/strains of mashkalai and six cultivars/strains of khesari collected from BARI, Joydebpur, Dhaka were used for the study. The cultivars/strains of mashkalai were M-2009, Narules/3,Charbangabari/3. Meherchandi/2, JCM-20, Baromashi, M-2007, M-2006, M-2039, Charbangabari/2, and JCM-8. The cultivars/strains of Khesari were K-6130 Jamalpur, Pahartali, K-6118, Charbadna and Barisal. Of the six cultivars/strains of khesari, the highest incidence of foot and root rot was on Pahartali (14.2%) followed by Barisal (12.5%), K-6118 (11.4%) and Jamalpur (11.1%). The minimum incidence of the disease was recorded on K-6130 (4.6%). Based on the present investigations, no definite conclusion can be drawn regarding the exact reaction of the different cultivars/strains of mashkalai and khesari. Therefore, further trails are suggested.

027 Bangladesh Agricultural University. Department of Plant Pathology. Survey on various diseases on khesari and mashkalai in some selected thanas of Mymensingh and Jamalpur district. Three Years Progress Report (1980-81 to 1982-83); Bangladesh Coordinated Mashkalai and Khesari Research Project, USAID Phase I: Disease Section. 1984. p. 33-41.

Nine different diseases were recorded on Khesari during the survey conducted at the different thanas of Mymensingh and Jamalpur districts in 1981-82 and they were: Blight, Downey mildew, Foot and root rot, Leaf spot, Leaf curl, Powdery mildew, Rust, Seedling blight and Yellowing. Among the recorded diseases, eight were major and one of minor importance. The prevalence of these diseases varied greatly with respect to the

location and stage of the growth of the crop. Seedling blight was recorded for the first time on the crop in the country. The cause of this new disease is yet to be identified. Of all the diseases, blight caused by mycosphaerella pinodes appears to be a newly identified disease of the crop.

028 Bangladesh Agricultural University. Department of Plant Pathology. Survey of various diseases on khesari and mashkalai in some selected thanas of Mymensingh, Jamalpur and Rajshahi districts. Three Years Progress Report (1980-81 to 1982-83): Bangladesh Coordinated Mashkalai and Khesari Research Project, USAID Phase I. Disease Section. 1984. p. 60-73.

The survey of different diseases on khesari and mashkalai was carried out in the selected thanas of Mymensingh, Jamalpur and Rajshahi districts. On khesari, ten different diseases were recorded namely, Blight Leptosphaerulina trifolii and Mycosphaerella pinodes), Downy mildew (Peronospora viciae), Foot and root rot (Fusarium oxysporum), Leaf spot (Cercospora cruenta), Powdery miloew (Oidium sp.), Rust (Uromyces viciae-fabae), Seedling blight (Unidentified), Wilt (Fusarium oxysporum), Leaf curl(virus) and Yellowing (Unidentified). Wilt of khesari appears to be a new record for the country. The prevalence of diseases varied with respect to geographic location, year of growing, pulse species and stage of growth of the crop. It may be mentioned that survey of diseases of mashkalai and khesari in Mymensingh and Jamalpur districts began from 1980-81. Rajshahi district has been included in the survey program this year only.

029 Bangladesh Agricultural University, Department of Plant Pathology. Survey of various diseases on mashkalai and Khesari in some selected thanas of Mymensingh and Jamalpur districts. Three Years Progress Report (1980-81 to 1982-83): Bangladesh Coordinated Mashkalai and Khesari Research Project,USAID Phase I, Disease Section. 1984. p. 3-13.

Eight diseases on khesari were recorded during the survey conducted in the selected thanas of Mymensingh and Jamalpur districts during 1980-81. The disease recorded on khesari were blight, downy mildew, foot and root rot, leaf spot, leaf curl, powdery mildew, rust and yellowing. The prevalence of different diseases recorded varied greatly with respect to pulse species, location, and stages of growth of the crop. Leaf blight (Leptosphaerulina trifolii) and wilt (Fusarium oxysporum) of mashkalai and Blight (L. trifolii) of khesari were recorded as new diseases of the crops from Bangladesh.

030 Fakir, Golam Ali. Dal foseler rogue o tar pratikar (Tr; pulse crops disease and their remedies). Integrated Black Gram and Grasspea Research Project, BARC. Mymensingh, Bangladesh Agricultural University, Department of Plant Pathology, 1983. p. 20.

It includes thirteen diseases and causes of diseases of grasspea. Diseases are: Foot and root rot, Rust, Cercospora leaf spot, Ascochyta blight, Leptosphaerulina blight, Downy mildew, Powdery mildew, Wilt, Leaf curl, Yellowing, Seedling blight, Root Knot, Nemic disease. Protection measures have also been described.

031 Fakir, Golam Ali. Estimate of crop losses due to seed-borne disease in Bangladesh (includes khesari). Mymensingh. Bangladesh Agricultural University, 1980. p. 16.

The estimated annual loss of stored seeds of khesari for sowing due to storage disease (based on 1977-78) is as follows: total areas covered 244 thousand acres per acre seed rate 12 seers; total seeds used for sowing 2660.00 tons; total loss of seed used for sowing Tk. 4,4000. Total seeds used for consumption 67.34 thousand tons, total loss of seeds used for consumption 673.40 tons, total loss seeds used for consumption 22.22 lakh taka.

032 Fakir, Golam Ali. Status of research on pulse (includes Lathyrus sativus) diseases at the Bangladesh Agricultural University. Mymensingh. Co-ordinated Scheme for the Improvement of Mashkalai and Khesari (BARC). Mymensingh, BAU, Department of Plant Pathology, 1983. p. 20.

In this study major works carried out on the diseases of four selected pulses, viz, Chhola (cicer arietinum), Khesari (Lathyrus sativus), Masur (lens culnaris) and Mashkalai (Vigna Munge). A total of 32 diseases were recorded on the four selected pulse crops during the survey. Of all the recorded diseases, 21 appears to be new record for Bangladesh. Leaf blight caused by Leptosphaerulina trifolii, recently recorded on Mashkalai. This disease seems to be a new world record. The prevalence of these diseases varied with respect to pulse species, location and growing year. Among the different diseases, foot and root rot of all the four selected pulses and cercospora leaf spot and yellow mosaic of mashkalai were most frequent and damaging. In certain years and in certain localities, blight, wilt and rust of chhola and also rust of lentil, blight, downy mildew and powdery mildew of khesari and powdery mildew of Mashkalai were found to breakout in epidemic form and caused considerable to severe losses to the crops.

033 Fakir, Golam A.; Hossain, M.M. Cowpea, grass pea and wingbean-newly recorded hosts of Leptosphaerulina trifolii (Rost) petr. in Bangladesh. Proceedings of the 8th Bangladesh Science Conference. Dhaka, BAAS,1983. p. 70.

Leptosphaerulina trifolii (Rost) petr. was observed to cause leaf spot/blight on cowpea (Vigna catjung Endl.), grass pea (Lathyrus sativus L.) and wingbean (Psophocarpus tragonolobus (L) Dc.) in certain areas of Jamalpur and Mymensingh districts. The pathogen was recorded on cowpea in 1982 in the experimental plots of the Horticultural Farm., BAU Campus, Mymensingh. On grass pea the pathogen was first recorded in 1981 in Mymensingh and Jamalpur districts. The fungus was found to infect grass pea in eight thanas of Mymensingh and three thanas of Jamalpur during 1981-82. The range of infection by the pathogen varied from 45.1 to 73.8%. The pathogen on wingbean was recorded in the Regional Research Station of BARI at Jamalpur in 1981. Almost all the plants (out of 70) had moderate infection by the pathogen. Blight symptoms on each of the three hosts have been described in detail.

034 Fakir, Golam A.; Hossain, M.M. Reaction of grass pea lines to foot and root rot (Fusarium oxysporum and selerotium rolfsii), 9th Bangladesh Science Conference, Dhaka, BAAS, 1984. p. 104.

Reaction of 58 lines of grass pea was tested against foot and root rot caused by Fusarium oxysporum and selerotium rolfsii under natural growing condition at the Regional Agricultural Research Station, Jamalpur and BAU Farm, Mymensingh in 1981-82 and 1982-83. On the basis of percentage of infected plants the lines were grouped as resistant (less than 5%) intermediate (6-15%) and susceptible (above 15%). Of all the lines tested at two locations for two seasons only one line 3977 appeared as resistant, 53 as intermediate and four as susceptible to foot and root rot.

035 Fakir, Golam Ali; Rahman, Loothfur. "Diseases of Khesari" in Pulse Disease Diagnosis Manual. Mymensingh, Graduate Training Institute, Bangladesh Agricultural University, 1977. p. 6-8.

This includes diagnostic symptoms of 4 diseases occuring on Khesari (Lathyrus sativus) crop with photographic illustrations. The diseases are: foot and root rot, leaf curl, leaf spot and yellowing. The causes of foot and root rot and leaf spot are Fusarium oxysporum and Cercospora sp. respectively and the causes of the remaining two are unidentified.

036 Rahman, M.H.; Ahmed, H.U.; Mondal, M.H. Studies on fungal association on pulse seeds (includes grass pea) at farmers' level storage. Proceedings of the 9th Bangladesh Science Conference. Dhaka, BAAS, 1984, p.149.

An investigation was made to study that fungal infestation with pulses seeds stored in different containers and condition at farmers' level. Seed samples of six pulses viz. lentil, mungbean, blackgram, gram, pea and grass pea were collected at every two months from five selected locations namely Jamalpur, Kishoregonj, Feni, Ishurdi and Jessore, The common containers were earthen pitcher, plastic bag, gunny bag, metalic drum, tin, dole etc. The seeds were incumbated and studied at BARI laboratory following standard method. Twenty three fungal species of 18 genera were identified from six different pulses. It was observed that the prevalence of field fungi like Alternaria tenuis, Cladosporium, Curvularia hunata, Fusarium and Cercospora was higher in the initial samples which gradually decreased with the increase of storage period, while storage fungi like Aspergillus, Pericilloim and Rhizopus was increased during storage. Among the identified fungi Aspergillus spp. was the highest (57.27%) while the incidence of Cphalosporium, Drechslera, Botryodiplodia, Myrothecium, Trichothecium and Botrytis was very low.

PLANT BREEDING

037 Bangladesh Agricultural Research Institute. Annual Report 1979-80. Pulses Improvement Project; Joydebpur, BARI, 1980. p. 197.

This first report on the pulses improvement project of BARI covers, very briefly, the research conducted on six major pulse crops during the year 1979-80. The purpose of this report is to help evaluate the work conducted and to set forth effective inter-disciplinary goals for for the future. Under Lathyrus, evaluation of germplasm has been described.

038 Bangladesh Agricultual University . Department of Soil Science. Interaction trials of promising rhizobia strains with recommended Khesari varieties at Ishurdi Farm. Fourth Annual Report 1983-84: Co-ordinated Scheme for the Improvement of Mashkalai and Khesari-Noduation and Nitrogen Fixation Section. 1984, p. 15-17.

The trial was conducted in split-plot design with three replicates for the screening of rhizobia strains for inoculation out of five strains. Results show the effect of inoculation on Khesari in producing effective nodules/plant, total no. of nodules/plant dry matter yield, N content and N-uptake after 35 days of sowing. The number of effective nodules per plant in Charbanda and 3968 variety were higher due to inoculation with BAU 444 but in local variety mixture of the strains produced higher number of nodules. The highest number of effective nodules per plant (9.2) was recorded in Charbadna variety due to inoculation with BAU 444 and the lowest (2.8) in local variety receiving no inoculation. Charbadna and V-3968 received higher amount of dry matter due to inoculation with BAU 444 than other inoculants and also in uninoculated control plots. All the varieties recorded higher N-uptake due to inoculation with BAU 444 strain. N-uptake value was correlated with the number of effective nodules per plant.

039 Bangladesh Agricultural University, Department of Soil Science. interaction trials of promising rhizobia strains with recommended Khesari varieties at farmer's field (Suhila). Fourth Annual Report 1983-84: Co-ordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section, 1984. p. 17-21.

The study was conducted in Suhila, a village near Fulbaria, Mymensingh. Both local and V-3968 of Khesari, BAU recorded higher number of effective nodules and total number of nodules per plant over other inoculants but in Charbadna variety BAU 444 was the best than others in nodulation. The highest number of effective nodules (9.44 per plant) was recorded by inoculation with BAU 439 in local variety of Khesari and the lowest (3.0 per plant) in local variety receiving no inoculation. The mixture of the strains recorded higher dry matter yield per plant and N-uptake after 35 days of sowing. Results show nodulation, dry matter yield, content and N-uptake by the plants after 65 days of sowing. Only the mixture of the strains recorded higher dry matter yield per plant and N-uptake than others. The mixture of the strains recorded higher grain yield over others including uninoculated control. The highest

grain yield of 1275 kg/ha was obtained by inoculation with the mixture of the strains in variety 3968 and the lowest yield in Charbadna receiving no inoculum. The mixture of the strains recorded higher grain yield with local and Charbadna variety but with the variety 3968, the BAU 439 recorded higher grain yields. In the mixture of the strains recorded higher amounts of N-uptake than others in all the three test varieties. The highest total N-uptake (62.2 kg/ha) was recorded with mixture of strains in variety 3968 while the lowest (33.3 kg/ha) was found in Charbadna and 3968 variety. However the strain BAU 421 recorded lowest N-uptake with an increase of 32% over control.

040 Bangladesh Agricultural University. Department of Soil Science. Interaction trials of promising rhizobia strains with recommended Khesari varieties in pots. Fourth Annual Report 1983-84: Coordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section.1984. p. 21-24.

The experiment was conducted at the net house of Department of Soil Science, BAU. Results indicate the beneficial effect of inoculation of Khesari with different rhizobia strains in nodulation, dry matter yield and N content and N-uptake. The highest number of nodules (12.55 per plant) was recorded with local variety receiving inoculum with BAU 439 and lowest (4.11 per plant) in Charbadna variety receiving no inoculum. The highest amount of N-uptake (1.85 mg/plant) was recorded in inoculation treatment with mixture of strains both in V-3968 and Charbadna. The highest amount of dry matter (103 mg/plant) was recorded in inoculation treatment with mixture of strains in Charbadna variety.

041 Bangladesh Institute of Nuclear Agriculture. Agronomic evaluation of germplasm (of Lathyrus sativus). Annual Report 1982: Bangladesh Institute of Nuclear Agriculture. 1982. p. 57-58.

Twenty four cultivars (16 local and 8 exotic) of Khesari were grown in the field in a randomized block design with three replications. Unit plot size was 4m x 1m and row distance was 50 cm. Ten plants were picked up randomly from each plot for taking data on various agronomic characters such as day to maturity, plant hight, number of pods/plant, number of seeds/pod, 100-seed weight and seed yield/plant. In general a narrow range of variability was observed for days to maturity (116-125 days) and number of seeds/pod(3.1-4.3). Variation for number of pods/plant, 100-seed weight and seed yield/plant was quite pronounced. It

has been observed that the exotic cultivars were bold seeded types. The local cultivars (L-1 to L-16) were small seeded but produced more number of pods/plant which ultimately increased seed yield. Exotic cultivars (GP-47 to GP-54) produced small number of pods and as a consequences the yield was considerably reduced. The variation for 100 seed-weight, number of pods/plant and seed yield/plant ranged from 4.17 to 7.89, 26.8 to 104.5 and 4.16 to 12.48 gm, respectively. INA accession numbers L-6, L-4 and L-1 showed better performance in terms of seed production/plant. But they possess high content of BOAA in their seeds. Variety L-14 possesses comparatively low content of BOAA (0.86%) than L-6 (1.23%)and L-1(1.26%). It is evident the number of pods/plant had the highest co-efficient of variability (35.76%) followed by seed weight (18.86%). It is indicated that selection on the basis of these two characters may result into greater genetic advancement in this crop.

042 Bangladesh Institute of Nuclear Agriculture. Grasspea (Lathyrus sativus L.); selection of 'Macro' and 'Micro' mutants.-Annual Report 1982, Bangladesh Institute of Nuclear Agriculture, 1982. p. 50-57.

Seeds of local collection, INA Sl. No. 'L-1', has been treated with different doses of $NaN_3$ and $M_1$ was grown in 1981-82. Though 'L-1' contains rather high amount of neurotoxin (1.26%), it was selected for mutagenic treatment ($NaN_3$) because of its higher yield and bigger seed size. The $M_2$ generation was grown during the period under report (1982-83) in plant progeny rows and three types of selections were made. There were 180 plant progreny rows. Seeds of 15 individual control plants were also shown in separate lines. The types of selection were: Thirty four individual variants (putative mutants) were selected on the basis of maturity, leaf characteristics, plant types, pigmentation, flower and leaf colour. In six plant-progreny lines all the plants showed uniformity in particular characters like earlines in maturity and pigmenation in pods. These lines have been kept seperately to test their uniformity in $M_3$ generation. The mutant lines showed considerable variation for days to maturity, plant height, number of branches and seed yield/plant. The highest variation was observed in number of pods/plant. Least variation was recorded for number of seeds/pod and pod length. The mutant line, '32(2)' produced the highest number of pods/plant (58.4) gm, and the highest seed yield/plant (8.1 gm).

043 Bangladesh Institute of Nuclear Agriculture. Variation in the content of neuro-toxin, B-(N)-oxalyl-amino alanine alanine (BOAA) and protein in some local and exotic cultivars of grasspea (Lathyrus sativus). Annual Report 1981 ; Bangladesh Institute of Nuclear Agriculture. 1981. p. 46.

Khesari dal contains a very high amount of protein and it is also the most important pulse crop of Bangladesh both in acreage and production. It has been reported that continuous consumption of Khesari dal for 2-3 months leads to an acute and incurable diseases called 'Lathyrism' (paralysis of lower limbs). The disease is known to be caused by the presence of an unusual amino acid B-(N)-oxalyl-amino-L-alanine (BOAA) in the seeds of khesari. Local varieties as well as varieties from India, GDR and other countries were collected to determine the portein content and the amount of BOAA present. The objective was to develop a high yielding and high protein variety of khesari which contains no or little BOAA. It was very interesting to note that the BOAA content in local cultivars was very high compared to the varieties of foreign origin. Acc. No. GP-49, GP-53, and GP-47 were luckily found to be almost free from lathyrism factor. All these varieties were grown in the field to evaluate their adaptive capacity under Bangladesh climatic condition. Most of the foreign varieties were poor in their performance under local field conditions. Necessary breeding procedure will be followed to transfer this low neuro-toxin character into local cultivars.

044 Kaul, A.K.; Islam, M.O.; Hamid, A. Screening of Lathyrus germplasm of Bangladesh for BOAA content and some agronomic characters. Paper presented at the Colloque Lathyrus conference on Lathyrus, France, September 1985. p. 19.

Assuming that lathyrism is caused by the freak amino acid-B-N-oxalyl-L-B diamino propionic acid (BOAA), a screening programme was initiated in 1979 to explore the possibility of isolating toxin-free or low toxin lines from germplasm systematically collected from ten districts of Bangladesh. The screening of germplasm has continued over the past five years. The study reveals that strain 3968, though earliest in maturity has the highest harvest index and relatively high fodder and grain yield when expressed on per day basis. LSD-3 seems to have performed better in terms of total dry matter yield. Showed lack of correlation between BOAA content and 1000 grain weight is of significance. It is of interest to note that strain 3968 is of low

in BOAA content as well as in the grain weight, while strain 3970 is high for both characters strain 'Jamalpur' though having medium seed weight has high BOAA content. BOAA content, when expressed on protein basis, has no correlation with grain weight. The same is expected since neither protein content nor BOAA content are correlated with seed weight. As there is a lack of correlation between BOAA content and protein percentage in the grain, it indicates that BOAA is synthesized and stored independent of protein content. However, contrary to these findings, Misra et al.(1979) have reported a positive and highly significant correlation between these two characters. Further detailed studies are called for. Although most of the cultivars of khesari in Bangladesh have blue coloured flowers, types have been detected that have white as well as pink flowers. An attempt was made to find if flower colour and BOAA content are correlated. Such genetic markers could be helpful in breeding for low toxicity. No such relationship could be established. The means BOAA content of three categories of flower colour do not vary significantly. In Bangladesh, honey bees selectively visit Khesari plants causing considerable intercrossing. Another study was made to determine possible association of seed coat colour with BOAA content. It appears that any generalization on the association between seed coat colour and BOAA content should await further study. This study does not permit to conclude that seed coat colour has any definite association with BOAA content in the grain. The attempt to establish morphological markers for BOAA content has failed so far. Also, the evolutionary significance of BOAA in the plant and its value to the crop to provide resistance against disease or pests could not be established.

045 Shaha,C.S.; Ali, M.S.; Shaikh, M.A.Q.; Razzaque, M.A. Study of variability and correlation co-efficients among yield components in grasspea (Lathyrus sativus L.). Proceedings of the 9th Bangladesh Science Conference. Dhaka, BAAS, 1984. p. 133-134.

Variation among 23 strains of grasspea was highly significant for number of pods/plant showed the highest genotypic (33.31%) and phenotypic (36.19%) coefficients of variation followed by seed yield/plant and number of branches/plant. Days to maturity showed the lowest spectrum of variability. The results indicated that individual plant selection based on number of pods and seed yield/plant would be effective for selection. Highly significant and positive correlation of seed yield with number of pods/plant,

number of seeds/pod number of branches/plant and plant height was observed at both genetypic and phenotypic level whereas days to maturity and 100 seed weight showed significant negative correlation with seed yield/ plant. The negative association between days to maturity and yield indicate that there is a possibility of obtaining short duration high yielding variety through selection and hybridization.

046 Shaikh, M.A.Q. Dose-effect relationship of gamma radiations as determined by chromosomal aberrations and nuclear damage in Lathyrus sativus L. and Vicia ervilia (L) willd. Bangladesh Journal of Botany. 1972, 1(1-2) p. 65-74.

Dry seeds of two plant species, L. sativus and V. ervilia, were irradiated with 5, 10, 15, 20, 25, 30 and 50 Krads doses of gamma rays from a $Co^{60}$ source delivering 5000r per minute to study the effect of radiation doses on the amount of chromosomal aberrations and nuclear damage produced in the somatic cells of their root-tips and thus to establish the response patterns of these two species to radiation and their comparative radio-sensitivity. The mean number and percentage of anaphase with bridges and the mean number and percentage of anaphase with fragments increased in the root-tips of the irradiated samples of both species over their respective controls. The increase was progressive with dose. The species L. sativus showed more chromosomal aberrations than V. ervilia in each of these parameters. The number of cells with micronuclei increased with dose in both the species more or less with similar frequency at lower doses but at higher doses V. ervilia root-tips produced larger number of cells with micronuclei than those of L. sativus. The root-tips of both the species without showing any appreciable difference between them, registered a progressive increase in the number of degenerated cells and a steady decrease in the number of normal interphases and dividing cells with increase in dose. It was concluded from the results that L. sativus is more sensitive to radiation than V. ervilia.

047 Shaikh, M.A.Q. Morphological abnormalities detected in the $M_1$ generation of Vicia ervilia and Lathyrus species following gamma irradiation of dry seeds. The Nucleus, 1970, 7(3). p. 183-189.

Air-dried seeds of V. ervilia and seven species of Lathyrus were irradiated with 5, 10, 15, 20, 25, 30 and 50 Krads of $Co^{60}$ gammarays. The types of abnormalities

observed in the $M_1$ generation were twin seedlings, stubby and severely damaged seedlings, seedlings showing loss of apical dominance, mottled and crinkled leaves, bifurcated leaves, bushy and small leaved plants, deformed and/or unfilled pods, black seed coat and black-and-white chimaeric seed coat colour. None of these variations bred true in the $M_2$ generation.

048. Shaikh, M.A.Q. Radiation induced mutants in Lathyrus sativus and their mode of inheritance. Nuclear Science and Application. 1972, 6 (A). p. 17-22.

Air-dried seeds of Lathyrus sativus strain Barisal were irradiated with different doses of gamma rays. Mutants were isolated in the $M_2$ generation and their pattern of segregation was studied in the $M_3$ generation. The mutant types detected in the $M_2$ generation were narrow-leafed, dwarf, bushy and white flowered. The mode of inheritance differed in the different types of mutants. Possible use of each mutant has been suggested.

049 Shaikh, M.A.Q. Radiation Sensitivity of lathyrus species and vicia ervilia (L) willd. III. Dose-effects on yield components and seed yields per plant. Bangladesh Journal of Agricultural Sciences. 1976, 3(2), p.130-138.

Air-dried seeds of seven species of Lathyrus viz. L. sativus, L. ochrus, L. aphaca, L. clymenum, L. nissolia, L. tingitanus, L. sphaericus and one species of Vicia, V. ervilia, were irradiated with gamma radiation (oCo) doses of 5 to 50 kR. The plants were grown under controlled greenhouse conditions. Plants were selected at random from each treatment including the control for studing the effect of radiation doses on some yield components and seed yields per plant. The species L. sativus and V. ervilia were also studies in the $M_2$ generation. The species differed in their reaction to various doses of radiation. Following irridiation, there was decrease in number of branches per plant in six species but increase in two; decrease in number of pods per plant in two species by increase in six; decrease in number of seeds per pod in all the eight species; decrease in number of seeds per plant in six species but increase in two; decrease in 1000-seed weight in two species but increase in six and decrease in seed yield per plant in five species but increase in three. There was more variability in the irradiated samples, both in the $M_1$ and $M_2$ generation, than the controls and also more variability in the $M_1$ than in the $M_2$ generation. Suitability working dose-range for each species is suggested.

050 Shaikh, M.A.Q. Radiation sensitivity studies of Lathyrus species and Vicia ervilia (L) willd. 1. Dose-effects on germination and survival. Nuclear Science and Application. 1972, 7 (A).

Mature, dry and dormant (6-7% moisture) seed of seven species of Lathyrus and one species of Vicia, from the same season of harvest were irradiated with 5 to 50 Krad doses of gamma-rays ($Co^{60}$). The responses of different species within a genus and two genera of the same family of various doses of gamma-rays were studied in terms of percentage of germination of seeds and survival of plants at the end of the first, second and third week and at maturity. There was a continuous effect of increased radiation doses on the germination of seeds of all species, V. ervilia being the most radio resistant. Among the species of Lathyrus, L. sativus exhibited the highest radio resistant followed by the medium-sensitive group, L. ochrus, L. tignitanus and L. clymenum and the most sentitive group , L. aphaca, L. sphaericus and L. nissolia. With survival as and end point, V. ervilia and L. sativus revealed similar responses as in the germination tests but one species of lathyrus showed inconsistent reaction; L. sphacricus, one of the most sensitive species, occupied the top position of the medium sensitive group. The order of decreasing radio resistance among the remaining five species of Lathyrus were, L. ochrus, L. tingitanus, L. clymenum, L. aphaca and L.nissolia, the last one being the most radiosensitive of them all.

051 Shaikh, M.A.Q. Radiation sensitivity studies of Lathyrus species and Vicia ervilia (L) Willd. II. Dose-effects on seedling heights during the first three weeks of plant growth. Nuclear Science and Application. 1973, 7 (A).

Experiments were designed to determine the relative radio-sensitivity of seven species of Lathyrus and one species of Vicia. Dry seeds (6-7% moisture) were irradiated with 5 to 50 Krad dose of $Co^{60}$ gamma rays. Seed germination and seedling growth operations were carried out under greed house conditions. Seedling heights were measured daily as an end point for 15 days from the first dry of germination followed by a final assessment on the 21st day. The results indicated that seed irradiation may retard or stimulate seedling growth depending on species and radiation dose. The eight species could be arranged in the following order of most retarded to most resistant: L. ochrus, L. Clymenum, L. tignitanus, L. aphaca, L. sativus, L. nissdia, L. sphaericus and V. ervilia,

the first five being retarded and the last three being stimulated. Reduction of total seedling height among the adversely affected groups also/varied depending on species and radiation dose. The faster growing species exhibited extreme arrest of growth even at lower doses as compared to the slower growing ones of the same genus. Similarly, among the stimulated group, the enhancement of seedling growth resulting from seed irradiation with lower doses varied in degree according to species. As an end point to determine radio-sensitivity, the usefulness of daily recording of seedling heights for an extended period during the early life of the plant as opposed to only one assessment at a particular growing stage is discussed.

052 Shaikh, M.A,Q. Radiation sensitivity studies of Lathyrus species and Vicia ervilia L. Willd. iv. Dose-effects on some plant characters. Nuclear Science and Application. 1972, 6(A) p. 9-16.

Dry seeds of seven species of Lathyrus and one species of Vicia were irradiated with 5-50 Krad doses of gamma radiation ($Co^{60}$). Both $M_1$ and $M_2$ populations were grown under controlled greenhouse conditions and dose-effects on some plant characters were studied. There was a decrease in plant height at maturity with increase in radiation dose in L. tingitanus and L. Clymenum, no effect in V. ervilia and L. sativus, increase in L. ochrus and L.nissolia following 5 Krad and in L. sphaericus and L. aphaco following all doses at which last surviving were found. Pollen sterility percentages in both generations increased progressively with dose in all species over their control samples but in the $M_2$ generation the increase was much less than was observed in the $M_1$. The percentages of sterile plants in L. sativus and L. ervilia increased in the treated samples in both the generations but the increase was not progressive with doses. Flowering and maturing were delayed in different degrees, in both the generations, depending on species and radiation doses.

053 Shaikh, M.A.Q.; Godward, M.B.E. Consequence of natural elimination of radiation-induced aberration on the $M_2$ seed-set, its germination and agronomic performance of the $M_2$ generation. Indian Journal of Experimental Biology. 1974, 12, p. 415-421.

Consequence of natural elimination of radiation ($Co^{60}$) induced aberrations on the seed-set at various ontogenetically different parts of the $M_1$ meristem, viability of these seeds and ultimate height and seed yield of $M_2$ plants developed from these seeds was

studied in the Vicia ervilia and Lathyrus sativus. In general, as opposed to control plants, the upper brances of treated plants produced more seeds than the lower ones. Similarly, the upper pod-positions along each branch produced more seeds than the lower pod-positions; this tendency was marked more in lower branches than in higher ones. Seeds from the control plants of both the species, whatever the branch of origin, showed similar percentages of germination. But seeds collected from upper branches of the treated plants showed higher percentage of germination than those of lower branches. In irradiated samples, there was a slight but consistent increase in the ultimate height and seed yield of $M_2$ plants and a decrease in variability in these characters with the upward shifting of positions of pods and branches. There was no such trend in the plants developed from control seeds whatever their place of origin in the branch and pod-position hierarchy. In general, the results provided conclusive evidence that $M_1$ plants have more normality in their upper than lower parts due to the elimination of aberrations with the development of the shoot meristem. Possible utilization of this variation in normality of the ontogenetically different parts of a treated plant in mutation breeding is discussed.

054 Shaikh, M.A.Q.; Godward, M.B.E. Follow-up studies on the eliminations of aberrations due to seed irradiation with the development of shoot meristem. Proc. 2nd General Congr. SABRAO, Feb.,22-28,1973, New Delhi, p. 83.

Air-dried seeds of Vicia ervilia and Lathyrus sativus were irradiated with 5, 10, 15, 20, 25, 30 and 50 Krad doses of gamma rays ($Co^{60}$). The seeds along with the control were sown and the plants were grown in the green house. Each pod or pods from each node were harvested, threashed, stored and counted separately. Mean number of seeds of branches $B_1$, $B_2$, $B_3$, and $B_4$ and in pod-positions $P_1$, $P_2$, $P_3$, $P_4$ and $P_5$ along each branch was calculated. Viability of seed from each was determined by germination tests. Ultimate height and seed yield of each $M_2$ plant were recorded. In general, as opposed to the control plant the upper branches of the treated plants produced more seeds than the lower ones. Similarly, the upper pod-positions along each branch produced more seeds than the lower pod-positions; this tendency being more remarkable in the lower branches than in the higher ones, the seeds from the control plants of both the species. Whatever the branch of origin, showed similar percentages of germination. But seeds collected from the upper branches of the treated plants showed

higher percentages of germination than those of the lower branches. In the irradiated samples, there was a slight but consistent increase in the ultimate height and seed yield of plants and a decrease in variability in those characters with the upward shifting of positions of pods and branches. There was no such trend in the plants developed from control seeds whatever their place of origin in the branch and pod position hierarchy. In general, the results provided conclusive evidence that the $M_1$ plants have more normality in their upper than lower parts due to the elimination of aberrations with the development of the shoot meristem.

055 Shaikh, M.A.Q.; Godward, M.B.E. Radiation and genetical studies to estimate the number of embrayonic initials taking part in the formation of the shoot meristem of Vicia ervilia and Lathyrus sativus. Euphytica 1971, 20, p. 312-326.

Dry seeds of V. ervilia and L. sativus were irradiated with $Co^{60}$ gamma rays. The $M_1$ plants were grown to maturity. During harvest, ten randomly selected plants were arbitrarily numbered (symbols $P_1$ to $P_{10}$ and the branches and the pod-position along each branch of each plant were numbered (symbols for branches, $B_1$ to $B_4$ and pod-position, $P_1$ to $P_5$) from the lowest to the topmost one. The seeds of each pod-position were collected, threshed, counted and, the next year, shown separately. Mutants were isolated from among the $M_2$ population and each mutant could be traced back to the particular topography of the $M_1$ plant. The seeds from the $M_2$ plants originating from different sectors of the $M_1$ plants were grown to $M_3$ generation to study the pattern of inheritance. The segregation data of L. sativus show that in some cases at least one and in other cases at least two embryonic initials were involved in the formation of the short meristem whereas in V. ervilia the number of embryonic initials involved was atleast two or three.

056 Shaikh, M.A.Q.; Godward, M.B.E. The meiotic consequences of radiation induced chromosome breaks in Lathyrus sativus and Vicia ervilia. Cytologia. 1972, 37, p. 497-505.

Mature and dry seeds of L. sativus and V. ervilia were irradiated with 5,10,15,20,25,30 and 50 Krad doses of gamma rays ($Co^{60}$) and $M_1$ and $M_2$ plants were grown along with the controls. Meiosis of both the generations were studied to detect and explain the types of chromosomal abnormalities produced at different stages of meiosis in the $M_1$ generation and that were subsequently

still present in the meiosis of the $M_2$ generation. Meiosis in the control flowers of both the species was normal. The various types of abnormalities observed in the different stages of the $M_1$ generation were as follows: Diakinesis: heavy fragmentation of the nucleolus; metaphases I: univalents, tetravalents, multivalents, fragments, complex interchanges, rings, clumped and unusual configurations and unorientated chromatin material forming a large, round and darkly stained mass when a few of the divalents aligned at the equatorial plate; anaphase I: abnormal separation of the homologues, single and double bridges without fragments, anaphase I with laggards only, unequal numbers of chromosomes going to the poles; anaphase II: single bridges with or without laggards, anaphase II with laggards only, unequal volumes of chromatin material in daughter nuclei, unequal pollen grains fused or twin pollen grains and very small pollen grains. In the $M_2$ generation, very few meiotic aberrations were observed in the species. They were as follows in the different stages of meiosis; diakinesis: fragmentation of the nucleolus; metaphase I: complex interchanges and configurations, fragments, unorientated chromatin material; anaphase I: lagging chromosomes in anaphase I; anaphase II: laggards in anaphase II, and unequal volume of nuclear material in the daughter nuclei.

057 Shaikh, M.A.Q.; Godward, M.B.E. The mitotic consequences of radiation induced chromosome breaks in Lathyrus sativus and Vicia ervilia. Cytologia. 1972, 37, p. 489-495.

The study deals with the mitotic consequences of gamma radiation induced chromosome breaks in L. sativus and V. ervilia following seed irradiation. Various types of mitotic anomalies were encountered. These included: 1. single, double, triple, multiple, X-shaped and interlocked bridges. The double bridges lasted very long persisting upto the late telophase and often the leaf pear-shaped projections in the daughter nuclei marking this positions. 2. Centric and acentric fragments in the metaphase and laggards in the anaphose were present. The fragments were of different lengths and the majority of them were in pairs. There were also some rings, minute deletions, dicentric chromosomes and chromatids present. 3. Unequal length of metaphase chromosomes showing much more variation in length than is observed in the normal Karyotypes. 4. 'Condensed' and 'non-condensed' micronuclei in the interphase cells were observed and there was increasing evidence indicating that some

of these micronucles divide and go to the daughter nuclei. 5. Degenerated cells having little chromatin material and showing less stainability were present. 6. Giant cells having about double the size of the ordinary root meristematic cells were present only in the species V. ervilia. Probable causes of the production of mitotic abnormalities following seed irradiation treatment were discussed in the light of the findings of other workers.

## SOIL BIOLOGY

058 Bangladesh Agricultural University. Department of Soil Science. Collection of root nodules of Mashkalai and Khesari from different pulse growing regions of the country (Bangladesh) for keeping effective inocula. Third Annual Report 1982-83: Coordinated Scheme for the Improvement of Mashkalai and Khesari - Nodulation and Nitrogen Fixation Section. 1983, p. 4.

The root nodules of Mashkalai and Khesari plants were collected from pulse growing areas of Jamalpur and Mymensingh. These were done in the last week of December, 1982. Rizobium strains of Mashkalai and Khesari were isolated in the laboratory from the field collected nodules and preserved for further study. The strains of Mashkalai have been numbered as: BAU 522, BAU 523, BAU 524, BAU 525, BAU 526, BAU 527, BAU 528, BAU 529 and BAU 530. The strains of Khesari have been numbered as BAU 451, BAU 452, BAU 453, BAU 454, BAU 455, BAU 456, and BAU 458.

059 Bangladesh Agricultural University, Department of Soil Science. Collection of root nodules of Mashkalai and Khesari from different pulse growing regions of the country (Bangladesh) for preparing effective inocula. Fourth Annual Report 1983-84: Co-ordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section, 1984, p. 4.

The root nodules of Mashkalai and Khesari plants were collected from pulse growing areas of Jamalpur, Islampur, Faridpur, Goalundo, Ishurdi, Jessore and Mymensingh. These were done during the last week of December,1983 Rhizobium strains of Mashkalai and Khesari were isolated in the laboratory from the field collected nodules and preserved for further study. The strains of Mashkalai have been numbered as BAU 521, BAU 522, BAU 523, BAU 524, BAU 524, BAU 525, BAU 527, and BAU 528. The strains of khesari have been numbered as BAU 457, BAU 458, BAU 459 and BAU 460.

060 Bangladesh Agricultural University. Department of Soil Science. Effectivity test of different rhizobium strains of Khesari in sand culture. Third Annual Report 1982-83: Co-ordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section. 1983, p. 8-9.

The present study was under taken with a view to see the comparative effectivity of different rhizobium of strains of Khesari in sand culture. Inoculation with rhizobium strains showed highly significant effect on nodulation, dry matter yield, N-content and uptake by the plant. Results showed that the number of effective nodules/plant varied from 0 noted in control to 37.4 counted in BAU 449. The strain BAU 449 showed the highest number of effective nodules which became statistically similar to BAU 448. All the strains produced higher number effective nodules over control. In non-effective nodulation, the strain BAU 447 produced the highest number (19.6) of nodule and the lowest (2.5) in control. The highest total number of nodule (52.7) was recorded in BAU 449 which became statistically similar to BAU 448 and BAU 449 which again became comparable to BAU 450. All the strains produced higher total number of nodules over control. In recording total dry matter yield of the plant BAU 449 recorded the highest quantity (106.3 mg/plant) which became statistically identical to the effect of strains BAU 448 and BAU 450. The lowest dry matter was recorded in control. All the strains produced higher amount of dry matter yield over control. The N-content in plant showed that the strain BAU 449 recorded the highest (3.10 per cent) and the lowest N-content recorded was 2.37% in control. It was observed that the strain BAU 449 recorded the highest (3.29 mg/plant) N-uptake which became statistically similar to BAU 448 and BAU 450. The strains BAU 445, BAU 446 and BAU 447 produced statistically similar amounts of N-uptake.

061 Bangladesh Agricultural University. Department of Soil Science. Effect of different locally isolated strains of rhizobium leguminosarum on the growth, N-fixation and yield of khesari in farmer's field. Third Annual Report 1982-83: Coordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and N-Fixation Section, 1983, p. 16-30.

Inoculation with rhizobium strains showed significant effect on nodulation total dry matter yield, N-content of and uptake by plant, the crop after 42 days of sowing. Results indicate the significant effect of inoculation of the crop with different rhizobium strains in

producing effective nodules, total number of nodules, total dry matter production, N-content and uptake by the plant. The strains BAU 439 produced highest (13.13) number of effective nodules per plant and was statistically similar BAU 444, BAU 421, and BAU 416 which became again comparable to BAU 424. All the strains produced higher number of effective nodules per plant over control. The highest total number of nodules per plant (19.13) was recorded in BAU 416 which became statistically similar to other strains and but different from control. In total dry matter yield, the strain BAU 444 recorded highest amount (380 mg/plant) which became statistically similar to BAU 439, BAU 416 and BAU 421 but different from BAU 444 and control. The highest amount of N-uptake (14.66 mg/plant) was recorded in BAU 444 which became statistically identical with other strains but different from control. The results showed the yield, N control, and uptake by the grain and straw after 98 days of sowing. The highest grain yield (844 kg/ha) was recorded in BAU 439 and the lowest (742 kg/ha) in uninoculated control. All the strains produced higher amounts of grain yield over control. The N content in grain ranged from 3.70% in control to 3.94% in BAU 439. The straw yield ranged from 1340 kg/ha due to inoculation with BAU 424 and 1477 kg/ha due to inoculation with BAU 439. The N content in straw ranged from 1.56% control to 1.83% in BAU 421. The total N uptake in grain and straw ranged from 48.68 kg/ha in control to 59.5 kg/ha in BAU 439. The results showed that relative total N uptake increased by 20.70% 17.39%, 12.73%, 11.76% and 2.83% due to inoculation with BAU 439, BAU 444, BAU 421, BAU 416 and BAU 424 respectively.

062 Bangladesh Agricultural University. Department of Soil Science. Effects of different locally isolated strains of rhizobium sp. on growth, N-fixation and yield of Khesari. Third Annual Report 1982-83: Coordinated Scheme for the improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section. 1983, p.11-16.

The trail was conducted in randomized block design with three replications for the screening of suitable strains for inoculation out of five strains. Inoculation with rhizobium strains showed significant effect on nodulation, total dry matter yield, N content and uptake by plant after 42 days of sowing. Results showed the significant effect of inoculation of the crop with different rhizobium strains in producing effective and total number of nodules, total dry matter yield, N content and uptake by the plant. The strain BAU 444 recorded the highest number of effective nodules

(12.40 per plant) which became statistically similar to BAU 439 and BAU 421 which again became comparable to BAU 416 and BAU 424. But different from uninoculated control. The highest total number of nodules (14.73) was recorded in BAU 439 and the lowest (10.60) in uninoculated treatment. The highest dry matter yield (328 mg/plant) was recorded in BAU 444 which became statistically identical to BAU 439, BAU 421. All the inoculated plants showed superiority in dry matter yield over control. In N content, the strain BAU 439 recorded the highest N percent (3.75%) and the lowest (3.52%) in BAU 424. It was observed that the N uptake per plant ranged from 5.69 mg in control to 12.23 in BAU 444 which were statistically identical to BAU 439 and BAU 421 but different from other treatments. It appears from the results that the strain BAU 421, BAU 439 and BAU 444 recorded better effects that others on different plant characters after 42 days of sowing. The strain BAU 444 recorded the highest grain yield (960 kg/ha) and the lowest (800 kg/ha) in control. All the strains performed better than the control. The N content in grain ranged from 3.64% in control to 3.97% due to inoculation with BAU 416. The strain BAU 444 recorded the highest strain yield (1236 kg/ha) and the lowest (1185 kg/ha) in BAU 416. The N content in straw was highest (1.85) in BAU 421 and BAU 439 and the lowest (1.73) in control. The total N uptake by grain and straw was recorded highest for BAU 444 of 60.61 kg/ha. All the strains recorded higher N uptake than control. The relative total N uptake was 15.71%, 14.82%, 9.19%, 16.79% and 20.90% in the strains BAU 416, BAU 421, BAU 424, BAU 439 and BAU 444 respectively. It appears from the experiment that the strains BAU 444, BAU 439 and BAU 424 were superior than others.

063 Bangladesh Agricultural University. Department of Soil Science. Formulation inoculum with already isolated s strains and test their effectiveness on Khesari. Third Annual Report 1982-83: Coordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section. 1983. p. 20-24.

To find out the suitable doses of inoculum material to inoculate with proper strains for successful production of Khesari and trail with 4 doses of inoculum was conducted. Results showed significant effect of inoculation of the crop with different doses of inoculum of the strain BAU 416 in nodulation, total dry matter yield, N content and uptake by the plant. The inoculum applied @ 40 gm/kg seed recorded the highest number of effective nodules (9.33) per plant which became sta-

tistically identical to and 20 and 60 gm/kg seed treatments but differed from 80 gm/kg seed treatment and control. In producing total number of nodules, the inoculum applied @ 40 gm/kg seed recorded the highest total number of nodules (16.13) per plant which became statistically identical to 20 and 60 gm/kg seed treatments but differed from others. In dry matter production, the inoculum applied @ 40 gm/kg s seed recorded the highest amount of dry matter yield (46 0 mg) which became statistically similar to @ 60 gm/kg seed treatment but differed from the rest. The N content in shoot varied from 4.43% in control to 4.86% in 20 gm/kg seed treatment. In N uptake by the plant, the highest amount (2208 mg/plant) was recorded due to application of inoculum @ 40 gm/kg seed which were statistically similar to other rates but different from control. The maximum grain yield (852 kg/ha) was recorded in the treatment where inoculum was applied @ 40 gm/kg seed and the lowest (766 kg/ha) was recorded in control. The N content in grain ranged from 3.70% in control to 3.96% in 40 gm/kg seed treatment. The maximum straw yield (1316 kg/ha) was recorded where inoculum was applied @ 40 gm/kg seed and the minimum (1123 kg/ha) was recorded in control. The N content in the straw ranged from 2.1% in control to 2.32% where inoculum was applied @ 60 gm/kg seed. The total N uptake by grain and straw was 51.92 kg/ha in control and maximum amount was recorded in treatment 40 gm inoculum/kg seed. The relative N uptake increased to 21.98%, 15.40%, 17.19% and 13.27% due to application of inoculum @ 40, 20, 60 and 80 gm/kg seed respectively over control.

064 Bangladesh Agricultural University. Department of Soil Science. Fourth Annual Report, 1983-84: Coordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section: A BARC Financed Project, Mymensingh, BAU, 1984. p. 32.

Experiment conducted in different carrier materials, peat, saw-dust and mixture of peat and saw-dust showed that peat was the best carrier with respect to viability of rhizobia cells. Effectively test of different Mashkalai rhizobia in sand culture showed that BAU 524 strain was superior in nodulation, dry matter yield and N-uptake by plants over all others. Field experiments were conducted at Jamalpur, Ishurdi and in a farmer's field with Khesari and promising rhizobia strains showed that mixture of the strains of BAU 421, BAU 439, BAU 444 was superior in total N-uptake by plants in all varieties. However the performance of BAU 439 and BAU 444 with local variety was more or less similar.

065 Bangladesh Agricultural University. Department of Soil Science. Interaction trials of promising rhizohia strains with recommended Khesari varieties at Jamalpur Agricultural Farm. Fourth Annual Report 1983-84: Co-ordinated Scheme for the Improvement of Mashkalai and Khesari-Nodulation and Nitrogen Fixation Section, 1984. p. 10-12.

The trial was conducted in split plot design with three replicates for the screening of rhizobia strains for inoculation out of five strains. Results showed the beneficial effect of inoculation of Khesari with different rhizobia strain in producing effective and total number of nodules, total dry matter yield, N content and N-uptake by the plants. The interaction effect of inoculum and varieties of Khesari was different in different treatment combinations in producing growth characters. In producing effective nodules in plant the mixture of the strains were superior to others, for local and the variety 3968 but BAU 439 was superior than others in Charbadna variety. BAU 439 recorded superiority on total number of nodules formed in case of local and Charbadna variety but mixture of strains recorded higher total number of nodules than others.

066 Bhatacharjiya, Paromesh. (Cultivation of pulses). Daler chash (includes Khesari), Krishikatha. Oct-Nov. 1982. Vol. 42, p. 307-312.

067 Bhuiyan, Z.H.; Islam, M.R.; Khan, A.R.; Hoque, M.S. Effect of different strain of rhizobium leguminosarum on three varieties of grasspea (Lathyrus satious L.). Proceedings of the Fourth Annual Conference of Bangladesh Society of Microbiologists, Feb. 7-8, 1985. Dhaka, Bangladesh Society of Microbiologists; International Centre for Diarrhoeal Disease Research, Bangladesh. 1985, p. 14.

A field experiment was conducted at the Regional Agricultural Research Station, Jamalpur, during the rabi season of 1983-84 using three different strains of grasspea rhizobium singly or in mixture, on three varieties of grasspea and yield and protein content was determined. Basal doses of 60 kg $P_2O_5$ and 40 kg $K_2O$/ha were applied from triple super phosphate and muriate of potash, respectively. The strains used were BAU 421, BAU 439, BAU 444. The tested varieties of grasspea were local, Charbadna and V-3968. Variation was observed on nodulation, dry matter, grain and straw yield. Inoculation with different rhizobium isolates showed highly significant effect on nodulation, dry matter yield and N-uptake at 35 days of sowing.

Specifically between rhizobium and grasspea varieties was observed on nodule formation, grain and straw yield. The strain BAU was the most effective inoculant for Charbadna. For variety V-3968, a mixed inoculation was better for nodulation and grain yield. The grain and straw yield increased by 20% and 25% respectively after inoculation with BAU 439, protein content of grain also increased.

FOOD, NUTRITION AND TOXICOLOGY

068 Aall, Cato. Pulses and oilseeds (includes Lathyrus sativus) in Bangladesh from a food and nutrition point of view. Dhaka,FAO/UNDP, 1976.

Describes importance of pulses, oilseeds and Khesari. Deals with the advantages and disadvantages of Khesari dal.

069 Ahmad, Kamal Uddin. "Lathyrism" in Adverse Effects of Food, edited by E.F. Patrice Jelliffe and Derrick B. Jelliffe. New York, Plenum Press, 1982. p. 71-76.

Neurolathyrism is a public health problem of significant dimensions. The recent findings of Ahmad and Jahan Jahan (1980) that subclinical deficiency of vitamin C in guineapigs renders the animal susceptible to the toxin present in L. sativus, has made possible the induction of experimental lathyrism in guineapigs. Undoubtedly, this finding will be useful in the isolation of a new toxin of lathyrism, or the confirmation that BOAA is the real toxin. The biochemistry of the condition, including the mechanism to how vitamin C exerts its protective action against neurolathyrism, may also unfold in the near future.

070 Ahmad, K; Jahan, K. Ascorbic acid in prevention and cure of neurolathyrism. Journal of the American College of Nutrition. 1983, 2(3), Abstract No. 107.

Experimental neurolathyrism was produced in adult guineapigs and monkeys by feeding them ascorbic acid deficient diet with seeds of Lathyrus sativus as principal source of energy. Fresh cases of neurolathyrism in human patients could be cured by administration of ascorbic acid. Neurological symptoms in every young chicks produced by alcoholic extracts of L. sativus seeds or monosodium gultamate could be prevented by L. ascorbic acid, iso-ascorbic acid or D. Glucono lactone but not by D glucono lactone, D glucono and lactone or reduced glutathione. Possible role of ascorbic acid

in maintaining homeostasis of neuroactive amines are considered. This would be a new biological function of ascorbic acid distinct from its role as-antiscor--butic vitamin or biological reducing agent.

071 Ahmad, Kamal Uddin; Jahan, Khursheed. Conquent of lathyrism. Nutrition News. 1982. 2 (1), p. 1-4.

Demonstration of efficiency of vitamin C in prevention as well as reversal (partial or full) of neurolathyrism in the monkey-caused by toxin preparations of khesari (and also MSG) encourages scientists to consider that the battle of neurolathyrism is won. A population well nourished in respect of the vitamin C will not develop neurolathyrism in spite of the use of khesari as principal item in the diet. It may be warned that khesari is not fully detoxicated if it is treated with hot water to wash out the 'toxin' even though B-oxalyl and B-diamino propionic acid (ODAP) the chemical which is assumed to be the toxic principal is a water soluble substance. Either a good deal of it exists in a bound form not removed by hot water treatment or there are other toxins which are not soluble in hot water and thus stay in the seeds in spite of the washing treatment. Washing with hot water is thus no guarantee that the seeds are nontoxic. For the same reason a variety of khesari having less of ODAP may not be nontoxic.

072 Ahmad, Kamal; Jahan, Khursheed. Conquest of lathyrism. Vision. 1984. 2(3), p. 1-2.

In lathyrism, the victim suffers from paralyses of one or both the lower limbs. There are various stages from a little bit of limping to crawling. Despite its long history, there has been no substantial progress in the cure, and prevention of this disease. With the exception of banning 'Khesari' cultivation, the major cause in the lack of this progress, is attributed to the failure to produce the disease in experimental animals. It has been discovered that although lathyrism could not be produced by feeding any experimental animals with Khesari, some neurological symptoms such as convulsions were produced when an alcoatiolic extract of the seed was administered intraperiotoneally to one day old (not older) chick. This phonomonon is used as a biological test for the isolation of a neuroactive amino acid from Khesari which was identified as B N-oxalyl L-B diamino propionic acid (ODAP). This has been regarded as the principal toxin (if not the only) in Khesari responsible for causing the disease. Following the epidemics of late seventies, scientists were attracted to researches on the disease and soon dis-

covered that the human diseases lathyrism did not occur in animals and visualised that it must be due to biochemical difference between men and animals in that the latter (except guineapigs and monkeys) are unable to synthesize ascorbic acid (vitamin C) in their body. Human beings can not synthesize vitamin C. Scientists who tried to produce experimental lathyrism in monkeys and guineapigs added vitamin C in the diet without suspecting that some kind of deficiency of vitamin C could indeed be a key condition in producing lathyrism in Khesari eating population. In guineapigs and monkeys which have been fed a diet of khesari adequate in all nutrients except vitamin C the symptoms of lathyrism soon appeared. The paralysis of hind legs is the principal symptom. This condition could be reversed by providing vitamin C in large dose. It must be remembered that deficiency of vitamin C alone in the absence of Khesari as the bulk item of the diet would not produce lathyrism. And that the deficiency of vitamin C does not have to be serious enough to produce scurvy. After producing experimental lathyrism in guineapigs and monkeys, scientists were able to cure a few patients of lathyrism from Kushtia and Rajshahi of Bangladesh. Following the example, some cases in India were also successfully treated in India. For the success of the curative effect of vitamin C in lathyrism it appears that only comparatively less severe cases are reversed. It is understood that the nerve cells (neurons) are not expected to be regenerated when they are once destroyed, though injuries to processes may be repaired scientists soon found out that not only ascorbic acid but some of its structural analogs such as isoascorbic acid and D gulone-a lactone also could be effective even though larger doses were required to prevent the neurological symptoms caused by the toxin of Khesari. This means that the role of ascorbic acid in the prevention or cure of lathyrism is an entirely different phenomenon from its role as an antiascorbutic vitamin. It suggests a role for the vitamin in the biological phenomenon of transmission of nerve impulses. Recently scientists discovered a method for the detoxification of Khesari. It simply consists of soaking of the powdered seeds of khesari overnight in limewater followed by cooking, preferably in a pressure cooker. It is a more application of simple chemistry that the amide linkage of B-N-oxalyl group of the toxin ODAP is split off during cooking in the alkaline condition created by soaking in lime water. Lime treatment of food grains is a common practice in many cultures such as treatment of corn in Mexico for making tortilla. It is hoped that liming of Khesari would also be possible in Bangladesh and India. This cooking practice with enough vitamin C in the diet will eradicate incidence of lathyrism from the world.

073 Ahmad, Kamal Uddin; Jahan, Khursheed. Khesari (Lathyrus sativus) detoxified. Nutrition News. 1984. 2(8), p.1-2.

Treatment of foodstuffs with lime (for example corn in Mexico, banana in Bangladesh for making special banana dishes) is a part of culture in many lands. Lime is a necessary ingredient for chewing betel leaves and is available in almost every household in the subcontinent. Soaked decorticated ground khesari seed with saturated lime water for 2-3 hours (using just enough clean super natent to soak) and then autoclaved the soaked material for about 10 minutes at 15 lbs pressure per square inch. In so doing it is found that the ODAP was completely destroyed. If pure ODAP was treated in the same way with with lime it was also lost. Autoclaving the seeds with water in lieu of lime water would not destroy the ODAP in the seed. Just boiling with lime water for about 30 minutes (instead of autoclaving~) will also remove the toxin from the powdered seeds. The treated khesari seeds could be dried and used for any food preparation. Should the preparation taste limy it could be lightly rinsed with water before drying. The above process kills two birds at the same time, destruction of the toxin ODAP as well as deactivation of trypsin inhibitors in the seed to improve its nutritional value.

074 Ahmad, Kamal Uddin; Jahan, Khursheed. Neurolathyrism and L.-Ascorbic acid: Research note. Food and Nutrition Bulletin. 1982, 4(4), p.65.

Neurolathyrism is a diseases that has crippled many thousands in the Indian Sub-Continent and elsewhere during the past several centuries. The disease appeared to affect humans almost exclusively. No experimental animal model was available to facilitate biomedical research on the subject until recently when guineapigs having a subacute deficiency of L-ascorbic L.sativus seed supplemental with minerals and the usual vitamins except for L. ascorbic acid, they developed typical symptoms of neurolathyrism, affecting the hind limbs. The same condition also appeared within two or three hours and following intraperitoneal administration of an extract of L. sativus in guineapigs previously made deficient in ascorbic acid not only protected the animals from the neuotoxic effect of L. sativus, but also had a curative effect on those that had earlier become paralysed by the toxicity of the seeds. The same symptoms of neurolathyrism in monkeys made deficient in ascorbic acid by feeding them cooked L. sativus seeds or by administering extracts of L. sativus intraperitoneally. Thus a subacute deficiency of L-ascorbic acid that was not severe enough to produce scorbutic

symptoms was found to be precondition for the appearance of neurolathyrism attributed to L. sativus seed. This also explained the failure to produce experimental neurolathyrism in laboratory animals that do not require any dietary supply of L. ascorbic acid or that were provided this vitamin in the experimental diet before was suspected that its deficiency could be predisposing factor. Finally, a neurotoxin, B-N-oxalye L-L, B-diamino propionic acid (ODAP),isolated from L. sativus seeds, was administered intraperitoneally in two-day-old chicks. It produced neurological symptoms such as retraction of the head and paralysis of the lages, indicating damage to the central nervous system.

075 Ahmad, Kamal Uddin; Jahan, Khursheed. Studies on Neurolathyrism. Third Asian Congress of Nutrition, Jakarta, October 6-10, 1980. p. 190-191.

Experimental lathyrism was produced in adult guineapig by feeding seeds of L. sativus properly cooked and supplemented with all vitamins except vitamin C developed neurological symptoms similar to these seen in human subjects in 2-3 months time. None of the animals which received vitamin C developed any neurological symptoms. Adult guineapigs fed on cooked Kalai (phaseolus radiatus) but kept deficient in vitamin C also developed neurological symptoms on the administration a preparation of L. sativus. If at the initial stage of the disease (monoplagia) vitamin C is administered the condition is reversed.

076 Ahmad, Kamal; Jahan, Khursheed. Studies on neurolathyrism. In Touch. 1982, No. 53, p. 13-14.

In the guineapigs, a diet of cooked L. sativus would developed neural symptoms comparable to those seen in human cases of lathyrism when no ascorbic acid is provided in the diet. Presence of ascorbic acid is provided in the diet will protect the animal from development of such symptoms. If the neural symptoms have not already gone too far (i.e. beyond the stage of monoplagia) the animals could be cured by administration of ascorbic acid. The experiments and observations there of made above though came out of intuitive provocations find relevance with the report of Ganopathy and Dwivedi, that the communities that suffered from lathyrism were those which had deficiencies of ascorbic acid.

077 Ahmad, K; Jahan, Khursheed. Prevention is easy, cure is possible. Future. 9, 1983-84 winter, p. 39-40.

During the mid 1970s mass people in Kushtia and Rajshahi were struck with lathyrism. The number of victims may be 16,000. The country produces some 70,000 tonnes of khesari over about 100,000 h. There was no known preventive measure for lathyrism except banning production of khesari. Indian scientists pioneered research on the disease and new knowledge was gathered. While a neuroactive toxin was isolated, it could not produce any neurological symptoms in any adult animal, but the lathyrogenic effect of the khesari toxin was demonstrated on adult monkeys, guineapigs and primates. From various nutrition surveys done in Bangladesh it has been recognised that vitamin C is one of the micro-nutrients of which the intake is very low in the population, that is 6-10mg a day. Experiments were made with guineapigs by feeding khesari to one group but without vitamin C, and another group khesari with vitamin C. Vitamin C deficiency and use of khesari must go together to cause the disease. It was noted that the khesari toxin failed to cause convulsions or other neurological symptoms in day old chicks if these were given 5 mg of vitamin C intraperitoneally before they were administered the toxin. It was found that vitamin C not only prevented lathyrism in these animals, but also cured the same. It is concluded that adequacy of vitamin C in the diet will prevent neurolathyrism on eating khesari. Vitamin C in therapeutic doses may also cure neurolathyrism, if administered soon after attack provided the neuronal damage is not too severe to be repaired.

078 Ahmad, K.; Jahan, K. Studies on the preventive and curative action of ascorbic acid on the neurological toxicity of monosodium glutamate. Food and Nutrition Bulletin. 1985, 7(1), p. 51-53.

In the course of the studies on neurolathyrism caused by Lathyrus sativus (LS), various neurological manifestation were reported by V. Nagarajan and C. Gopalan in one-day old chicks, when the latter were, given extracts of LS seeds intraperitoneally. Subsequently a neuroactive amine, B-N-oxalyl-L-a, B-diamino-propionic acid (ODAP), was isolated ffom the seeds of LS that minicked the neurological symptoms caused by the extract. It is found that such symptoms did not appear in the chicks when they were given ascorbic acid (AA) some 10 to 15 minutes before the administration of the toxic extract of LS. It was further found that adult guineapigs and monkeys, which need a dietary source of AA, developed paralysis of the hind legs and sometimes respiratory

difficulty if an extract of LS was administered to them after they had been fed an AA-deficient diet for some weeks to lower their serum AA level to 0.2-0.4 mg/dl. At this stage of deficiency there were no scorbutic symptoms. The conditions paralleled to a great extent those seen in human neurolathyrism, but no such symptoms were seen in those animals that were not made deficient in AA prior to the administration of the toxic extract. These symptoms were found to be reversible if AA was given immediately after the appearance of symptoms. It was concluded that AA counteracted the neurotoxicity of ODAP from LS. The studies demonstrate the toxicity of Monosodium glutamate (MSG) in one-day old chicks weighing 32-35g. Different amounts of MS were put into 0.5ml of water and administered intraperitoneally. While a dose of 2g/kg body weight caused only mild symptoms, toxicity became severe when the dose was raised to 2.5g/kg. These studies were made to demonstrate the curative action of AA against MSG toxicity in adult guineapigs monkeys, which are not able to biosynthesize AA. Guneapigs weighting 300-350g and monkeys weighting 2.5-3 kg. were selected, They were made deficient in AA by feeding an AA-deficient diet until serum AA levels fell to 0.3-0.4 mg dl. At this point no scorbic symptoms were seen. A dose of 2g/kg of MSG was administered to each animal intraperiton eally in a 0.5-ml aqueoses solution. All the animals became sick, but 5 mg. of AA given subcutaneously cured all of the guineapigs, and 50 mg cured all monkeys. These doses were arbitrary.

079 Al Nasir, Tareak. Experimental Neurolathyrism. <u>In Touch</u>, 1982, No. 53, p. 14-16.

The aim of the present study is to find out the anatomic basis, if any in the experimental lathyrism produced in guineapigs in the laboratory by feeding them boiled lathyrus sativus (i.e. without vit. C) only. Guineapigs from both the experimental and control groups will be killed after the end of twelve weeks. The experimental group developed lathyrism in an average of one to four weeks time and were killed accordingly. The control group were killed after one week of the last animal killed from the experimental group. On gross examination, the lungs of the experimental group showed marked congestion. This congestion may be due to respiratory muscle paralysis. The cornea of most of the animals of the experimental group also appeared hazy. The brain and spinal cord showed no abnormal findings of gross examination. To prove it thirty guineapigs were to be fed exclusively on boiled Khesari (without Vit. C) for at least twelve weeks. They could drink all the water they wanted. 10 other guineapigs of the same type

were fed a normal diet with Vitamin C to serve as a basis for comparision. After 12 weeks the guniea pigs fed with khesari were to be killed and prepared for examination (unless they got so sick they needed to be killed ahead of time). Besides being dissected the animals would have a series of laboratory tests to show if there was any poison in the blood or changes taking place in the nervecells, the fibres supporting the nerve cells, or the sheath of the nerve cells which would show degeneration (or a slow wasting away of the cells). Results showed that all the guinea pigs fed Khesari developed symptoms like those of lathyrism in only one to four weeks so were killed well before the 12 weeks originally scheduled. The other groups were all killed within a week after the last one of the Khesari group. Disscetion and visual examination showed no defects in the brain or spinal cord. There was lung congestion in the Khesari group and the outside coverings of their eyes (the cornea) appeared hazy. One possible reason for lung congestion could be the paralysis of muscles around the lungs (because meassages from the brain were disturbed or stopped) but there could also be other causes.

080 Anon. Seminar on lathyrism. In Touch. 1982, No. 53, p. 24.

A national seminar on lathyrism organized by Shaw Unnayan of Rajshahi in association with Institute of Nutrition and Food Science (INFS), Dhaka,University (DU), was held on Dec. 29,1981 INFS, D.U. Following were the recommendations of the seminar: 1) A survey should be conducted in Rajshahi, Kushtia, Pabna, Jessore, Faridpur, Tangail, and Dhaka to identify the actual number of cases in order to prepare a rehabilitation programme. 2) People in general should be educated about the bad effects of Khesari. The government publicity media should play an effective role in this campaign. 3) Alternate foods(rice and wheat) should be supplied to the most poor of the above mentioned areas at a subsidized rate. Food for work programmes should be scheduled during the period when people in general take khesari. 4) Cultivation of khesari be discouraged (if possible banned) and its cultivation should be replaced by cultivation of other pulses. Action research should be done to find out ways and means to replace khesari cultivation with other crops. 5) In the light of the above recommendations the government should declare an action plan to combat lathyrism. This action plan should be integrated with national plan. 6) Long term and more extensive rehabilitation should be taken up by the government and other voluntary agencies. 7) An international seminar should

be arranged to share the experience of other countries regarding lathyrism.

081 Bhuiyan, Abdul Quadir. Lathyrism in Bangladesh; a study of the victim's families. In Touch. 1982, No. 53. p.5-7.

This article is a study on the socio-economic conditions of lathyrism affected families in Bangladesh. These basic facts about Lathyrism affected families are useful in designing a programme for the prevention of the disease and for the rehabilitation of the victims. The data for the present study was collected mainly through a survey of 14 of the 23 affected Thanas (in Rajshahi and Kushtia). These were: 1) Puthia, 2) Charghat, 3) Godagari, 4) Tanore, 5) Nawabganj, 6) Shibganj, 7) Nachole, 8) Natore, 9) Baraigram, 10, Gurudaspur, 11) Gangni, 12) Mirpur, 13) Daulatpur, and 14) Bheramara. There were 7592 lathyrism affected families in these 14 thanas. 404 (5.32%) of these 7592 families were selected through random sampling procedure for interviewing. Although the thanas and the families were selected through a random sampling procedure, attention was given to include different categories of places and families. Questionnaire in Bengali was used in the survey. Data about the demographic characteristics of the lathyrism patients and their families is important in study of their socio-economic conditions. It is found that 60 (14.85%) households have 1-3 persons, 156 (38.61%) households have 4-6 persons, 174 (36.38%) households have 7-9 persons, 32 (7.92%) households have 10-12 persons, 7 (1.73%) households have 13-15 persons and 2 (0.49%) households have 16 or more persons. 1037 (40.41%) males and 1109 (43.21%) females are illiterate. Thus a vast majority (83.62%) of the lathyrism patient family members are illiterate. However, 186 (7.24%) males and 86 (3.35%) famales have acquired primary level education. In fact most of these person can read printed matter and write their names in Bengali. 92 (3.53%) males and 24 (0.93%) females have acquired secondary level education, 12 (0.46%) males and 6 (0.23%) females have passed S.S.C. examination and 9 (0.35%) males and 2 (0.07%) females have passed H.S.C. examination. There are only 3 male graduates and no female is found in these families. 839 of the total 1339 males and 638 of the total 1227 females are unmarried. On the other hand, the number of ever married males is 500 and females 589. Thus the number of ever married females is higher than the males. Out of 404 families, the number of landowning families is 227. Majority of the land owning families own land between 1-3 bighas each. The number of landless families is 177 (43.81%), 30 of these 177 families do not have even their own bari

(homestead); they live in other homesteads. It is mentioned in an Indian report that 75% of lathyrism victims are landless labors. The number of 'Working persons' in the sampled 404 families is 1430 and that of 'non-working persons' 1136. Thus the number of non-working persons' per 100 working persons is 79.44. The category of 'non-working persons' include children, students, persons living on charity, old persons, persons having no work and lathyrism patients incapable of doing any work. In the category of 'working persons' 286 (20%) are working in the agricultural sector. The number of persons doing non-agricultural work is 1144 (80%). The category of non-agriculture covers a wide range of occupations such as business, service, etc. 340 (48.11%) of the total 449 families have income upto Taka 500 per month. There are several reasons why these families ate khesari regularly before meals. Firstly, khesari is cheaper than rice or wheat. Secondly, they did not know the bad effects of khesari. Thirdly, in some parts of the study areas (e.g. Nawabganj) khesari is given as wage to day labours. It should also be mentioned here that the incidence of lathyrism has positive correlation with the increase of price of food items. Thus 66.45% of the total patients of the study areas were attacked by lathyrism during 1971-75, when the price of rice and wheat surpassed all previous records. However, most of the people in lathyrism areas are now aware of the bad effects of eating khesari. As a result there are fewer new cases of lathyrism. It is clear from the above discussion that lathyrism is not a simple disease. It is basically a problem of poverty. This is not only consideration, however, because there are other poverty stricken people in Bangladesh who have not been attacked by this disease. Poverty must be coupled with food habits to cause this disease.

082 Chowdhury, M.H. Lathyrism. Dhaka Medical College Journal. 1971-72, V.1, p. 15-19.

The consumption of seeds of lathyrus sativus has been known to cause disease neurolathyrism. The neurotoxicity of B-N-Oxaly L-B diamins propionic acid from the pulse lathyrus sativus has been isolated by P.S. Cheema, K. Malathy, G. Padmanalesn and P.S. Sarma of Indian Institute of Science. On animal experiment they found the following results: Intra-peritoneal administration of B-N-Oxalyl-L-B diamenopropiopic acid, the nematoxies from Lathyrus sativus to 12 day old rats causes typical convulsions within 10 minutes. There is accumulation of Glutamine in the brain and chronic ammoris toxicity is indicated. But this does not occur in adult rat.

It was concluded that B-N-oxalyl-L-B diamenopropionic acid interferes with the ammoris generating a fixing mechanisms in the brain and leads to chronic ammoris toxicity. Lathyrus sativus grows abundantly in the delta of Rajshahi, Kushtia, Khulna and Faridpur. The poor people consume this khesari dal as a staple food in place of rice for 8 to 10 months of the years as this pulse is cheep. The spastic paraplegia mainly takes place in lumber segments and involve the lower limbs. Hypothesis which stands for this involvement is due to the fact that during plough metabolism in the lumber segment is more active than other segments of spinol cord. The people should be encouraged not to take this dal as a staple food in place of rice. But nobody should be afraid of taking this dal in the form of soup as nematoxin is destroyed in boiling.

083 Daulatin, M.; Hoque, M.S.; Joarder, G.K. Studies on the incidence of aflatoxin in pulses (including khesari). Proceedings of the the 8th Bangladesh Science Conference, Dhaka, BAAS, 1983. p. 190.

Investigation on pulses shows the samples of Mushuri (Lensesculenta ) collected from the market contains aflatoxin also (about 2%). The seasonal effect on the prevalence of aflatoxin producing fungal species, Aspergillus flavus was noted. Aflatoxin has not been detected so far in khesari (Lathyrus sativus). The qualitative determination of aflatoxin was done by using a standard flourescent method. Both the pulses have been found to be considerably infected by fungal and the incidence of Aspergillus flavus, well known for producing Aflatoxin have been found to be considerable also. The investigations were carried out in case to Mushuri throughout a year, examining ten samples each month both for fungal flora and aflatoxin.

084 Hagman, G. Khesari Dal (Lathyrus sativus); the poisonous pea. ADAB News, 1977. 4(12), p.7.

Khesari dal is a very hardy plant. It can be cultivated without fertilizer or irrigation in very poor or even saline soil. This pulse gives a guarantee for a good winter crop even during those dry years when other crops fail. Especially at that time many of the poorest depend on Khesari dal as the alternative to starvation. The disadvantage of this dark grey pulse is the content of BOAA a poisonous amino-acid which affects the nervous system if consumed in large quantities over long periods. The danger level is exceeded if the daily intake of Khesari dal is more than 25 percent of the diet. The poison caused a muscular paralysis called lathyrism.

Loss of sensibility in the joints and spasmodic cramps forming the calf muscles into hard balls are the first symptoms. The disease can be stopped at this stage by avoiding khesari dal completely, but if the consumption continues it will end up in chronic paralysis of the lower part of the body. Lathyrism is most common among men between 15-45 years of age. There are fewer victims among women, who possibly are resistent by a sex hormone. The disease sometimes strikes children and causes death in a few days. Lathyrism has been known to man for thousands of years. Hippocrates in 410 B.C. mentioned that men and women consumed too many peas became incapable of walking. In Germany cultivation of 'the poisnous pea' was prohibited in 1671. France was affected by an 'epidemic' around 1830. The tragic phenomenon hardly is discussed by the mass media, and little information has been given to the poor as to how to avoid being poisoned. The most tragic point is that all these thousands of victims easily could have avoided being crippled. Khesari dal can be de-poisoned very simply. Parboil the pulses or leave them to soak hot water, then let them dry in the sun.

085 Haque, Md. Emdadul. Medical aspects of lathyrism. In Touch. 1982, No. 53, p. 7-8.

Lathyrism is a disease of nervous system characterised by paralysis of lower limbs. It is a selective spastic paraplegia. The lower motor neurones of the inferior extremities are affected resulting in limitation of movement and pain in the lower limbs and often complete paralysis of the legs. This disease is caused by excessive and prolonged consumption of Khesari (seeds of lathyrus sativus or other species) as a main food usually at the time of scarcity or famine. The toxin of this plant causes selective destruction of the lower motor neurones, an irreversible condition. The severity of degree of affection depends upon period and amount of consumption of khesari as major portion of food intake. In summary, the progress of the disease proceeds through four stepes: first stage is characterised by weakness of the lower limbs with spasticity of the leg muscles, so that movement at the knee and ankle joints are restricted and painful. In the second stage flexion of the knee knee is more marked and there is a certain amount of inversion of the foot with a tendency to walk on toes. In the third stage the symptoms described above are more marked and the affected person can walk only with the help or support of crutches or a full length stout stick. In the fourth or last stage the knee joints became completely flexed and standing posture as well as walking, even with support, becomes completely impossible.

086 Huque, Quazi Md. Emdadul. Use of boiled and fried Khesari (Lathyrus sativus) in growing chick ration (M.Sc. Thesis). Mymensingh, Bangladesh Agricultural University, Department of Poultry Science, 1976.47 p.

The experiment was carried out for a period of 16 weeks to compare the effects of feeding value of both processed (boiled and fried) and unprocessed (raw) Khesari (Lathyrus sativus) in growing chicks on body weight, feed consumption, feed efficiency and mortality and also to study the effect of toxicity. There were 108 chicks used in the experiment and were divided into three groups having three replications of 12 chicks each.Group number one, two and three were supplied with raw, boiled and fried Khesari respectively. The average body weight per chick of three groups raw, boiled and fried at the age of 123 days were 762.9 grams, 895.3 grams and 849.8 grams respectively. The average weight gain was highest in boiled khesari which was significantly (statistically) higher from raw khesari. But no significant difference was observed between boiled khesari was higher compared to fried khesari. The results indicate that feeding of processed khesari was superior than unprocessed khesari and boiling was more effective than frying. The average feed consumption per chick for raw, boiled and fried khesari were 5893.8 grams, 6498.6 grams and 6444.4 grams respectively. Feed efficiency for raw, boiled and fried khesari were 8.33, 7.73 and 8.12 respectively. Feed effieiency was highest in boiled khesari and the difference was highly significant from raw and fried khesari. There was practically no difference in mortality among the different groups. It is evident from the experimental results that the performance of feeding boiled khesari to growing chicks was superior in all respect. It was assumed that the boiling of the khesari reduced toxicity or increased digestibility or palatability of feed more completely than frying method used in this experiment. From the results of this experiment and the findings of the previous workers, it can be concluded that raw khesari should not be fed to chicks as it is neither safe nor economical.

087 Hussain, Muhammad. Quality studies relating to neurotoxin and protein contents of germplasms of lathyrus seeds. Report of Sabbatical leave Research at BARI, November 23, 1983 to May 22, 1984, Mymensingh, Mymensingh, Bangladesh Agricultural University, Department of Biochemistry, 1984. p. 4-11.

Consumption of Lathyrus seeds was long known to cause a paralytic disease called lathyrism. Incidence of this disease is quite high in Bangladesh affecting

mostly the poor and landless people in the northern part of Bangladesh. The disease is generally reported to occur during the period when food is scarce and people depend only on khesari seeds for their daily caloric intake for at least 3 months consecutively. It was, therefore, felt quite urgent that the germplasm of khesari either exotic or local which are available in Bangladesh, are analysed for their neurotoxin content and thus it may be possible to find a few varieties which are low in neurotoxin contents which will then be dealt with by agronomist and plant breeders for their multi-plication. The study revealed that the protein of the various germplasms ranged from 25% to 35%. About fifty percent of the germplasms of lathyrus sativus seeds had more than 30% protein in which 3668/25 and 3600/2 (1983) had the highest protein contents, being 35.10% 34.25% respectively. The ODAP contents varied from 0.56% to 1.8%. Out of the total germplasms, forty five had ODAP content less than 1% of these 3976, 3955, 3941/1983, 3968, 3716, 3607 had the lowest ODAP content varying from 056% to 0.77%. Contrary to the finding of Barat et. al.(1979), there does not seem to exist a negative relationship between ODAP content and protein content. But the inference on this report depends on the statistical analysis. The thousand seed weight ranged from 32.50 gram to 56.70 grams. The thousand seed weight is not found to be related to the protein and ODAP content. Statistical analysis of the data may reveal fact about this. Preliminary work on the neurotoxin content of husk showed that husk contained negligible amount of the toxic principle, but the works need be repeated. Further work will involve the repetition of the analysis of the BOAA contents of those germplasms which were found to be low in neurotoxin contents as well as those having high neurotoxin contents. Statistical analysis between protein, neurotoxin and thousand seed weight will offer a better picture which will lead to the identification of a few promising varieties to be recommended for intensive cultivation.

088 Idris, S.M. Replacement of Khesari; the only way for permanent eradication of human lathyrism. In Touch. 1982, No. 53, p. 11-12.

Pulses are the chief source of vegetable protein. So, mass replacement of khesari should be made through an alternative pulse. The motor dal (field pea) may well be the best substitute for khesari. Motor seeds at the rate of 16-18 seers per acre can be broadcast in the B. Aman paddy field in exactly the same way as khesari.

The inputs which are required and the return obtained are almost the same as khesari. Peas can be consumed as a fresh vegetable and as well as dal after the maturity of the seeds. The green creeping plant of motor and the straw after threshing could also be used as fodder like khesari. The only problem of motor cultivation is that the'sak' (the young leaves and branches) and green pods are stolen away from the field causing poor yield. This primarily happens in isolated cases. If large scale motor cultivation is undertaken, then there would be no such problem of stealing pods and sak. However, overnight replacement of khesari is not possible. Concentrated efforts should be taken to create awareness among the general public about the poisonous effects of khesari utilizing all available media. The Agricultural Information service should also publicize these messages through their communication structures. Extension workers can play a vital role to motivate the farmers to grow alternative crops. In this way the tradition of khesari cultivation may be broken down, freeing a vast number of rural people from the hazards of lathyrism.

089 Institute of Public Health, Nutrition, Dietetics and Food Science. Annual Report 1977-78. Dhaka, IPHN, 1978.

Describes nutritative value of food stuffs of Bangladesh. Determines the toxic factor in Khesari dal.

090 Jahan, Khursheed. Studies on neurolathyrism. Thesis (Ph.D. in Nutrition). Dhaka, University of Dhaka, Institute Nutrition and Food Science, 1983, p. 154.

Neurolathyrism may occur at any age, but the incidence is the highest in young adults between 15-30 years. The syndrome appears in human due to continuous eating of khesari as staple for 3-6 months. The attack of the neurolathyrism is usually very sudden, the symptoms start with aching of waist and rigidity of calf muscles and partial or total loss of control over the lower limbs. Some patients have exaggerated knee and ankle jerks and ankle clonus. The isolation of neurotoxin was done from L. sativus seeds B-N-oxalyl-L a-b diaminopropionic acid (ODAP) by RAO et.al, Adiga et al, Murti et al. Rukmini isolated another toxic factor from khesari seeds and established the structure of the toxin as N-B-D-glycopyranosyl-N-L arabinosyl a,b diaminoprionitrib. Nagarajan et.al. and Murti mentioned presence of the osteotoxic substance in L. sativa seeds. The khesari toxin ODAP (b,oxalyl-L,a,b diamino propionic) produces neurological symptoms in very young animals. Ascorbic acid protects experimental animals from the neurotoxic effort of toxin present and the khesari.

Monosodium glutamate (MSG) when given to ascorbic acid deficient adult guineapigs and adult monkeys produce the neural symptoms. Ascorbic acid prevents or cures these toxic syndromes, When there is enough ascorbic acid in the diet or when the animal is able to make its own ascorbic acid, ODAP finds these receptor sites already occupied by ascorbic acid and therefore, it is kept out. It may quite be that when a ODAP molecule is once bound with the receptor it is stuggish in dissociating itself from the receptor. This may explain the slow recovery of neurolathyrism or that it causes in severe cases irreversible changes in the physiological property of the central nervous system. Thus it is found that a new role of ascorbic acid in the physiology of central nervous system which was not thought of before.

091 Jahan, Khursheed; Ahmad, Kamal Uddin. The first person over to recover from neurolathyrism in two centuries. Nutrition News, 1982, 2(5), p.8.

Kabiruddin, a youngman of 22 from Kushtia felt paralysed in both the legs in 1982. He was treated with 500 mg of L-ascorbic acid (i u) for two weeks and then given same amount of vitamin C orally every day. At the end of two weeks shivering was gone and he could walk with more confidence. After 2 months Kabir was fully recovered. He was advised to eat every day a lot of fresh citrus fruits and vegetables which were not part of his daily diet when he got sick. Kabiruddin is perhaps the first person ever to recover from disease neurolathyrism in 2 centuries that the disease has been known.

092 Kabir, Yearul; Ahmad, Kamaluddin. Protective role of vitamin C against neurolathyrism in guineapigs. Journal of Pakistan Medical Association, January 1985, p. 2-5.

Guineapigs maintained on a vitamin C deficient diet for 30 days lost body weight (13.3%) and had reduced level of of vitamin C (48.9%) in the sorum. These guineapigs demonstrated a consistant pattern of neurological signs of neurolathyrism when administered intraperitoneally with an extract of lathyrus sativus seeds, equivalent to 31.5 mg of active toxin, B-N-oxalyl L-d, B-diaminopropionic acid (ODAP). On the other hand, animals in the control group which received the vitamin (15 mg/day/head) throughout the experimental period were resistant to these symptoms after the same level of the toxin administration. The results therefore demonstrate that vitamin C has a protective role against neurolathyrism in adult guineapigs.

093 Khaleque, A., Rahman, A. Utilization of Khesari dal (Lathyrus sativus) in processed food products. Proceedings of the 4th and 5th Bangladesh Science Conference, Rajshahi, 2-5 March, 1980, Dhaka, BAAS, 1980, p. 162.

Although the production of khesari dal is the highest of all pulses grown in Bangladesh, its use is limited to the poorer section of the population due to several inherent factors. Khesari dal is a very valuable protein source and its proper use can solve some problems of protein malnutrition. The detrimental substances and the indigestible carbohydrates were removed and the protein and starch fractions were isolated from presoaked, unsoaked and powered khesari dal. The pH and salt solutions have no effect on higher extractibility of protein and starch over that of water. The higher amount of protein and starch was obtained from presoaked dal than that of either from non-soaked or powered dal. The use of isolated protein and starch fractions may find use in preparation and new food products.

094 Kaul, A.K.; Islam, M.Q.; Begum, K. Variability for various agronomic characters and neurotoxin content in some cultivars of khesari (Lathyrus sativa L) in Bangladesh. Bangladesh Journal of Botany, 1982, 11(2), p. 158-167.

One hundred and seventy two cultivars of khesari (Lathyrus sativus L) were analysed for the lathyrism causing toxin, namely, B N-oxylyl-L-a -B diamino propionic acid (BOAA). Three cultivars having significantly lower toxin content were identified. No association was found between the toxin content and any of the agronomic or morphological character. BOAA content was not correlated with protein content in the grain. Low toxin content of lines was found to be stable under varied environmental condition.

095 Long, W. Meredith. Lathyrism; explained for non-medical people like me. In Tough. 1982, No. 53, p. 17.

There is a poison in khesari. In small amounts it does no harm. Khesari can also be cooked so as to lesson the amount of the poison. But when khesari is eaten over a long period of time with almost no other foods, more and more poison comes into the body. Once the poison becomes strong enough it begins to kill the motor nerve cells in the legs. Once the motor cells are completely dead, messages can no longer run between the brain and the muscles in the legs. The poison does not hurt the sensory nervous system. The brain can still receive messages from the legs but it

cannot send messages back again. Since these messages from the brain to the muscles in the legs are necessary to make the legs move, the person can no longer move his legs. He is paralyzed. Because he can no longer use the muscles in his legs the muscles become weaker and weaker and the legs become thinner and stiffer and stiffer. The end result is the beggar that you see who from the legs up may be strong and healthy, but his legs are thin, curled up, and useless. He must push himself along on his bottom using his hands, crawl on his knees, or be pushed in a wheeled cart. Most cells in the body can reproduce or repair themselves. A cut will heal. Bones will grow back together. Nerve cells, however, once they are gone, forever. They cannot be healed and new ones will never grow in again. Therefore, once the poison has killed the nerve cells leading to the legs. the damage is permanant. The only way to control lathyrism is to keep people from eating the poison. Lathyrism is therefore much more of an educational, socio-economic, and agricultural problem than a medical one.

096 Masum, M. The battle against lathyrism; some considerations on economic front. In Touch. 1982, No. 53, p. 18-20.

Khesari is the cheapest of all pulses. It virtually provides most of the protein requirement of those who can be categorised as absolutely and extremely poor. At times of floods and droughts, in periods of famine and acute shortages, the poorer sections of the people substitute khesari for rice and wheat, eat it as a staple food and thereby become victims of lathyrism. In some areas where khesari is produced the labourers are also paid in terms of khesari, in much cases, almost automatically enters into their consumption basket. Consumption of khesari as a staple depends mainly on the relative price of khesari vis a vis other traditional staple food crops like rice and wheat, and on the income distribution prevailing in the country. The change in income distribution over 1963/64-1976/77 as it occured in Bangladesh. It is quite obvious that inequality has grown considerably over this period, particularly in rural areas. The per household real income of the bottom 85% has declined from Tk. 1352 in 1963-64 to Tk. 910 in 1976-77 while the income of the 10% has increased from Tk. 4571 to Tk. 4715. As income distribution becomes more and more skewed, the number of persons below the absolute poverty line and also the number of potential victims of lathyrism also increases.

097 Mian, Abdul Latif. Grow more pulses to keep your pulse well; an essay of Bangladesh pulses (includes Lathyrus sativus), Mymensingh, Bangladesh Agricultural University. Department of Agronomy, 1976, p. 14.

In respect of area and gross production, khesari is the most extensively grown and mostly producing pulse, commanding 26 and 27%, respectively, of the national pulse area and production. On the basis 5 years (1969-73) average yield and production, khesari gave the yield (2.4 md/ac) and production (21,000 ton) of seed protein. In protein yield, khesari was followed by Mashkalai. It is a common belief that khesari is harmful for human health as it causes lathyrism. Khesari is a very good cattle feed both as a green fodder and a protein concentrate and is widely used as such no harmful effect of khesari on cattle health in Bangladesh is known to have been reported. Indian Council of Agricultural Research (1969) reports that the former reports describing khesari for causing lathyrism in man and even death to animal have been disproved by recent investigations. It suggests that it is not khesari but a common weed akta (Vicia sativa) which grows with khesari, that causes the ailment while Whyte et al. (1966) have not indicated Vicia sativa to be toxic.

098 Rahman, A; Latif, M.A. Effect of feeding khesari (Lathyrus sativus) in growing and laying birds. Thesis (M.Sc. A.H.). Mymensingh, Bangladesh Agricultural Univ., 1973.

Three experimental rations (commercial feed; basal + 5% Khesari and basal + 10% khesari) were used to study its effects upon the performance of growing and laying birds under the Agricultural University Farm conditions, Mymensingh. It was observed that the group feed with basal 10% khesari showed highest body weight gain, highest egg production, lowest mortality and best feed efficiency (3.98) amongst the groups studied. Feed efficiency was poorest (4.32) in the group feed with basal (commercial feed) and intermediate (4.32) in the group feed with 5% Khesari. Statistical analysis indicated that the treatment ration had no significant influence on the mortality of birds.

099 Sarker, Profulla C. Lathyrism; a disease of poverty in rural Bangladesh. In Touch. 1982, No. 53. p. 2-4.

Lathyrism is a toxic neurological disorder due to over consumption of Khesari (Lathyrus). The problem of excessive consumption arises when Khesari is used as the staple food, or as a major part of food for several

month consecutively. The consumption of Khesari is associated with poverty, famine, ignorance, and bad food habits. Lathyrism is a poor persons disease. In the study area it was found that about 57 percent of the victims of lathyrism were landless labourers and the rest of the victims were subsistance farmers. New cases of lathyrism are closely related to famine. Usually the famin breake out because of destruction of food crops due to natural calamities. In this sort of situation the people have no choice but to increase their consumption of Khesari during the period of 1972-75 when the price of rice and wheat was high, the number of new cases of lathyrism increased to epidemic propertions in the study area. Ignorance is also associated with lathyrism. In the study area about 57 percent of the victims were illiterate. The disease ecours only when the Khesari is eaten in relatively large quantities. People prepare flour from Khesari and mix this with other pulses locally known as anaj. From the anaj a special kind of unleavened bread is prepared called dhapra or chapra. This food is not boiled and therefore the toxin is not removed. Consequently, this has its bad effects. Sometimes the people eat half-boiled Khesari which is also harmful. If Khesari is eaten as dal (soupy relish) with rice or roti (Chapati), then lathyrism does not occur. In the study area most of the people of the poorer section were half fasting. The belief of the patients about the causes of lathyrism is the fate, Karma and supernatural spirits (Kirkpatrick; 1979). Most of the people in this study area are engaged in agricultural work, irrespective of whether they are land owners or landless. During the second stage of the disease the patients gradually become inactive. When the patients fail to improve from treatment they become frustrated. They then become crippled physically, economically and mentally. Prevention of the disease and the rehabilitation of the victims are the two services now being provided in regard to lathyrism. The Shaw Unnayan, a voluntary organization is rendering services with the help of the interested organization viz., Swedish Free Church Aid, Swedish International Development Agency and The World Food Programme is providing wheat for the prevention of the disease. Under this scheme two thousand victims are getting one mound of wheat monthly free of cost. In addition 63 development workers have been appointed by the Shaw Unnayan to work in the villages of 23 thanas of Rajshahi and Kustia Districts. There is a motivational programme to change the people's food habit, and also the rehabilitation of the victims. For the rehabilitation of the victims, 2000 affected persons and some of their family members are involved in endiculture (growing of silkworms on leaves of castor oil,

cassava, and sweet potato). To run this programme necessary inputs have been provided for the participants free of cost or of low cost: seeds, seedlings, worm eggs, chemicals, working house etc. There is also a revolving fund for providing spinning wheels on credit. Shaw Unnayan has already distributed spinning wheels among the victims and an additional 500 victims have been given training to operate the spinning wheels in the future. A shorterm loan has been given to 15 victims for production of ice cream sticks. 19 victims have been trained in bee keeping. These services are not adequate, however, because the total number of victims is about 11,000. Among them only 2000 victims are being helped.

## Personal Author Index

SUBJECT INDEX