ANNUAL REPORT

1995-2001

Rajendra Agricultural University

Pusa-848 125 (Samastipur) Bihar

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FOREWORD

After the bifurcation of Bihar, Agriculture is the only alternative to meet required demand of divided Bihar for its development. In this context, there is need to reorient the programme and policies to face the new challenges and task ahead. Rajendra Agricultural University, Pusa, Bihar has started working in this direction by prioritization of research areas to be taken up for the purpose.

Research related to Crop Sciences, Veterinary Sciences, Agricultural Engineering, Fisheries, Dairy Technology, Basic Sciences, Home Sciences are being carried out in this University through sustained efforts of scientists in various research laboratories located in different agro-ecological zones spanning throughout the State. Location specific problems are being dealt with for the benefit of farmers of the state and production oriented technologies in various areas have been generated. There has been commendable achievements in area of Honey Production Technology, Mushroom Production Technology, Agri-horti Technology, Boro rice Production Technology, Maize Production Technology, Sugarcane Production Technology etc. Number of crop varieties developed by this University in various crops are being successfully cultivated by the farmers where these varieties and other technologies have stood the test of time. The linkages with farmers in remote areas has been strengthened during the period under reference by holding large number of kisan goshties, training etc.

The academic programme of this University is running regularly and sessions begin in time. The teachers and the scientists of this University have proved to be competent enough to train students at UG and PG level which has resulted into the selection of our students in national competitions in various fields.

The officers and scientists involved in preparation of this report deserves appreciation for their painstaking effort. Deans, Directors, Chairmen, and Heads also deserve thanks for rendering help by sending their respective reports in time for the preparation of this document.

(V. P. Gupta)
Vice-Chancellor

I ACADEMIC ACTIVITIES

Under-graduate Programme

The University awards Bachelor degree in Agriculture, Veterinary & Animal Sciences, Dairy Technology, Fisheries, Home Science and Agril. Engineering. The intake capacity of the various programmes of the University at Under-graduate level is as follows :

Agriculture	:	100	Veterinary	:	60
Dairy Technology	:	25	Fisheries	:	10
Home Science	:	25	Agril. Engg.	:	25

Reservation policy of State Govt. is strictly followed in the admission based on the Competitive test conducted. The University has following Colleges with the faculty mentioned against their names :

	Faculty		College
A	Agriculture	1	B.A.C., Sabour
		2	T.C.A., Dholi
B	Veterinary	1.	B.V.C., Patna
		2.	S.G.I.D.T., Patna
		3.	College of Fisheries, Dholi
C	Agril. Engg	1	C.A.E., Pusa
D	Home Science	1	College of Home Science, Pusa (4 year degree Programme)
E	Basic Sciences & Humanities	1	Faculty of Basic Science, Pusa

P.G. Departments are located at Pusa, Patna, Sabour and Dholi

Intake capacity,students admitted & declared passed in Under-graduate programme during the year 1995-96

Programme	Intake capacity				Students admitted	Students passed	
	Sanction seat	40% extra *	10% ICAR	Total			
B.Sc. (Ag.)	100	40	10	150	141	79	(Admitted in 91-92 and before)
B.V.Sc. &A.H.	60	24	06	90	90	77	(Admitted in 90-91 and before)
B.Tech.(Agril.Engg.)	25	10	03	38	38	28	(Admitted in 91-92 and before)
B.Sc.(D.T.)	25	10	03	38	38	01	(Admitted in 90-91 and before)
B.Sc.(Home Sci.)	25	10	03	38	34	12	(Admitted in 92-93 & before)
B.F.Sc. **	10	04	01	15	--	--	

* 40% extra admission was effected by the approval of Academic Council.

** Admission was not taken in this year.

Number of candidates admitted and declared passed in Under-graduate programme during the year 1996-97 to 2000-2001.

Programme	Intake Capacity					Candidates admitted					Candidates declared passed				
	96-97	97-98	98-99	99-2000	2000-2001	96-97	97-98	98-99	99-2000	2000-2001	96-97	97-98	98-99	99-2000	2000-2001
Under- graduate															
B.Sc. (Ag.)	100	100	100	100	100	92	71	51	76	94	71	24	27	57	33
B.V.Sc. & A.H	60	60	60	60	60	63	62	56	62	59	53	51	37	32	79
B.Tech (Ag. Engg)	25	25	25	25	25	23	21	18	14	22	13	09	09	17	23
B.Sc. (D.T.)	25	25	25	25	25	22	24	20	11	19	10	09	14	21	01
B.Sc. (H.Sc.)	25	25	25	25	25	14	12	04	11	15	15	05	09	10	08
B.F.Sc.	10	10	10	10	10	10	10	08	08	08	07	01	06	05	-
Total	245	245	245	245	245	224	200	157	182	197	169	99	102	142	144

The courses in Under-graduate programme are being taught in accordance with Deans Committee Report of ICAR. Courses in Computer & Biotechnology have been introduced giving a modern look to the course curricula.

Post-graduate Programme.

Post-graduate programme exists in the disciplines of Agronomy, Soil Science, Entomology and Agril. Zoology, Plant Pathology, Agril. Economics, Plant Breeding, Extension Education, Nematology, Horticulture (Olericulture), Horticulture (Pomology), Agril. Statistics, Botany and Plant Physiology, Biochemistry, genetics, Veterinary Medicine, Vety. Anatomy, Vety Pathology, Gynaecology, Pharmacology, Parasitology, Vety. Public Health, Vety Animal Nutrition, Animal breeding, Vety. Physiology, vety. Surgery and Radiology, Vety. Microbiology, Livestock and Poultry Management, Soil and Water Engineering, P.H.T., Farm Machinery, Food Nutrition, Extn. Edn. (H.Sc.), FRM and LPT. Admission in M.Sc. programme are being done through Competitive Test.

The University is emparting Ph.D. degree in Agronomy, Plant Breeding, Soil Science, Plant Pathology, Entomology & Agril. Zoology, Agril. economics, Extension Education, Horticulture (Pomology), Horticulture (Olericulture), Botany & Plant Physiology, Genetics, Vety. Anatomy, Vety. Microbiology, vety. Parasitology, Vety. Medicine, Vety. Pharmacology & Toxicology, Animal Breeding & Genetics. Admission in Ph.D. programme has been decided to be taken through Competitive test from session 2001-2002.

Financial assistance in the form of fellowship @ 1200/p.m. to the students of Mastger Degree Programme and @ 1400/p.m. to the student of Ph.D. programmes is provided to 75% of the intake capacity of different programmes.

Intake capacity, students admitted and declared passed in M.Sc./Ph.D.programme during the year 1995-96

Programme	Intake capacity			Candidates admitted	students passed	
	Regular Student	In-service Candidate	Total			
M.Sc.(Ag.)/M.Sc.	90	22	112	92	48	(Admitted in 1993-94 and before)
M.V.Sc.	35	12	47	19	08	- do -
M.Tech.	07	03	10	10	09	- do -
Ph.D.	25	20	45	20	24	(Admitted in 1992-93 and before)

Statement showing the details of candidates admitted and passed in P.G. as well as Ph.D. programme during the period from 1996-97 to 200-2001

Programme	Intake capacity					Candidates admitted					Candidaes declared passed				
	96-97	97-98	98-99	99-2000	2000-2001	96-97	97-98	98-99	99-2000	2000-2001	96-97	97-98	98-99	99-2000	2000-2001
Post-graduate Programme/Ph.D. Programme															
M.Sc. (Ag)/M.Sc.	86	86	86	86	86	74	76	80	54	75	34	35	48	73	32
M.V.Sc.	38	38	38	38	38	26	29	29	20	29	-	02	04	16	22
M.Tech	06	06	06	07	07	06	04	02	05	05	05	03	06	03	01
Ph.D.	26	26	26	26	26	16	11	20	26	15	24	05	05	13	03
Total	156	156	156	157	157	122	120	131	105	124	63	45	63	105	58

The quality of our students can be gauged from the fact that the ICAR is now conducting admission tests for admission in different Postgraduate Programme of the State Agricultural Universities of the country as well as ICAR Deemed Universities and the students from the R.A.U. are competing in largest number in those examinations and our alumni are almost now in most of the other States of the country pursuing Postgraduate Education in various Branches of Agricultural Sciences. At Undergraduate level, this University was almost one of the first in the country to have introduced the Combined Competitive Entrance Test almost 20 years ago for admission to 1st year of the B.Sc (Agriculture) Degree Programme. Likewise, this University was also one of the first in the country to have introduced the Rural Agricultural Work Experience Programme for the final year students of the B.Sc (Agriculture) Degree Programme about 12 years ago. In the introduction of Semester System, 10-point grading scale and 50:50 combined system of Internal and External grading also RAU has been one of the first Agricultural Universities in the country.

Added to this, is the fact that RAU has now introduced Entrance Test for Postgraduate Admission also since 1999. Likewise, from the year 2001, Entrance Test for admission to Ph.D programme has also been approved by the Academic Council and is going to be implemented. All these efforts are going to help in ensuring quality and excellence in the area of Agricultural Education, in particular and Agricultural Development, in general.

The Scientists of the Faculty of Agriculture are actively engaged in all the three functions i.e., Teaching, Research and Extension Education so that a teacher also does some research and vice versa. Likewise, a teacher/researcher is also in touch with the farmers and the Extension system of the State Government. The Institute Village Linkage Programme (IVLP) is providing a strong link between the teachers/scientists and the farmers and the feed-back that is received from the farmers help in refining our technology.

Departments have further increased the number of Seminars/Symposia and the teachers/scientists are encouraged to participate in various national and state level seminars/workshops/symposia etc.. organized by different Agencies including the ICAR and other funding Agencies.

As part of Development Assistance provided by the Indian Council of Agricultural Research. the Undergraduate Colleges at Sabour and Dholi as well as the Postgraduate Departments of the Faculty at Pusa have been strengthened considerably in terms of providing new equipments/appliances to the Laboratories. meeting the requirements of chemicals and such other items for effective practical classes by the students. modernizing the Seminar Rooms with audio-visual equipments. providing the Computer facilities to the Departments and making available additional text books etc.. related to different areas in the University Library.

As part of the catch-up grant provided by the Indian Council of Agricultural Research. old buildings have been given a fresh look by due rejuvenation and renovation process. A new building in the Faculty at Pusa i.e., the Department of Forestry Building and Girls Hostel at Dholi initiated in the year 1992-93 have now been completed. The facilities of Apiary have been further strengthened and students are also given vocational training in order to learn the techniques of Bee-keeping. Likewise. facilities for Mushroom culture and growing Horticultural Crops under the shades of trees and perfection of the Agro-Horti and Agro-Forestry System are being demonstrated to the students and. of course. the Visiting Extension Officials and the farmers.

Dr. P.N. Jha. Dean. Agriculture (Former Vice-Chancellor) got the highest National Award of the Indian Society of Extension Education i.e., Dr. D.K. Mishra Memorial Lecture Award for the year 1999-2000 on 29-31 May 2001.

Dr. P.N. Jha is also the first Professional of Agricultural Extension in India to have been inducted as a Fellow of the National Academy of Agricultural Sciences with effect from 1st January, 2001.

Dr. Ram Sakal, Chief Scientist (Soil Micronutrients) got the coveted S.N. Ranade Memorial Award at National Level in October 2000 for excellence in micronutrient research.

Dr. Ram Sakal, Dr. A.P. Singh and Dr. R.B. Sinha jointly received the TSI/FAI Award on Plant Nutrient sulphur for the year 2000.

During this period Dr. Ramagya Thakur the Chief Scientist (Rice) now retired got Dr. B.P. Singh Memorial Award of RAU for his significant work in Rice Breeding.

Dr. J.P. Upadhyay, Associate Professor of Plant Pathology was declared as the Best Teacher by the RAU from the Faculty of Agriculture in the year 2001.

Despite the above encouraging developments, the Faculty today suffers from acute shortage of teachers/scientists over the past few years because of non-filling up of the vacant posts and the large number of people retiring year-after-year. This is an alarming situation and is bound to adversely affect the quality as well as the output. Today, almost 90% posts of University Professors/Chief Scientists in the Faculty are vacant. Almost 60% of the sanctioned posts of Associate Professors/Senior Scientists are also vacant. A number of posts of Assistant Professor/Junior Scientists cadre are also vacant particularly in teaching side. These posts are all sanctioned by the State Government. The position by 2002 is going to be further alarming when a number of senior level teachers will also retire. Therefore, a serious thought is to be given to improve the situation by filling-up of the posts by direct recruitment at the earliest so that the situation does not turn-out to be beyond remedy.

The funds under Non-Plan Head for the class room teaching and for meeting such other essential requirements of contingencies for recurring and non-recurring items are also not made available by the State Government except for the salary payment and naturally the teaching programme is bound to suffer.

II. RESEARCH ACHIEVEMENT

AGRICULTURE

RICE

The major research thrust has been to increase rice productivity through breeding high yielding varieties and designing more efficient system of Crop management for irrigated, rainfed low land, deepwater, summer and Boro seasons.

Germplasm maintenance and varietal development

* Total number of 951 (1996), 1198 (1997), 1302 (1998), 1097 (1999) & 960 (2000) germplasms were maintained and evaluated. Considerable number of segregating breeding materials were handled at Pusa, Patna and Sabour Centres during these periods.
* During the period under report the rice research unit of the University has credit to develop following high yielding varieties for different agro-ecosystems of the State. Their characteristics features are as follows :-

Variety	Duration (days)	Hights (cm)	Suitability	Yield (q/ha)	BLB	BS	BPH
Kishori	140	115	Rainfed low land	60 q/ha	MR	R	R
Satyam	140	115	Low land	60 q/ha	R	R	R
Richharia	130	85	Boro & Kharif	60.5 q/ha	MR	MR	-
Dhanlaxmi	145	95	Boro & Kharif	60.5 q/ha	R	R	-
Saroj	115	100	Upland	50 q/ha	R	R	-
Santosh	140	120	Rainfed low land	50 q/ha	MR	R	-

Agro-technology

* In rainfed lowland condition, Rajshree has been found suitable for normal and delayed transplanting and responded favourably to nitrogen (N) application up to 80 kg/ha. In ill drained condition total basal application of N through Neem coated Urea was found superior.
* Suitability of various varieties according to ecologies have been worked out. Proper Plant Population per unit area has been found to increase the yield many fold. Direct seeding has been found more economical than transplanting in flood-prone area.

* Under post flood condition medium late, late and Photo-sensitive varieties have been recommended for transplanting.
* To increase the total productivity of deepwater ecosystem mixed cropping with mung bean or sesame has been found remunerative and has been recommended.

Plant protection

* Application of granular insecticide i.e. Phorate or Carbofuran @ 1.0 kg a.i./ha in the nursery 5 days before pulling the seedlings has been found most effective to control the infestation of Stem borer, Whorl maggot and Leaf folder at tillering stage. This recommendation is included in package of practices.
* To control major insect-pests in standing crop, spraying of Monocrotophos/ Endosulfan/Ekalux @ 0.5 kg a.i./ha or granular application of Phorate or Carbofuran @ 1.0 kg/ha have been recommended.
* Seed treatment with Bavistin or Emisan-6 @ 1 g and 2 g/kg seed respectively have been recomended. The treatment increase 10-15 per cent more germination and provides healthy seedling for higher yield.
* Date of sowing has pronounced effect on yield and development of diseases. Late sowing after 20th June showed appreciable decrease in yield and increase in severity of diseases especially in long duration varieties. Therefore, early sowing is recommended.
* Nitrogen application has pronounced effect on severity of diseases especially BLB and Sheath rot. Balance dose of NPK (80:40:20 kg/ha) has been recommended.

WHEAT

Germplasm maintenance & varietal development

* 1491 germplasm lines (774, 493 & 224 at Sabour, Pusa & Patna respectively) obtained from National & International sources were maintained & evaluated :-
* RW-3413 variety of Wheat was released by R.A.U., Pusa & Bihar State variety release Committee in 1996. This variety has been recommended for high fertility, normal sown irrigated conditions. It is a semi dwarf variety with dark green leaves and white fusiform ear. The variety has higher yielding ability, more resistance to brown rust & high to lerance to Karnal bunt as compared to U.P. 262. The average yield is 45-50 q/ha. Grains are amber coloured & semi-hard.

* Some promising varieties developed at other centres of the country were also recommended for cultivation in Bihar on the basis of their excellent performances.

Agro-technology

* Maximum yield of about 50 q/ha was obtained at 150:60:40 kg NPK/ha which was significantly superior than the yield obtained at 120:60:40 kg N:P:K/ha. Among the varieties PBW-443 recorded the highest grain yield.
* Under restricted irrigation, it was found that grain yield increased significantly with increasing levels of irrigations. The maximum mean grain yield was obtained from three irrigations viz., pre sowing + CRT + late tillering stage.
* The delay in wheat sowing beyond 30th November results in yield decrease at the rate of 30 kg/ha/day.
* Under seed management in surface seeding in rice wheat cropping system, seed rate of 175 kg/ha recorded significantly higher grain yield than the lower seed rate of 125 and 150 kg/ha.
* In wheat-mustard inter-cropping system, sowing of one row of mustard after three rows of wheat or paired row of mustard after six rows of wheat recorded significantly higher wheat equivalent yield than one row of mustard after two rows of wheat or two rows of mustard after four rows of wheat and also wheat grown alone in pure stand.

Plant Protection

* Delayed sowing of wheat and poor weed management are the two most important problems in rice-wheat cropping sequence. Use of Zero-till-seed-fertilizer drill has shown great promise in reducing turn around period between rice harvest and wheat seeding at experimental station and also at farmer's field. A part from timely sowing; it also reduced phalaris minor problem.
* A number of herbicides and their combinations were evaluated. Herbicides like Isoguard (Isoproturon + 2,4-D) at 0.75 + 0.5 kg/ha, leader (Sulfosulfuron) at 22 g ha^{-1} and sencor (metribuzon) at 250 g ha^{-1} was found very effective against phalaris minor and other broad leaved weeds in wheat field.
* Screening of the genotypes for resistance against leaf blight disease under heavy disease pressure was done. None could be rated as resistant. 44 were moderately

resistant. Brown rust was another important disease. Black rust and loose-must did not appear.

* Survey of wheat growing areas for ear cockle disease indicated a low (0-5) per cent of disease incidence on limited areas in the district of Madhubani and Darbhanga. None of the variety was found to be resistant against ear cockle disease.

MAIZE

Germplasm maintenance and varietal development

* Two quality protein Maize (QPM) hybrids with high yield potential having 48 per cent and 40 per cent yield superiority over best check have very recently been released by R.A.U., Pusa in the name of "SHAKTIMAN-1" and "SHAKTIMAN-2" which may be used for replacement of normal maize hybrids and composites specially during Rabi and Summer. These QPM hybrids have high quantity of tryptophan & lysine (1.01 % and 4 % respectively) which were deficient in the normal maize hybrids. Because of high yield potential (120 q/ha) and nutritive quality (protein rich), these QPM hybrids have better acceptability amongst the farmers and are suitable for infant food, food for old/aged persons as well as lactating mothers and quality feed for animals. The grains are white & yellow coloured.

* Bihar has been poineer in winter (rabi) maize cultivation. Separate winter maize breeding programme was started & varieties suitable for winter (rabi) cultivation were developed & released from Dholi centre of R.A.U., Pusa (viz:- Laxmi, Hemant, Rajendra Hybrid Makka 1 & 2) with production potential of 65-76 q/ha. Breeder seed production & also development of suitable package of practices were done during the period under report.

* A total of 77 germplasm lines and 255 inbred lines (180 white & 75 yellow) are available with the Dholi centre.

* An elite bulk population of late white group has been developed from 12 component genotypes through chain crossing & random mating.

Agro-technology

* The optimum date of sowing during Kharif season was found to be 25th May to 10th June while for Rabi season it was 15th October to 20th November.

* The optimum plant population for getting desired/maximum yield was found to be 53,000 and 66,000 per ha respectively for Kharif & Rabi season respectively.
* Row to row distance of 75 cm & 75 cm and plant to plant distance of 25 cm & 20 cm, respectively should be followed during kharif & Rabi seasons respectively for better yield.
* Application of Atrazine or Tafazine @ 1.5 a.i./ha as pre emergence both in Kharif and Rabi seasons reduce the weed flora in maize and has been found most economical.
* Split application of nitrogenous fertilizer i.e. 1/3rd at sowing, 1/3rd at earthing up and 1/3rd at tasseling gave the maximum efficiency of fertilizer use.
* To get maximum yield during rabi season irrigation should be applied at soil moisture availability of 70 per cent before tasseling and 70 per cent after tasseling. On the whole six irrigations are sufficient for rabi maize production.
* Inter-cropping as noted below has been found suitable and remunerative for Kharif and Rabi seasons.

(a)	Kharif	(i)	Maize + Groundnut	(ii)	Maize + Arhar
(b)	Rabi	(ii)	Maize + Potato	(ii)	Maize + Pea
		(iii)	Maize + Radish	(iv)	Sugarcane + Maize

* Transplanting of maize in winter season is feasible when late harvesting of paddy crop is done. The yield obtained by transplanted crop is better than the yield obtained by direct sown crop under late sown situation.

Plant Protection

* Disease resistant genotypes of maize were identified for the significant diseases viz :- Maydis leaf blight, turcicum leaf blight, Common rust and Post flowering stalk rot
* **Integrated Disease Management (IDM)**

Proper cropping sequence, timely sowing (25th May to 10 June for Kharif and 1st to 15th November for Rabi). Organic amendment or green manuring, seed treatment with Tricho-derma product or Captaf @ 2.5 g/kg seed before sowing, balanced nutritional application, irrigation at the interval of 20-25 days as per soil moisture condition with suitable drainage facility and if needed, spraying the standing crop with the suitable strength of the chemical as recommended against the particular disease to reduce the disease incidence.

SMALL MILLETS

PROSO MILLET

Germplasm maintenance and varietal development

* A total number of 283 germplasms of prosomillet representing different growing regions are being maintained.
* Out of the total germplasm maintained (i.e. 283), 25 genotypes were identified resistant to shoot fly and Helmintho sporium.
* In Co-ordinated trial, genotype TNAU 137 gave highest grain yield (3358 kg/ha) with 66 days maturity.
* In station trial genotype 5667 recorded highest grain yield (3185 kg/ha) with 68 days maturity.

Agro-technology

* In nitrogen X varietal trial, variety K1 produced highest grain yield of 1372 kg/ha which was 7.2 per cent, 12.7 per cent and 13.9 per cent higher than the varieties TNAU 124, TNAU 112 and TNAU 196 respectively.
* Increasing levels of nitrogen alongwith basal application of 20 kg each of P_2O_5 & K_2O increased the grain yield.
* Nitrogen levels of 40 & 60 kg/ha produced 39.6 per cent and 53.2 per cent higher grain yield as compared to 20 kg N/ha.
* Application of bio-fertiliser increased the grain yield to the tune of 10.6 per cent as compared to Control (i.e. without bio-fertiliser).

Plant Protection

* Local survey for different insect pest of prosomillet indicated shootfly to be its major pest whose incidence varied between 1.00 to 22.0 per cent.
* Out of 283 germplasm screened, 71 proved to be tolerant where as 4 genotypes i.e. GPM 59, GPM 198, GPM 202 & GPM 224 were found to be resistant to shootfly under natural infestation.

FINGER MILLET

Germplasm maintenance and varietal development

* In IVT., genotype IVT 11 recorded highest grain yield (1705 kg/ha) followed by IVT 8 (1696 kg/ha) with maturity period of 103 and 120 days respectively.

* Under AVT early & medium maturity group, genotype AVTE 8 (1746 kg/ha) & AVTM (1704 kg/ha) produced highest grain yield with 82 & 92 days maturity respectively.
* In white ragi station trial, Dholi Marua-1 recorded grain yield of 796 kg/ha with 94 days maturity.

Agro-technology

* Application of increasing levels of nitrogen increased grain yield & differences between any two levels were significant between the limits of 0 to 60 kg N/ha.
* Early rice (Saket - 4) - Potato (RA - 1) - Summer Ragi (RAU - 3) Cropping sequence gave significantly highest net profit of Rs. 28,242/- per ha per annum in comparison to other sequences where potato was replaced by Maize (Rs. 19,525), Lentil (Rs. 12,113) & Rajmash (Rs. 7,702).
* Drilling ragi tended to increase the net profit than transplanting in inter cropping system.

Plant protection

* Survey revealed the incidence of gray weevil (0.51 to 7.12 %), grasshopper (1.23 to 11.01 %), aphids (0.53 to 3.13 %), earhead caterpiller (0.84 to 6.76 %) & shoot fly (0.53 to 7.15 %) on finger millet.
* Of the six natural enemy Complex Spiders, Coccinella & house sparrow posed to be the potnetial predators upon finger millet pest complex.
* Considering the entire pest complex, the genotypes AVTE - 6, AVTE - 8 and AVTE - 11 in early group; genotypes AVTM - 14, AVTM - 2, AVTM - 6, AVTM - 5 and AVTM - 15 in medium group; genotypes AVTL - 7, AVTL - 5, AVTL - 3 and AVTL - 10 in late maturity group & the genotypes IVT - 21, IVT - 24, IVT - 28, IVT - 8 & IVT - 3 in initial varietal trial were screened out to be tolerant to gray weevil, grasshopper, aphids, cutworms, earhead caterpillar & shootfly.

BARNYARD MILLET

Germplasm maintenance and varietal development

* In BAVT, entry BAVT - 10 produced highest grain yield (1140 kg/ha) with 6 days maturity followed by BAVT 8 (1116 kg/ha).
* In station trial highest grain yield was recorded by entry RAU 7 X RAU 8 (152 kg/ha) with 68 days maturity.

Agro technology

* Variety VL 175 recorded highest grain yield of 1311 kg/ha which was 1.2 per cent & 3.6 per cent higher than the varieties VL 178 & VL 29 respectively.
* Increasing levels of nitrogen increased grain yield & significant difference was observed between 0 to 40 kg N/ha levels.

FOXTAIL MILLET

Germplasm maintenance and varietal development

* In IVT, entry FIVT 7 recorded highest grain yield (394 kg/ha) followed by FIVT 8 (372 kg/ha). In AVT, entry FAVT 7 gave highest grain yield (381 kg/ha).
* In station trial, 28 entries were tested in which entry FAVT 11/90 (1000 kg/ha) gave highest grain yield & another 11 entries recorded higher yield than national check i.e. Arjuna (707 kg/ha).

Agro technology

* Variety SIA 326 produced highest grain yield of 1273 kg/ha under agronomical trials which was 4.9 per cent & 8.5 per cent more than the varieties GPUS 25 & TNAM 186 respectively.
* Increasing levels of nitrogen from 0 to 40 kg N/ha increased the grain yield significantly.

PULSES

Germplasm maintenance and varietal development

Crop genotypes developed, identified and finally recommended for cultivation under different agro-climatic situations.

Crop	Genotype	Specialities/Suitability
Pigeonpea	Bahar	Resistant to sterility mosaic, widely adaptable/suitable for cultivation throughout the State, as pure and inter/mixed crop under normal sown condition.
	Sharad	Resistant to Alternaria leaf blight, suitable for pre-rabi sowing as pure crop.
Chickpea	RAU-52	Suitable for Tal and Diara areas under normal sown condition.
	Rajendra Chana - 1 P 256	Suitable for normal sowing in Tal and Diara areas, late sowing after paddy in North Bihar Plain region.
	C 235	Suitable for normal sowing in Tal and Diara

		areas, Late sowing as paira, mixed/inter cropping in North Bihar plain regions.
	Pant G-114	For normal sowing in tal and Diara area; for paira/mixed Inter cropping in North Bihar plain region.
	BR 78 (Green seeded L 550 (Kabuli)	For culinary purposes, to be grown under plant protection umbrella.
Mungbean	Sona PS 16, PDM-54, T-44	For Summer Season
	Amrit	For Autumn planting as catch crop between kharif maize and wheat.
	NP-18, NP-28 PDM-11	For spring sowing.
Urdbean	T 9, Pant U 19, Pant U 30	For summer as well as kharif season.
	Naveen	For Autumn planting
Lentil	Arun (Bold seeded)	For North and South Bihar plain regions.
	Rajendra Masoor - 1	For South Bihar plain region under moisture stress condition.
Lathyrus	BIOL - 212, 222	Relatively llow neurotoxin (BOAA) content and suitable for paira/pure cropping in Bihar plain region.
Rajmash	PDR - 14	Suitable for whole Bihar under irrigated and high fertility condition.
Peas	Rachna (Tall type) Aparna (Dwarf type)	Powdery mildew resistant and suitable for whole Bihar

Agro-technology

Attempts have been made to enhance productivity of different grain legumes through agronomic manipulation combined with exploitation of more efficient Rhizobial strains and also to explore new niches for pulses cultivation. Salient achievements are given below:

* Development of agro-techniques for successful cultivation of Rabi pigeonpea for the first time in the country.
* Determination of agronomic requirements for late chickpea crop after paddy under North Bihar situation.

* Establishment of Rajmash, newly introduced grain legume, through appropriate agronomic manipulation.
* Integrated soil, water, nutrient and weed management strategies for better harvest of different pulses, viz. pigeonpea chickpea, letnil, lathyrus, rajmash and peas, grown either as pure crop mixed/inter/paira cropping.
* Sustainable cropping systems involving grain legumes as an essential component.
* Exploration and exploitation of more efficient Rhizobia strains as ecofriendly agent for fixing atmospheric nitrogen in soil.
* Field evaluation of phosphate solubilising bacteria (PSB) in pigeonpea and chickpea.

Plant protection

As a result of systematic research efforts biotic constraints due to insect pests, diseases and nematodes have been clearly identified and strategies for their management in different pulses have been developed as briefed below :

Problems	Crops & extent of damages	Management tactics
(A) Insect pests		
Pod borer (*Helicoverpa armigera*)	Chickpea (10-50 %) Pigeonpea (5-20%)	Pheromone trapping, integration of cultural control through intercropping of chickpea with linseed/corriander/mustard etc., biological botanical i.e. NSKE (5%), need based application of synthetic insecticide.
Cutworms	All Rabi Pulses in Endemic areas of Tal & Diara (20-80%)	Prophylactic control through pre-sowing seed treatment with chlorpgriphos.
Pod fly	Pigeonpea (10-60%)	Synchxonisation of insecticidal spray with crop phenology and pest activities.
Pea stem fly	Peas (20-40%)	Insecticidal seed treatment, delayed sowing and intercropping with oat/barley.
Bihar hairy Caterpillar	Mung & Urdbean	Mechanical cum biological control of egg mass & gregarious larvae.
(B) Disease		
Yellow mosaic virus	Mung & Urdbean	Resistant varieties, crop

			rotation, intercropping, seed treatment with fungicides, foliar spray, use of biocontrol agent like *Trithoderma Viridae*, particularly in case of pigeonpea and chickpea wilt.
	Cercospora leaf spot	Mung & Urd bean (10-15%)	
	Wil, sterility, alternaria leaf blight, phytophthora blight.	Pigeonpea (5-75%)	
	Wilt and root rot	Chickpea (10-25%)	
	Powder mildew and rust	Peas (5-10%)	
	Wilt & rust	Lentil (10-25%)	
	White mould	Rajmash (15-40%)	
	Powdery and downy mildew	Lathyrus (10-25%)	
(C)	Nematode		
	Root knot nematode	All pulses (20-90%)	Seed treatment with suitable
	Cyst nematode	20-65%	nematicides, soil amendment
	Reniform nematode	10-30%	with oilseeds cakes, crop rotation

OIL SEEDS

Rapeseed Mustard

Germplasm maintenance and varietal development

* **Rajendra Sarson -1**

  The variety was released by R.A.U., Pusa and State Variety release Committee in 1996 for irrigation & rainfed areas of Bihar & yellow sarson growing areas of Country. Identified by National Varietal Identification Committee as early maturity (102 days), high yielding (15 q/ha) with 44.5 per cent oil content, R/MR to alternaria blight and white rust under natural field conditions and offers aphid escape.

* **Swarna**

  Released by RAU Pusa and SVRC in 1997 as medium maturity (110-120 days) HY (16 q/ha) & high oil content (46 %).

PROMISING MATERIALS OF R & M DEVELOPED

(Evaluated in Station - AVST and AICRP - IVT, AVT trials)

* TORIA : RAUDT - 1, Dholi composite 9401 and Dholi composite 9402.

* **Yellow Sarson**

Rajendra Sarson - 2 (RAU DYS - 89-111), MM (110 days) HY (1500 kg), oil content 44.2 per cent, bold seeded (4.3 g) on Nation basis (AICRP - IVT, AVTI & AVT II) suitable for intercropping with wheat.

* **Mustard - Late sown**

(1) RAURD 9403 : HY (Av. 1200 kg ha^{-1}), medium maturity (102-105 days) MR against alternaria blight at Pod stage, performed well under State AVST and AICRP-IVT and AVT I levels and at farmers FLDs. Release proposal to be submitted.

(2) RAURD 1002 : HY (av. 1150 kg ha^{-1}) medium maturity (103-105 days), oil content 40 per cent, performs well under experiments and FLDs. Release proposal to be submitted.

(3) RAURD 9710 : HY (1200 kg ha^{-1}), MM (104-107 days) performed well under AICRP - IVT and AVT I levels, on Farm demonstrations to be conducted.

Agro - Technology

* Suitable production technology developed and demonstrated on farmers fields.
* Optimum sowing time : Soon after Hathia rains starting Toria and YS in second week followed by timely sown mustard upto October and upto Nov. Ist week for delayed sown and up to 25 Nov. for late sown mustard after paddy harvest.
* Black Gram - Toria - Wheat sequence of followed by sesame - Toria Wheat was 103 per cent and 71 per cent higher over predominant Rice-Wheat system.
* Yellow Sarson - RYS - 2 and RYS - 1 intereropped with wheat in 2:6 ratio gives better returns.
* Application of Sulphur gives better profits and responded upto @ 40 kg ha^{-1} followed by @ 20 kg ha^{-1}.
* Paira cropping of mustard was identified as suitable cropping system for efficent utilization of residual moisture.
* Performance of mustard under Zero tillage in Rice field was found remunerative at higher N levels (120 kg) (First year 2000-2001 expt.)

Plant Protection

* *Alternaria brassieal* revealed predominance over *A brassicieola* in Bihar.
* Dholi isolate of *A. brassical* was found most vinulent among 7 Isolates (5 from agroclimatic zones of the then Bihar, One each from W. Bengal & Assam.

Effective chemical control of alternaria blight by 0.2 per cent IPRODIONE or Mancozeb at 60 and 80 DAS (days after sowing).

Effective chemical control of white rust by 0.25 per cent Ridomil MZ or 0.2 per cent Mancozeb at 60 and 80 DAS.

egrated management of mustard aphid was done by

Early sowing of crop (i.e. soon after Hathia rains), escapes aphid attack & diseas too.

Removal and distruction of aphid infested twigs in early stages reduces aphid population greatly.

Effects to preserve Coocinalids (Lady bird beetle) for natural biocontrol and use of safer insecticide like Endosulfan 35 EC.

Chemical control by Metasystox 25 EC or Endosulfan 35 EC @ 700-1000 ml/ha in 1000 Lit. water followed by another spray after a fortnight, minimises aphid population.

BER CROPS (POTATO)

rmplasm maintenance and varietal development

Rajendra Alo-2 variety of potato was developed & released by R.A.U., Pusa in 1996. It has medium maturity period of 90-100 days. The average yield is 22-55 t/ha. It has dark green foliage, red tuber & good taste with medium floury flesh. There is absence of waxy hardiness after cooking. It has field resistance to late blight. This variety is suitable for calcareous as well as neutral soils of Bihar plains. A total of 11 and 82 red & white tuber coloured germplasm (indigenous) were collected & maintained.

Five (viz:- MS/91-1326, JW-160, JX-23, JX-90 & MS/89-60) and Six (viz:-MS/89-1095, MS/90-542, JX-161, JX-214/85-P-670 & 85-P-718) promising genotypes were identified in different coordinated trials for early (75 days) & medium (90 days) maturity respectively & better keeping quality & promoted for on farm trials.

ro-technology

Soaking of tubers in solution containing 1 per cent Urea, and 1 per cent sodium bicarbonate for 5 minutes + Bio-fertilizer (Azotobactor + Phospho Bacteria) and 150:80:120 kg/ha of N:P:K was found better for higher yield of potato.

* Two rows of garlic in between two rows of potato recorded heigher net profit of Rs. 53,986.00 only.
* Potato variety, Kufri Badsah recorded highest tuber yield of 26.5 t/ha by application of 185:100:145 kg/ha of N:P:K. However, tuber potato seed (TPS) varieties (HPS 1/13, C3, 92-PT-27) responded to a higher level of (180 kg/ha) potassium application.

Seed multiplication

* Pure and disease free seed of potatoes of different varieties e.g. K. Sutlej, K. Badsah, K. Ashok, K. Pokhraj, K. Jawahar and K. Sinduri were multiplied & distributed among the farmers on payment basis.

TUBER CROPS (OTHER THAN POTATO)

Germplasm maintenance and varietal development/trials

Crop	No. of collections at Dholi	No. of collections at nine coordinating centres in State Agril. Universities viz. (Rajendra Nagar, Coimbatore, Jorhat, Dapoli, Kalyani, Faizabad, Ranchi, Jagdalpur, Shillong, Navasari)
Sweet Potato	1127	738
Yam bean	137	59
Arvi	73	63
Winged bean	20	Nil
Doscorea esculenta	10	29

* Dholi centre of AICRP maintains highest number of accessions in Sweet potato, Yam bean and Winged bean. In Sweet Potato alone 1127 accessions are maintained out of which 469 have been catalogued as per International descriptor.
* Maintenance & trials of earlier released varieties as noted below under AICRP on tuber crops were done during the period under report :-

Sweet potato : Rajendra Sakarkand (RS) 5, RS 35, RS 43, RS 47.

Yam bean : Rajendra Mishrikand (RM) 1. (Only released variety in India).

Arvi (Colocasia) : White Gauriya

Elephant foot yam : Gajendra (Adopted)

* The Sweet potato varieties developed at Dholi have been released for commercial cultivation for Assam, Karnataka, Andhra Pradesh. Maharastra, West Bengal and Uttar Pradesh. Yam bean variety (RM 1) are widely cultivated on commercial scale in Assam, West Bengal and Eastern part of U.P.

* **Identification of genotypes for flood prone areas :**

In the districts of North Bihar, flood havoc during rainy season has been a recurrent phenomenon. When the flood receds there is need of food and feed for consumption to human and animals in shortest possible period. The following early bulking genotypes of Sweet potato have been identified.

Genotypes	Yield (t/ha) after planting			
	75 days	90 days	105 days	120 days
X - 92	22.3	28.4	29.6	29.8
X - 24	13.3	20.4	21.8	22.3
Sreebhadra	14.2	18.4	19.3	20.1
DOP 92-93	-	16.6	-	25.1
DOP 93-19	-	17.7	-	23.3
DOP 92-163	-	19.2	-	26.6

Agro - technology

Sweet Potato

* **Two tier cropping system :**

Planting of shallow and deep bulking varieties (cross 4 and RS 5) in alternate rows at row and plant spacing of 30 cm and 15 cm respectively recorded 30 per cent more yield.

* **Cropping sequences**

	Sequence (Annual)	Net income (Rs./ha)
(i)	Maize (Kharif) - Sweet Potato - Onion	35226
(ii)	Maize (Kharif) - Sweet Potato - Wheat - Moong	36137

Yam Bean

* Application of higher dose of K reduced the cracking percentage. Marketable tuber of 38 t was harvested at 200 kg of K per ha.

* Three rows of yam bean sown in between two rows of September planted sugarcane spaced at 60 cm gave maximum net income of Rs. 31225.00 per ha.

Deflowering with application of 2,4-D at the rate of 56 ppm resulted in higher tuber yield and proved economical.

Maize (Kharif) - Yam bean - Onion, cropping sequence has been recommended for plains of north Bihar. The other sequence like maize (Kharif) - Yam bean - Wheat - Moong has also been adopted by the farmers.

Elephant Foot Yam

* Inter cropping of elephant foot yam with vegetable cowpea has given maximum net return (Rs. 62000.00) per ha.
* Elephant foot yam when planted in the first week of March with seed size of 500 gms and spaced 50 x 50 cm recorded significantly highest corm yield of 75.0 t/ha.
* Application of nutrients at the rate of 150: 60: 150 kg/ha of NPK with their split application in three equal doses (1/3 basal, 1/3 at 30 DAP and 1/3 at 60 DAP) produced highest yield.

Colocasia (Arvi)

* Cropping sequence of colocasia - rainy season Onion - Rajmash recorded highest net return of Rs. 29792.00 per ha.

Plant protection

* Dipping of corm in streptocycline (300 ppm) for half hr. before planting proved best in controlling leaf blight disease & increased yield to the tune of 51.1 t/ha.
* Percentage of plant and leaf area infection was lowest in Muktakeshi followed by Nadia local but white Gauriya was best in yield (14.2 t/ha) though plant and leaf infection were 21.6 per cent and 15.3 per cent, respectively.

Landmark achievement

Prior to implementation of the project there was neither any improved varieties in any tuber crops nor any recommended package of practices for crop production. After implementation of the project there was significant increase in productivity.

Crop	Productivity (t/ha) of Bihar	
	Before implementation of the project	After implementation of the project
Sweet potato	6.8	9.2
Yam bean	14.8	25
Elephant foot yam	22.4	68.6
Arvi (Colocasia)	12.7	14.2
Yams	14.3	20

SUGARCANE

Germplasm maintenance and varietal development

* Different crosses are made with sugarcane varieties having desirable characters both at NHG Coimbatore and at Pusa (Bihar) every year and fluffs are collected for further breeding programme. Out centre is the only centre where crossing programme is done at both the place where as at other centres crossings are done only at NHG Coimbatore. 15 to 20 crosses are made at Coimbatore where as 10 to 15 crosses are made at Pusa every year. From the fluffs collected from Coimbatore and Pusa, seedlings of sugarcane are raised. Up till now 633526 hybrid seedlings were raised which ranged from 3966 to 45513 in different years. These seedlings are grown in colonal generation (C_1 to C_4) after rigorous selection and then name is given to variety.

The varieties identified in AICRP workshop are included in the Zonal varietal trial, and evaluated in North Central Zone (Pusa, Motipur, Seorahi Gorakhpur, and Betuadhari). Up till now 49 B.O. and 27 CoP cane varieties were identified and included in Zonai varietal trials in different years.

* Sugarcane varieties released/identified by AICRP workshop and Central Varietal Release Committee during 1996-2001 are as under :-

Sl. No.	Name of the variety	Year of release	Maturity group	Yield potential/ha	Sucrose % in Juice
1	B.O. 120	1977	Early	94	17.51
2	B.O. 128	2000	Mid-late	98	18.04
3	CoP 9301	1999	Mid-late	104	18.35
4	B.O. 130	2000	Early	95	17.32

* The mid-late sugarcane variety B.O. 128 released by the Central Variety Release Committee in 2000, gives high tonnage and high in cane and is also resistant to diseases and pests.

Agro-Technology

* Nitrogen responded significantly up to 200 kg/ha. P application brought significant improvement in cane yield and conjoint use of 200 kg N and 100

P_2O_5/ha recorded higher cane yield than other combinations. Differences in sucrose per cent juice due to N,P and N X P were non-significant.

* Among shy tillering varieties, B.O. 70 recorded significantly higher cane yield at 75 cm row spacing where as in profuse tillering varieties, B.O. 91 produced significantly higher can yield at 90 cm row spacing. Sucrose % in juice did not differ significantly by these treatments.

* In late planting sugarcane planted after the harvest of wheat, N dose should be increased upto 150 kg/ha with 60 cm row spacing. However, in view of low cane yield it may not be admissible to go for late planting after the harvest of wheat in Bihar.

* In rainfed condition, B.O. 109 showed significantly higher cane yield (6.24 %) and commercial cane sugar than B.O. 108. N @ 120 kg/ha recorded 3.1 t/ha higher cane yield and 0.4 t/ha higher commercial cane sugar than at 60 kg/ha. Trash mulching @ 3.5 t/ha proved significantly superior to atrazine application and hoeing at monthly interval which showed 8.2 and 19.4 per cent higher cane yield, respectively. Differences in sucrose % of juice by these treatments were non-significant.

* Potassium application was non-significant in cane yield under rainfed situations. Increasing levels of K up to 100 kg/ha. showed improvement in cane yield and sucrose % of juice though statistically similar to 50 kg/ha. There was reduction in fibre % by application of K. The K concentration significantly increased with increasing levels of K nutrition with its maximum value at grand growth period and minimum at formative phase.

* Weeds in sugarcane can effectively be controlled by herbicides. Sencor 1 kg a.i./ha at pre-emergence + trash mulch @ 3.5 t/ha at 45 DAP and Sencor 1 kg a.i./ha at pre-emergence + 2,4-D @ 1 kg a.i./ha 50 DAP proved equally effective and recorded 43 & 37 and per cent higher cane yield than unweeded control sucrose % in juice remained unaffected by these treatments.

* In ratoon cane, profuse tillering variety (B.O. 91) recorded significantly higher cane yield and commercial cane sugar than shy tillering variety (B.O. 70). Gap filling did not influence all the morphological characters except millable canes/ha and recorded 12.02 per cent more yield than the control. 125 per cent recommended dose of fertilizer increased ratoon cane yield by 13.2 per cent

over 100 per cent recommended dose and at 100 per cent, 28.56 per cent more over 75 per cent recommended dose. Sucrose % in juice did not differ significantly by these treatment.

* Paired row planting of 3.60 cm row spacing (15 0 % seed rate) recorded maximum cane yield, which was significantly higher in plant cane (23.9%) and subsequent ratoon cane (22.4 %) than normal planting by furrow method (90 cm row spacing). 225 kg and 150 kg N/ha recorded 12.2 and 7.4 t/ha more plant cane yield and 3.8 and 1.2 t/ha more subsequent ratoon cane yield respectively than 75 kg N/ha.

* Among technology demonstration through adaptive trials, paired row planting of sugarcane with 150 per cent seed rate along with recommended dose of fertilizer proved to be the best on the basis of 405 adaptive trials conducted in farmer's field in reserve areas of sugarfactories which recorded 20-27 t/ha more cane yield than existing farmer's practice i.e. furrow method of planting.

* In ratoon management technology demonstration based on 706 adaptive trials conducted in farmer's field, Stubble shaving + gap filling + recommended dose of nutrients along with plant protection measures produced the highest ratoon cane yield and recorded 15 to 16 t/ha more yield than existing farmers practice.

* Sugarcane varieties B.O. 70, B.O. 74, B.O. 75, B.O. 786, B.O. 78, B.O. 88, B.O. 91, B.O. 108, B.O. 109, and Co 1148 were tested upto 225 kg/N/ha. These varieties recorded significantly higher yield up to 180 kg/ha in plant where as upto 225 kg in ratoon cane without affecting cane juice quality. Among these varieties B.O. 91 and B.O. 109 were more efficient utilizer of N. Significant increase in yield of cane was obtained with 100 kg P_2O_5 in calcareous soil where as 50 kg P_2O_5/ha in calcareous saline soil along with improvement in cane juice quality.

* Gama HCH applied @ 1 kg a.i. per hectare on sugarcane setts recorded a saving of 50 kg N/ha without affecting cane juice quality. The insecticide increased modification but inhibited nitrification temporarily in calcareous soil.

* In soil test crop response experiments, targetted yield equations were developed for both plant and ratoon canes in calcareous soil. These equations were tested in follow up trials at farmer's fields. It was found that the yield targetting up

75 tonnes and 50 t/ha can be achieved with plant and ratoon cane, respectively when fertilizers were applied on the basis of soil test using these equations.

Neem cake and Karanj cake blended urea (1.4) and urea super granules (USG) enhanced the efficiency of N to the tune of 50 kg N/ha. Path analysis suggested that NH4-N was more important in predicting uptake of N by sugarcane. Calcium ammonium nitrate recorded 8.8 per cent higher cane yield over urea in calcareous soil. Application of N should be done in 2 or3 splits but 3 splits were beneficial which should be completed within 120 days after planting in calcareous soil.

* Intergrated use of inorganic N and pressmud cake (PMC) recorded more improvement in cane yield than inorganic N alone. Use of Azotobacter recorded further improvements in it but juice quality was not affected significantly with the use of these materials.

* Inoculation of P solubilizer increased cane yield upto 75 kg P_2O_5/ha when phosphate was applied in any form but MRP @ 100 kg/ha in calcareous soil.

* Cane yield increased significantly upto 100 kg K_2O/ha when harvested in 11 months and there was no deterioration upto 14 months (during hot April). Improvement in sucrose in juice was also recorded up to 0.7 unit with 100 kg K2O/ha. Potash was able to decrease the fibre content in sugarcane.

* Large number of sugarcane varieties were tested for gur quality. In early varieties B.O. 99 and B.O. 120 while in mid-early varieties B.O. 91, Co 1148 and CoP 9302 produced superior quality gur with respect to colour and other attributes. Gur produced from early vareities like B.O. 99 and B.O. 120 and mid-early B.O. 116 was of very good quality.

* Yield of sugarcane increased significantly upto 80 kg S/ha in calcareous soil which is deficient in sulphur. Pol % in juice increased significantly up to 60 kg S/ha (0.93 unit) but was at par with 80 kg S/ha. Sugar yield (CCS q/ha) also increased up to 80kg/S/ha. Residual effect of sulphur was recorded on ratoon cane yield and Pol % in juice increased significantly upto 40 kg S/ha but increased regularly upto 80 kg S/ha.

* Integrated use of 5 t/ha sugarcane trash plus 15 t/ha PMC to sugarcane plant crop only alongwith recommended dose of NPK in a 4 year crop cycle (Sugarcane plant - Sugarcane Ratoon I-Sugarcane Ratoon II-Summer moong)

recorded significant improvement in cane yield of both plant and 2 ratoons as compared to full recommended dose of N. Hence, 50 per cent N can be saved with the use of organic manures. Available N. P_2O_5 and K_2O in post-harvest soil samples after completion of 4 years crop cycle were not affected much. Treatment receiving only NPK recorded more decrease in these available nutrients as compared to its initial soil status. Treatment receiving resistant decomposable organic material (sugarcane trash) revealed higher values of available nutrients but not superior over initial soil status in 4 years. Therefore, these organic materials could not maintain soil productivity up to 4 years when applied once at the start of the crop cycle.

Plant protection

* Diseased debris present in soil served as primary source of secondary infection of red rot pathogen under field condition.
* Plant and ratoon crops of subsequent multiplications showed the presence of red rot disease when plant crop was raised with hot-air treated (52°C for 4 hrs.) as well as hot-water treated (50°C for 2 hrs) setts indicating the failure of these treatments in controlling red rot disease.
* Sett germinability and yield of sugarcane increased after moist-hot air treatment at 50°C for 4 hrs.
* Whori and nodal methods of inoculation failed to produce red rot disease in plant and subsequent ratoon crops indicating the ineffectiveness of inoculation methods.
* On the basis of pathological behaviour of isolates of red rot pathogen on differential varieties, the presence of at least 3 pathotypes in Bihar was confirmed. The most virulent pathotypes are prevalent in Champaran area whereas, the weakest in South Bihar. Pathotypes having inermediate virulence are distrubited in Darbhanga and Samastipur areas.
* The mean wilt severity index varied from 0-4 depending upon the degree of resistance of cane varieties. Hence, the feasibility of production of wilt syndrome inoculating wilt fungus and applying the stress conditions was confirmed.

* Sett treatment and soil drenching with bioagents (Trichoderma viride and Gliocladium virens) enhanced the sett germinability but failed to control settling morality and red rot disease.
* 473 zonal varieties/genotypes were evaluated artificially against red rot, smut and wilt diseases to know the level of their resistance. 6 varieties showed highly resistant, 185 resistant and 141 moderately resistant reactions. These varieties were either released for general cultivation or being used as the source of resistance in breeding programme.
* Gama HCH or heptachlor @ 1.0 kg a.i. ha^{-1} was found effective against shot borer, when applied at the time of planting.
* Six sprayings of phosphomidan or endrin @ 0.75 kg a.i./ha was found effective against stalk borer.
* Endosulfan or monocrotophos @ 0.75 kg a.i./ha was found effective against 3rd brood of top borer.
* The incidence of stalk borer was recorded maximum in autumn planted crop on stalk basis.
* Carbofuran 3 G @ 1.0 kg a.i./ha was found effective against 3rd brood of top borer.
* Integrated pest management for plant and ratoon crop of sugarcane was established and found quite popular among farmers such as removal of dead hearts of shoot/root borers, top borer (1st and 2nd broods), stripping of dry leaves for stalk borer as well as scale insect.
* Sevin granules @ 1.0 kg a.i./ha was found effective against scale insect when applied thrice along with detrashing.
* Aldicarb @ 2.0 kg a.i./ha was found effective against scale insect when applied at 180 days after stubble shaving in ratoon crop.
* Dichlorophos or monocrotophos @ 0.5 kg a.i. + 25 kg urea/ha were found effective against balck bug and army worm.
* Application of sumicidin @ 0.004 per cent at 50th and 60th days after planting or gamma HCH @ 1.0; kg a.i./ha at planting was found effective against shoot borer.
* Sumicidin 0.004 per cent or monocrotophos @ 0.75 kg a.i./ha in Ist week of September and mid October was found effective against stalk borer.

* Screening of germplasm under this project is being done every year against major insect pests under natural condition. Every year more than 25 varieties/genotypes were screened at this centre in which 5 to 6 varieties were found to be tolerant against shoot, root and borers.

* Among naturally occurring bio-agents of major pests of sugarcane, stendbracone disease, cotesia flavipes and Rhachonotus scirpophagae, larval as well as pre-pupal parasitiods of different borers were found at Pusa Centre. The para-sitization was varied from 20 to 30 per cent every year on different borers.

JJUTE & MESTA

Germplasm collection, maintenance & varietal trials

* 315 *Capsularis* and 155 *Olitorius* germplasm are being evalauted and maintained.

* One experiment of I.E.T. with 20 promising cultures of *Olitorius* jute under the All India Co-ordinated Research Project was conducted. Statistically fibre yield differences of all varieties under test were found significant. The variety CO-44 recorded highest fibre yield (29.40 q/ha) followed by CO-2 (28.93 q/ha) in comparison to national check JRO-632 (28.60 q/ha).

* Screening of 100 germplasm (50 entries each of *G. olitorius* & *C. Capsularis* was done. Data in respect of yield contributing traits as well as fibre yield on five plant basis were recorded & compiled. None of the *Capsularis* varieties were found better than the standard varieties. However, in Olitorius jute 19 varieties were identified better than the standard check i.e. JRO - 524 and JRO 632.

* A.V.T. on *Olitorius* jute to select suitable high yielding varieties was conducted with six varieties namely CO-19, CO-28, CO-32, CO-40, JRO-524 and JRO-632 (check). Statistically fibre yield difference of all the varieties under test was found to be non-significant.

* I.E.T. with promising *Capsularis* culture showing resistance to root rot and stem rot disease and high yielding was conducted with 16 promising cultures including two check varieties i.e. JRC-212 and JRC-321. Varietal differences in respect of fibre yield was found non-significant.

* Iso-genic line of male sterile *Capsularis* jute was maintained.

* A dominant male sterile line in *Olitorius* jute has been developed and is being maintained.

Agro technology

* Mid May sowing with clipping at 45 days after sowing gave higher seed yield than other treatment (4.050 q/ha).
* Optimum cultural and manurial schedule for jute & mesta crops in relation to variety have been developed for Bihar.

Plant Protection

* Study on the basis of plot sampling techniques for estimation of incidence of jute pests revealed that the outer rows of both the varieties of *Capsularis* & *Olitorius* were found to be prone to Apion and Semilooper attack than inner rows. In case of *Capsularis* the injury index of Apion was found 66.67 and in *Olitorius* 57.14. Incase of semilooper the incidence was 66.67 per cent and 15.15 per cent in *Capsularis* and *Olitorius* respectively.
* Survey and surveillance of diseases of jute around 20 sq.k.m. from the centre revealed that the Jute crop of both the sp. of different varieties was affected from the stem rot, root rot and anthracnose which ranged from 0.5 to 25 per cent for stem rot, 0.5 to 30 per cent for root rot and 0.5 to 10 per cent in anthracnose.
* Survey and surveillance of disease around 20 sq. k.m.from the centre revealed that mesta crop of local variety was affected from the root rot and anthracnose which ranged from 0.1 to 2.5 per cent for foot-rot and stem rot, 0.1 to 1.5 per cent for root rot and 0.1 to 0.75 per cent for anthracnose.
* Control measures for major pests and diseases have been developed.

FRUITS

Germplasm maintenance and varietal development

Mango

* In evaluation of germplasm highest cumulative yield was recorded in Banglora (i.e. 385 kg per plant) which was followed by Gulabkhas (290.0 kg. per plant) and Dudhia Maldah (235.1 kg. per plant). However maximum T.S.S. content was recorded in Amrapali i.e. 21.90 per cent.
* In variatal trial of commercial cultivars of four different zones of the country, Mallika was the best in respect of both yield and quality having 85.52 kg. fruits

per plant. This was followed by Banglora (41.66 kg. per plant). Maximum average fruit weight was also recorded in Mallika i.e. 478. 75 gm.

Litchi

In litchi hybridization trial 30 mature fruits of different cross combinations were obtained out of which 19 stones had germinated. Ten bearing hybrid plants are being screened. Maximum fruit weight (918.0 g) was recorded in hybrid 70 (purbi x Bedana) which was closely followed by hybrid 172 (purbi x Bedana). Hybrid 172 also recorded maximum (77.7 %) pulp content.

Guava

Out of 10 collections, Allahabad safeda was found superior than others in respect of yield and quality parameters. Maximum yield of 131 kg. per plant was recorded in Allahabad safeda while minimum (6.38 kg/plant) was obtained in Kuhir Safeda. Evaluation of hydrids revealed that a plant of cross between Apple Colour X Sardar showed maximum fruit weight (240.00 g), yield (70.38 kg/plant) and vitamin C content (300 mg/100 g of pulp).

Banana

81 accessions of Banana are being maintained at HRS, Birauli.

Aonla A varietal trial with seven varieties was conducted at B.A.C., Sabour and the variety NA-10 is showing better growth at B.A.C., Sabour.

Agro-technology

* In the inter cropping trial of mago with the vegetables, maximum yield was recorded in onion (13.81 q/ha) followed by radish (18.25 q/ha). Among the legumes lentil produced maximum yield (7.19 q/ha).
* Double spray of 15 per cent fertiliser grade urea at 50 per cent bloom was found to be most effective to regulate the guava crop for winter season in respect of yield & quality.
* In banana the trial on standaridisation of optimum dose and time of nitrogen application revealed a significant effect of different doses of nitrogen applied in several splits of fruit yield. The best yield was obtained when 250 g nitrogen was applied in seven splits i.e. 200 g in 4 splits upto 165 days after emergence and 50 g in 3 splits in later half of the vegetative phase.

In potassium nutrition trial, application of 300 g K_2O/plant/year in 4 splits gave the best yield when 2/3 of this amount was applied upto 165 days and rest 1/3 upto 300 days of sucker emergence in banana.

In the trial on chemical control of weeds in banana, the integrated weed control measures which consisted of growing cowpea in the inter row space and incorporating into soil at flowering stage followed by one spray of glycophosphate @ 2.0 kg a.i./ha. gave the best yield. The treatment growing double crop of cowpea in the inter row space and incorporation into soil at flowering stage and chemical weed control with spray of glycophosphate @ 2.0 kg/ha. followed by another spraying of 1.0 kg/ha also produced comparable results.

* In an another trial on estimating losses from weed in banana it was observed that no weeding caused reduction in yield to the extent of 28 per cent in R_1 crop cycle. The weed free plantation gave yield as high as 51.75 t/ha.

* The trial on screening of banana varieties for high and low input situations showed better performance of the variety, Kothia under low input condition in respect of yield where as under high input conditioners Kothia, Robusta and Alpan gave better but comparable yield.

* The different treatments consisting of inorganic fertilizers alone or in combination with organic form in various proportions failed to exhibit any significant difference in either morphological characters of yield of banana.

* In the nutrition trial on coconut conducted at Sabour the fruit numbers increased with increase in dose of potash and phosphate upto 1500 g per plant interms of Muriate of Potash and SSP respectively. Maximum (44.33) number of fruit per plant was observed with application of Urea 750 g, SSP 1500 g & M.P. 1500 g.

Plant Protection

* Altogether 31 pests of mango mainly hoppers, mealybugs, shoot gall, fruit fly were recorded in the pest surivillence. The hopper population was recoreded maximum in April when minimum R.H. was lowest. For control of mango shootgall it was observed that monocrotophos @ 0.072 per cent and quinolphose @ 0.05 per cent, being at per, proved most effective.

* In screening of 48 mango germplasm, studies revealed that 8 germplasm namely Dadamian, Ambaiabi, Sensation, Rangata J. Sanhakarbi, police, Gaurject and

Neelam were free from malformation. Amrapali showed maximum incidence of malformation (38.45 %) and fungus isolated was *Fusarium moniliforms.*

VEGETABLES

Germplasm collection evaluation & varietal improvement

* In Bhindi, 13 collections out of 48 were found promising.
* In brinjal, 8 collections out of 100 were found promising.
* **Brinjal Long (IET)** -The variety DBL - 11 produced the highest yield of 191.44 q/ha which was statistically at par with variety Rajendra Annpurna (181.36 q/ha).
* **Brinjal Long (AVT-II)** - The maximum yield of 189.69 q/ha was recorded in variety NDR 26-1 which was statistically alike with variety Rajendra Annupurna (188.33 q/ha).
* **Brinjal Green** - The variety Rajendra Baigan - II gave the maximum yield of 205.25 q/ha which was statistically at par with Sabour Local 17-19 (198.72 q/ha).
* **Brinjal Round (IET)** - The highest yield of 207.83 q/ha was exhibited by the variety KS-224 which was statistically at par with varieties D-2, 88-6, (204.6 q/ha) Muktakeshi (198.69 q/ha) and DBR - 8 (190.28 q/ha).
* **Brinjal Round (AVT-II)** - The varieties KS-224, D-2-88-6, CHBR-3 and CHBR-1 were statistically alike with each other having yield of 205.81 q/ha, 205.78 q/ha, 184.63 q/ha and 180.41 q/ha, respectively.
* **Ridge-gourd (IET)** - None of the varieties superceeded the Sabour local yielding 60.15 q/ha.
* **Ridge-gourd (AVT-I)** - Sabour local variety significantly out yielded (58.9 q/ha) the other varieties.
* **Ridge-gourd (AVT-I)** - Sabour local variety and KRG-5 were statistically at par with each other yielding 61.34 q/ha and 56.64 q/ha respectively.
* **Brinjal hybrid (long)** - The highest yield of 219.03 q/ha was obtained in hybrid-5. However, it was statistically at par with hybrid NDBH-12 (198.1 q/ha).

* **Brinjal hybrid (round)** - The Pusa hybrid -6 produced the maximum yield of 201.52 q/ha which was statistically alike with hybrid CHRBH - 2 (195.44 q/ha), CHRBH - 1 (187.78 q/ha & ARBH - 576 (182.04 q/ha).

Plant protection

* **Bhindi (resistant varietal trial against YVM)** - Varieties NDO - 1, VRO - 5, VRO - 6, D - 1-87-5. VRO - 3, VRO - 4, Arka Abhay, P-7. PB-57 and Arka-Anamika rated as resistant showing less than 10 per cent disease intensity. Among resistant sources B-1-87-5 gave the maximum yield of 93.50 q/ha.
* **Brinjal (Seasonal occurance of diseases)** - Brinjal crop suffered from a number of disease like damping off, phomopsis blight etc.
* **Brinjal (Management of diseases)** - Seed treatment with Captan (0.25 per cent) with soil drenching @ 0.25 per cent reduced the damping off diseases at nursery stage. For the control of phomopsis blight of Brinjal carbendazine @ 0.8 per cent was found most effective in reducing the diseases as it recorded 5.3 and 3.3 per cent, blight and fruit rot respectively.
* **Chillis (integrated management of insect virus)** - Nylone net + soil application of carbofen at nursery stage and three sprays of Imidaciorprid at field stage was found most effective in reducing insect borne virus.
* **Bhindi (Management of Bhindi pest i.e. jassids and borer, variety Prabhani Karanti)** - Among the six chemicals trial profenphos (800 g a.i./ha) showed to be most effective against both jassids and borer with a highest yield of 78.95 q/ha.
* **Bhindi - (Seasonal incidence of insect pest, variety - Pusa Sawani)** - Jassids incidence varied from 5.32 to 25.70 per cent between 1st week of July to second week of September. The maximum damage by borer as shoot damage (15.32 %) was found in the 3rd week of August and as fruits damage (24.32 %) in the 4th week of August Incidence of red spider mite was found at the fag end of the crop with a maximum of 17.55 per cent in the last week of September.
* **Brinjal (IPM of Brinjal early pests, variety-Mukta Keshi)** - The treatment included both seedling root dip and foliar sprays of insecticides. The seedling treatment with imidacloprid (1.0 ml per litre water) was found effective against emilaphna beetle and jassids. Profenphos (800 gram a.i. per hectare was found to be effective against borer giving the highest yield of 182.35 q/ha.

* **Brinjal (IPM module for the management of brinjal pests complex, variety-Mukta Keshi)** - The treatment included both plants products and synthetic insecticides used at different stage of crop growth. Among the treatment the module of NSKA (4%) - Profenphos (800 g a.i./ha), cypermathrin NSKE followed by profenphos and cypermethrin initiated first spray after flower initiation and subsequent at fortnight interval were found to be effective against pest complex. The highest yield of 285.50 q/ha was found in this treatment.

* **Cowpea-evaluation of neem based product and some safer Chemicals agaisnt leaf minor** - Monocrotophos (400 g a.i./ha) was found to be most effective against leaf minor giving minimum leaf minor incidence (3.25%) with a highest yield of 65.35 q/ha in varieties Pusa Komal.

* **Cucumber-Seasonal incidence of insect pests, varieties Balam** - Both red pumpkin beetle (*PAPHIDOPALPA FOVELCOLL*) and fruit fly (*Dacus cucrbitae*) were found to infest the crop. The most severe infestation of fruit fly was found in the 4th of August with a fruit damage of 25.38 per cent. The infestation of red pumkins beetle was not severe ever as compared to fruit fly.

SPICES

Germplasm collection, maintenance & varietal development

* Altogether fiftyeight germplasm of fenugreek, fortyeight of Corriander, Fiftysix of Fennel, twentyone of nigella and twenty two of Omum (Ajawain) have been collected from different parts of Bihar and India and their morphophysiological trials and yield performance were recorded.

* Spices varieties already identified and pipeline are as under :

Crops	Varieties	Proposed Name
Turmeric	RH - 5/90	Rajendra Laxmi
Fennel	RF - 17	Rajendra Saurabh
Omum (Ajawain)	RA - 9	Rajendra Mani
Kasuri Methi	R.K.M. - I	Rajendra Abha

Agro-technology

* In case of turmeric, daughter rhizomes of 25 g size sown at the spacing of 30 cm X 20 cm yielded highest and generated maximum profit per unit area.

* Seed-rhizomes of 20 g size sown at 30 cm x 20 cm spacing produced highest yield of rhizomes in case of ginger.

* Turmeric and ginger sown on 23rd May and mulched with *Shisham* leaves prodced highest yield. The crop sown during June and July was found to be poor yielder.

* In a manurial trial, it was observed that 60 kg N, 60 kg P_2O_5 and 20 kg K_2O gave highest yield of ginger.

* Turmeric yielded highest when 150 kg N, 50 kg P_2O_5 and 100 kg K_2O/ha was applied.

* Application of 15 kg/ha of iron sulphate and 20 kg/ha of zinc sulphate increased turmeric yield significantly.

* Corriander sown on first October yileded 13.89 q/ha and yield was gradually reduced in late sown crops. The essential oil content was maximum (0.85%) in crop on 16th October but essential oil yield was maximum (10.27 kg/ha) in crop sown on 1st October.

* A fertilizer dose consisting of 60 kg N, 40 kg P_2O_5 and 20 kg K_2O per ha produced higher yield of corriander (15.25 q/ha) grown as irrigated crop in calcareous soil of North Bihar. The yield under control was 11.08 q/ha only.

* Effect of different micronutrients viz. Zinc, copper, iron, molybdemum, boron, manganese and tracel - 2 on corriander was studied. The mean yield data revealed that corriander responded well to foliar application of copper, zinc and molybdenum regarding yield as compared to rest of the treatment and control. The maximum increase in fruit yield over control was 28.00 per cent under zinc and molybdenum treatments. The essential oil yield was 7.56 kg/ha under copper as well as 7.27 kg/ha and 6.48 kg/ha under zinc and molybdenum respectively. The lowest essential oil yield of 5.61 kg/ha was recorded under control.

* Fenugreek sown on 30th October yielded higher as compared to sowing on 1st October, 15 November and 15th December.

* Experimental results of fertilizers trial on fenugreek indicated that 40 kg N, 60 kg P_2O_5 and 20 kg K_2O/ha produced maximum seed yield.

* Fennel sown in nursery during first week of September and transplanted during first week of October registered its superiority over other dates of sowing.

* In a intercropping trial of fennel, fennel + radish was found to be more remunerative per unit area as compared to other combinations.
* Application of 60 kg N, 40 kg P_2O_5 and 20 kg K_2O produced higher yield of fennel variety Rajendra Saurabh.
* Omum and Nigella both respnded to fertilizer application and both crops yielded highest at 60 kg N, 30 kg P_2O_5 and 20 kg K_2O/ha levels.

Plant protection

* In seed treatment trial of ginger against shoot ot disease ridomil MZ @ gm/litre of water for 1 hr. was found more effective as compare to other fungicides.
* In varietal trial on turmeric only two varieties viz., Kohinur and G.L. Puram were found resistant against leaf spot disease. In case of leaf blotch disease only Kodur and G.L. Puram were found highly resistant and resistant respectively.
* In varietal trial of corriander, Rajendra Swati and UD - G8G were found resistant against stem gall disease.
* In case of cercospora leaf spot disease of fenugreek, HM-103 was found resistant agaisnt the disease.

BETELVINE

Germplasm collection and evaluation

All toghter 22 germplasms have been collected from different localities of the state and different states of the countary and maintained in the betelvine conservatory.

Agro technology

* All the treatments on the effect of irrigation schedule IW:CPE of ... significantly improved almost all the growth attributing characters of betel vine. The keeping quality of betel leaves and nutrient uptake were aggravated by ... method.
* Soil application of organic fertilizers in the form of oil cake FYM and 200 N/ha in four equal splits significantly increased the vine length and ... incidence of disease and there by increased the yield of betel leaves ... maximum cost : benefit ratio 1:18.72 was received with FYM.

Plant protection

* In Integrated Pest Management of root-knot nematode in betelvine, Neem @ 500 kg/ha + soil drench with carbofuran @ 0.1 per cent + 3 applications ...

Paecillomyces lilacinus inoculated neem cake @ 500 kg/ha significantly suppressed nematode population and development of root galls.

Reniform nematode *(Rotylenchulus reniformis)* at inoculum level of 5000 and 10,000 were found signficiant in causing gradual yellowing, reduction in size of leaves leading to wiliting of vines.

Epidemiological studies of Phytophthora leaf rot caused by *Phytophthora* sp. and Anthracnose disease incited by *Collectrichum* spp. with Bangla variety of Betelvine indicated that temperature ranging from 15 to 25°C and relative humidity above 90 per cent coupled with rainfall and number of rainy days per week had positive effect on the incidence and per cent disease index (PDI) of Phytophthora leaf rot. The important contributing environmetal factors for disease incidence were maximum relative humidity, maximum and minimum temperature which seems to have accounted for 65.2 per cent, 14.2 per cent and 16.8 per cent respectively of the total variation in disease incidence.

Integrated disease management of Phytophthora foot and leaf rot of betelvine revealed that sanitation accompanied by drenching of Bordeaux mixture (1.0%) followed by soil application of Biological agent (*Trichoderma viride*) and one more drenching of Bordeaux mixture was superior to other treatments in respect of suppression of the disease and there by increased the yield in terms of number of consumable betel. This treatment was found most economical producing Rs. 3.28 on investment of rupees one.

Three drenching of Bordaux mixture (1.0%) at monthly interval and 6 sprays of Bordeaux mixture (0.5%) at fortnightly interval starting from the onset of monsoon was significantly superior to other treatments in terms of suppression of Phytophthora foot rot incidence of betelvine and thus increased the yield of the crop i.e. number of leaves per hectare.

Cropping System Research

- Nine rice based cropping sequences viz; rice-wheat dhaincha (GM), rice-maize-dhaincha (GM), rice potato sunflower. rice-potato-onion. rice-vegetable pea-okra, rice-mustard-sunflower, rice-weat-moong, rice-maize-moong, rice-berseem-maize + cowpea (both as fodder) were evaluated for their production potentials and economics of the nine sequences tried. The three sequences viz; Rice-potato-onion (T_4), Rice-potato-sunflower (T_3) and Rice-Barseem-Fodder maize + Fodder cowpea (B) were higher scorer in net return with values of Rs. 79177, Rs. 75.210 and Rs. 74,640/ha respectively.

- In an experiment of rice-wheat system, one of the two cereal crops in the sequence had to be substituted by an oilseed or a pulse crop very second. third or fourth year either during *kharif* or rabi season along with standard one year sequence of rice-wheat (control). Results indicate that the standard one year sequence of rice-wheat (T_1) reckoned significantly low net return as compared to others except 75 where component crop chickpea substituted during rabi failed due to unprecedented situations.

- Twelve treatments of rice-wheat systems of which four treatments with recommended NPK application in various proportions (50:50:40:100, 75,75.100:100%), 6 treatments with integrated use of fertilizers and organic sources and one each of unfertilized control and farmers practice of fertilization (50% recommended dose of NPK) were tested. The treatments were arranged in randomized block design with four replications. Results indicate that on the whole, the treatments T_{10} (50% N substitution through green manure to rice crop and 100% recommended dose of NPK through fertilizer to wheat crops) and T_6 (a substitution of 50% N through FYM to rice crop and 100% recommended dose of NPK through fertilizer to wheat crop) were at par in wheat equivalent but significantly superior to remaining treatments under test. The treatment T_6 has been maximum scorer of total biomase (19496 kg/ha) closely followed by T_{10} with total biomas of 19195 kg/ha.

- To monitor the long range effects of rice-wheat crop sequence at graded fertilizer on yield stability and soil fertility, all combinations of 3 levels each

N (40.80 and 120 kg/ha) and P_2O_5 (0,40 and 80 kg/ha) and 21 levels of K_2O (0 and 40 kg/ha) with one control plot in each block are being tried in 3^2 x 2 factorial partially confounded design. There was significant increase in wheat equivalent of the shole rice-wheat system with increasing levels of NPK individually.

Study was conducted to maximise the yield and profit from a given rice-wheat system of cropping by optimum combination of input use and crop management. There was significant increase in wheat equivalent of rice-wheat system with increasing level of fertility and addition of 10 tonnes FYM, individually.

FORAGE CROPS

Fodder Maize

- Newly developed composite, namely, PFM-99-1 produced maximum green fodder and significantly more than the check African Tall. The second ranking genotype, namely GRM 82-2 also produced significantly more green fodder than the check African Tall. The top ranking entry was early in silking, shorter in plant height but more leafy. The new composite was developed from GBM-84-3, African Tall, APFM-11, APFM-8 and APFM-15 selected on the basis of *per se* performance and combining ability over environments for fodder traits.
- Teo-maize produced maximum green fodder and significantly more than the best-check J 1006 (136.51/ha). It was tallest and more leafy.

Fodder Bajra

In initial varietal trial of fodderbajra including six entries and two checks, the green fodder yield ranged from 347.2 to 444.4 q/ha. The entries TNB 9902 produced maximum green fodder followed by TNFB 9903 (423.6) and TNFB 9901 (412.1). These entries significantly out yielded the best check Raj Bajra Chari-2 (356.5). The highest yielding entry was quite tall (229.5 cm) and leafy (0.36).

In advance varietal trial an fodder bajra with four entries and two checks the green fodder yield varied from 200.0 to 316.7 q/ha. None of the entries out yielded the best check Raj Bajra Chari-2.

Cowpea + Maize

In evaluation of Cowpea genotypes intercropped with J 1006 maize prouced maximum green fodder (156.3 q/ha) and significantly more than the second combination of J 1006 + CK-1-2 which yielded 111.0 q/ha green fodder.

Berseem

In initial varietal trial of berseem with nine entries and two checks. the mean fodder yield ranged from 305.2 to 343.8 q/ha whereas dry matter yield varied from 38.2 to 48.5 q/ha. The entry GL 174 produced maximum green fodder (348 q/ha) and dry matter (48.5 q/ha) yield. However. it was at par with the highest yielding check wardan (338.5) for GFY and Mescai (42.1) for DHY. The highest yield intry was average in plant height and leafiness.

In first year advance varietal trial of berseem having five entries and two check the green fodder yield and dry matter yield varied from 59.4-32.0 and 6.7-44.3 q/ha respectively. The entry BL 17 produced maximum green fodder and dry matter yield followed by 98-2 and L-167. However, these entries were at per with highest yielding check Mescavi.

In second year advance varietal trial of berseem the green fodder yield and dry matter yield varied from 316.6 to 363.9 and 35.7 to 5.1 q/ha. respectively. The entry HFT-97-3 (362.5) and HFT 130 (358.3) are significantly more than the highest yielding check wardan (327.8). The DMY of 97-3 was maximum. These entries were average in being and more leafy.

Annual Lucerne : In initial varietal trial of annual lucerne with five entries and one check. none of the entries significantly out yielded the best check. However entry Anand-2 produced maximum green fodder yield. LL composite was the tallest and RL-88 was the most leafy.

Fodder Oat

In initial varietal of trial of multicut fodder oat with 14 entries and 2 checks none of the entries out yielded the best check UPO-212 in terms of green fodder

However, the OL-1221 produced significantly more dry matter (60.7) than the best check UPO-212 (49.5). It was alsobetter in plant height and L/S ratio than the check UPO 212.

FLORICULTURE

- Rooted cuttings planted on 15th August followed by 1st August significantly yielded higher flowers of chrysanthamum
- Nitrogen @ 15 g/m^2 followed by 10g/m^2 and closer spacing i.e. 30 x 30 cm yielded economically higher flower's yield.

Gladiolus

- F.Y.M. @ 7.5 kg/m^2 and 20x10 cm spacing followed by 30 x 10 and 20x20 cm significantly gave higher number of spikes, corms and cormels/m^2.
- Nitrogen @ 60g/m^2 and P_2O_5 @ 20g/m^2 yielded higher number of spikes, corms and cormels/m^2
- Applause variety of Gladiolus appeared to be highly resistant to root knot nematode.

French Marigold

- FYM @ 7.5 kg and 10g N/m^2 followed by N @ 20g/m^2 increased the yield of flowers over other treatments.
- Nitrogen @ 20g/m^2 and closer spacing i.e. 30x5 cm followedby 30x30 cm gave better result in respect of flowers yield.
- Minimum Root Knot index and maximum tomato yield was recorded with intercropping of marigold (1:1 row) which was at par with the treatment of Carbofuran @ 1.0 kg a.i./ha.

HONEY BEE

- Introduction of Italian Honey Bee was done by the scientists of Rajendra Agricultural University, Pusa in 1988 and adopted by the beekeeper in short span of time. Honey yield with this species (i.e. Italian Honeybee) is high and highest in Bihar as compared to any other States of India i.e. 40 and 60 kg/hive/year under stationary and migratory bee keeping respectively, if weather conditions are favourable. The Litchi and Karanj honey produced in Bihar has high demand nationally and internationally by about 1553 beekeepers producing about 3250 tonnes honey in a year.

- Major and minor bee flora of different districts have been identified and floral map as well as migratory routes have been prepared for the guidance of beekeepers.

- Qualitative and quantitative study of nector sugar of litchi, Indian mustard, Karanj etc. have been worked out.

- The foraging behaviour of honeybee on different crops have been studied. Honeybees have proved the most efficient pollinator. Litchi fruit setting, fruit size and fruit weight increased significantly when honeybee colonies are kept in orchard.

- The increase in yield and quality of seed was observed in coriander, onion, sunflower and mustard, in mustard honeybee alone contributed about 60% increase in the yield of the crop.

- Inter and Intra species robbing during dearth period has been effective checked in beehives attached with anti-robbing device developed under AICRP on Honeybee.

Rajendra Agricultural University, Pusa is the first in India where Social Scientist was attached with AICRP on Honeybee to develop educational package for transfer of apiculture technology and the work was appreciated at national level leading to sanction of another two projects, one on sustainable bee keeping and another on improving efficiency of Italian honeybee for increasing honey & crop yield under the CGP and NATP respectively.

Every year honey festival is organized to bring beekeepers, Scientists and traders at one plate from to disseminate the modern technology to beekeeper and to solve their problems of honey marketing.

MEDICINAL AND AROMATIC PLANTS

A living repository (herbal garden) of more than 165 germplasms of medicinal and aromatic plants has been developed under Central Sector Scheme. 17 species of commercial importance are multiplied. Agro-technology of 8 medicinal and 8 aromatic plants of commercial importance is being developed. The cultivation of important medicinal and aromatic plants is being popularised among farmers.

Under NATP on "Conservation of Plant Bio-diversity- medicinal plants", exploration trips were conducted and several medicinal plants collected and multiplied for studying variability. The traditional knowledge regarding their use in the treatment of disease was also recorded.

SOIL SCIENCE

Critical limits of zinc, copper, Iron, Manganese, Boron & Sulphur were evaluated in a number of Soils & Crop plants for determining their deficiencies and taking remedial measures. The salient findings and recommendations are as under :

- Zn deficiency was found to be 40-70 per cent in north Bihar, 45-50% in South Bihar plains and 30 per cent in Chotanagpur plateau region.
- Boron deficiency in Bihar soils ranged from 30-45% & Sulphur deficiency from 15-64%
- The Cu, Fe & Mn deficiencies were sporadic
- Soil application of Zn & B proved superior to their foliar sprays. However foliar sprays of Fe proved superior to soil application.
- Application of 5 kg Zinc (25 kg Zinc sulphate) per ha annually in calcareous soils and alternate year in non-calcareous soils was found to be quite effective in tacklinge the problem of Zn deficiency in crops viz. ; rice, wheat, maize etc. Mixing of 5 t FYM per ha with Zinc Sulphate enhanced the Zn-use efficiency to

the tune of 50% split application of Zinc sulphate @ 50% of its full dose as basal and remaining 50% as top dressing at tillering stage and as side dressing in maize at Knee high stage is also recommended if full dose has not been applied at sowing/transplanting time of crops.

- Soil application of 15-20 kg borax per ha to alternate crop in calcareous and 10-15 kg borax per ha in non-calcareous soils deficient in boron is recommended. However foliar spray of 0.30% boric acid solution in water (2-3 sprays) is effective to control boron deficiency in crops specially fruits. Application of 20 kg borax per ha. at sowing, enhanced chickpea fruiting. Like wise application of 20 kg borax/ha has successfully controlled the browning of curds and hollow stem in cauliflower when applied at transplanting.

- Application of 40 kg sulphur per ha (335 kg SSp per ha) to alternate crop is recommended. However 60-80 kg sulphur per ha has emerged as an ideal dose for sugarcane.

- Raising of rice seedlings in Calcareous soil after puddling has proved quite effective in controlling iron chlorosis. 3-4 foliar sprays of 1-2% $FeSO_4$ solution in water at 10 days interval is recommended to prevent iron chlorosis in standing crops.

- On the basis of large no. of soil test crop response (STCR) experiments. fertilizer recommendations schedules and fertilizer adjustment equations based on soil test values were prepared for farmers and soil testing laboratory uses. The whole works of the project were published in a manual for general use. The salient recommendation are as under :

- Fertilizer recommendations based on targeted yield equations is economical and profitable.

- A reasonable amount of inorganic fertilizer can be saved with the application of organic fertilizer like compost/biogas/slurry/oilseed cake etc. with organic fertilizer. This will maintain the fertility status of the soil without affecting the yield.

- The compost (10 t/ha) + Crops residues could save 50% recommended dose of NPK i.e. 50 kg N, 30 kg P_2O_5 & 20 kg K_2O/ha in rice and wheat under rice-wheat cropping systems.

- Green manuring with green gram/green gram straw incorporation after taking 4-5 q/ha of moong grain could substitute 25% recommended dose of NPK to rice and wheat i.e. 25 kg N, 15 kg P_2O_5 and 10 kg K_2O/ha in calcareous soil under both upland and lowland situations.

- Green manuring with dhaincha, sunhemp and black gram could save about 12.5 kg/ha Zinc sulphate to crops under rice-wheat rotation

- Continuous disposal of sewage effluents and sludges in soils in Patna and Pusa increased the contents of micronutrient cations and toxic heavy metals three to five times over background values. The contents of three metal cations in plants grown on such soils also increased one and half to two times. The contents of the heavy metal cations in soils and plants however, were within safe limits.

- Most of the trace metal cations in the sludge treated soils had very low mobility down the profile. In case of intensive sewage-sludge application for over 100 years in Patna soil, the mobility of cadimum, Nickel and chromium was up to 45 cm Soil depth

- Three modynamic parameters of reaction of organically complex cadmium in Patna soils were worked out through equilibrium and Kinetic studies. Theoretical model to predict ionic activity of cadmium in soil solutions were developed.

- Phosphorus is the limiting element in Pusa, Samastipur and Muzaffarpur districts

- Only compost application on @ 15 t/ha (fresh weight) increased paddy yield by 3.3 to 15.0 q/ha over absolute control.

- Research works on INM reveals that the application of 10 t compost + 10 kg BGA/ha only in kharif could save about 25 Kg N, 15 Kg P_2O_5 and 10 kg/ha in both kharif and rabi crops under rice-wheat cropping system.

- Mulch with crop residues could not only increase the yield of rice and wheat but could save about 25 kg N, 15 kg P_2O_5 and 10 K_2O/ha in both Kharif and Rabi crops under rice-wheat cropping system.

FORESTRY

- Some promising clones of populus deltoides such as PIP-201, 220, 101, 102, 104 and PIP-307, 313, 315 were screened out for Bihar.

- Ginger and turmeric proved to be the best intercrop under heavy shade of the orchard in Kharif season. Among the vegetable crops chilly and tomato gave better yield than other crops. Some of the fodder crops such as Cunia grass, Dinanath grass and oat also gave better results under shaded situation of the orchard.

- Among the nursery stock, the minimum and maximum seedling height (cm) as well as diameter (cm) of Tactona grandis Linnf ranged from 55 to 100 and 1.30 to 2.20 in the Munghyr Zonal plot; 52.0 to 106.0 and 1.50 to 2.1 in the Pusa Zonal plots and 50.0 to 100 as well as 1.3 to 2.0 in the Madhopur Zonal plot respectively.

AGRO FORESTRY

- Chah (*Acacia lenticularise*), Semal (*Bombax ceiba*), Kadam (*Anthocephalus cadmbva*), Popular (*Populus deltoides* G_3 and C_{48}), bankat (*Wendlandia exserta*) and Shisham (*Dalbergia sissoo*) have been identified as promising species for cultivation in Bihar.

- Shade loving crops like turmeric, ginger, elephant foot yam, sweet potato, dinanath grass and guinea grass showed less reduction in yield and were economical when cultivated under the tree and bamboo grooves.

- Populus deltoides G3 based intercropping along age series of 1-9 years under two crop rotations viz. Maize-wheat (1-4 years), turmeric (5-9 years) pigeonpea (1-5 years) turmeric (6-9 years) showed overall benefit: cost ratio 5.13 and 6.69, respectively at the end of 10 the year after the harvest of populus

- Epicormic shoots of chah, gamhar, shisham showed better rotting as compared to stem cuttings from the plants of same age

- Pre-treatments of seeds in bioling water for 0.5 minute for akashmuni and subabul; hot water at 50^0C for 10 minutes for kharif. imli. safed siris. chah and conc H_2SO_4 for 10 minutes for chakundi and amaltas were recommended to optimise germination.

- Potting media with composition of soil. sand and FYM in the proportion of 1:1:1 was found most suitable for growing nursery plants of most of the MPTs.

- Fuel wood from annual lopping of half of the lower branches in the canopy in 4-7 yr. old plantation with density of 1723 trees/ha varied between 8.6 t/ha-14.5 t/ha

- The common diseases, pests and nematodes associated with the different MPTs were identified.

- Damping off (Phythium sp.), rotting (Rhizoctonia sp.) and wilting (*Fusarium solani*) are the common diseases observed in such trees.

- Cladabrastic melitricha. Celostena seabrutor. Stromatium barbatum. Butocera rutomaculata. Inderbelate Fracernis. Brachytrypus postentosus and Hybela Purea are common pests affecting such trees.

Nematodes: Tylenchorhynchus. Heliotylonechus. Paratylenchus. Meloidogyns.

SEED TECHNOLOGY

- For seed production in maize it was observed that planting ratio of 2.6 i.e. two lines of male and six lines of female could produce maximum seed yield in comparison to other ratios used.

- Determination of isolation distance for seed production in Mustard revealed that safe isolation distance for foundation and certified seed production are 75 and 125 meters respectively.

- Micronutrient (Borax 0.25-100%) and growth regulator (TIBA @ 25-75 ppm) spray in Sunflower generally improved the seed quality.

- In potato it was observed that the size of seed tuber and spacing had significant effect on tuber production. With the increase in seed size from 20 to 50 gms the yield of tuber increased significantly. Reduction in spacing from 60 x 20 cm and 50 x 20 cm to 40 x 20 cm also increased the yield. The highest tuber yield was obtained when the tubers of 50 g were planted at 40 x 20 cm distance.

- Effect of plant density on seed yield and quality of cauliflower revealed that the maximum yield was obtained when planted at the spacing of 75 x 40 cm followed by 60 x 60 cm and minimum was obtained when planted at spacing of 80 x 75 cm.

- Seven physio chemical methods were used for breaking seed dormancy in *Vicia faba* (bread bean). It was observed that small incision on seed coat was most effective for breaking seed dormancy without any harmful effect.

- It was recorded that germination test of finger millet can be performed successfully by paper method at 30^0C with the duration of 3 days for first count and 5 days for final count.

- For standardization of procedure for breaking seed dormancy of Kasuri Metho. the scarification of Seed over 5 minutes and paper for 2-5 minutes was found to be the most effective.

- The pre-sowing seed treatment like hydration followed by drying or treatment with GA3 (100 ppm) were found effective in enhancing the speed of germination and establishment.

- Polythene (400 guage) lined in jute canvas was found most suitable for bulk seed storage followed by HDPE nonlamineted inter woven bag and jute canvas bag respectively. However care must be taken to dry the seed to about 9% moisture content before packaging.

- The fungicide. Raxil (1.0 g/kg) has been found more effective as compared to carboxyl (2.5 g/kg) and Carbendazim (2 g/kg) in the control of loose smut of wheat seeds.

- Rice seed treatment with streptocycline and plantomycine at 200 ppm reduces the seed borne in oculum of xanthomonas oryzae pv oryzae.

BREEDER SEED PRODUCTION

Tirhut College of Agriculture. Dholi of Rajendra Agricultural University. Pusa. Bihar is one of the centres for breeder seed production which is fully financed by ICAR and has done appreciable work in meeting the breeder seed requirement of the state. This centre produces breeder seed not only for the State but also produces breeder seeds of national varieties against GOI indent. Even in the undivided Bihar. Rajendra Agricultural University used to supply more than 80% of the breeder seed of different crops required in the state.

Now for the plains of Bihar, Rajendra Agricultural University is capable to produce and supply the entire requirement of breeder seed of different crops. Ten years average figure of quantity of breeder seed produced by Rajendra Agricultural University with respect to some major crops comes to 93.0 quintals for rice as against trhe State requirement of 111.0 quintals; 365.2 quintals for wheat as against the requirement of 750.0 quintals; 30.4 quintals for pulses as against the requirement of 67.0 qintals; 4.15 quintals for oilseeds as against the requirement of 1.40 quintals ; 1.27 quintals for vegetables as against the requirement of 2.0 quintals and 0.71 quintals for jute as against the requirement of 0.15 quintals.

ENTOMOLOGY

- The application of carbofuran on rice @ 1.0 kg a.i./ha at the nursery stage and repeated dose after 20 and 40 days @ 1.0 and 2.0 kg a.i/ha, respectively has left residues on grains and husk. but were below the maximum residue limit (MRL) of 0.2 mg/kg. So carbofuran can be recommended for the control of pests on paddy crops.

- Carbofuran and endosulfan residues were found below detectable levels (0.01 mg/kg) in maize grains and straw at the harvest.

- No detectable residues of dimethoate and matasystox on mustard and phorate on groundnut were found in the seeds at harvest. However, endosulfan residues (0.04-0.11 mg/kg) were found in the mustard seeds at harvest and were below MRL.

- The residues of endosulfan and its metabolites were detected in chickpea grains (0.04-0.08 mg/kg) and were below MRL values. At recommended rate of application, lindane, fenvalerate, cypermethrin and deltamethrin residues were detected in grains, but these were quite low (0.01-0.02 mg/kg). Therefore, these insecticides can be safely recommended for the control of pests on chickpea crop.

- No detectable residues of endosulfan, fenvalerate and lindane were found in pigeonpea grains at harvest. Residues of monocrotophos and fenitrothion were detected in very small amount (0.02-0.06 mg/ha) in grains and were below MRL

- Lindane residues were not detected in green grain and pod covers following application @ 0.4 and 0.8 kg a.i./ha

- The waiting period of endosulfan, fenvalerate and lindane on green pea pods were found as 4,4 and 7 days respectively at the recommended rate of application. At harvest endosulfan residues in grains were 0.07 mg/kg and below MRL. However, no detectable residues of fenvalerate and lindane were found in pea grains.

- Endosulfan and lindane application at recommended rate on cowpea result safe waiting periods of 4 and 7 days respectively on green cowpea pods.

- The safe waiting period for the application of endosulfan, fenvalerate, cypermethrin at the recommended level on okra fruits was found as 2 days. Thus the use of these insecticides is quite safe. However, the waiting period

monocrotophos on okra fruits was 7 days. It should not be used on okra as fruits are picked every third day.

- The waiting period of endosulfan, monocrotophos and fenvalerate on brinjal fruits were found as 1.6 and 1 days respectively at recommended rate of application.

- In cauliflower the safe waiting period of endosulfan, monocrotophos and fenevalenerate were found as 3.1 and 1 days respectively.

- Pesticide residues were monitored in farm gate and market samples of different vegetables like Cabbage, cauliflower, okra, brinjal, parwal, bitter gourd etc. some of the samples were found contaminated with pesticides. However, only 4% of the samples exceeded MRL values. Organochlorine pesticides other than HCH and endosulfan were not detected.

- HCH and endosulfan residues were detected in few samples of apple and guava collected from local markets. The residues were below MRL values. DDT residues were not detected in any samples.

- Sample of whole milk of cow and buffalo collected from local vendors and milk centres were analysed for HCH and DDT residues. HCH residues ranged from 0.01-0.28 mg/kg and DDT residues from 0.04-0.58 mg/kg. 37.5 per cent of the samples contained HCH residues above the prescribed MRL value.

- Some samples of vegetarian and non-vegetarian total diet were found contaminated with HCH, DDT and endosulfan residues. Residues of DDT and endosulfan were within their prescribed safe limits.

- Soil samples (0-15 cm) collected from different cropping systems showed the presence of HCH, DDT and endosulfan residues. The concentration of HCH was found maximum in rice-wheat cropping system and endosulfan in vegetables.

- Residues of Organochlorine insecticides (in ppb) were detected in samples of surface water (river and pond) and ground water (open well and hand pump).

Concentration of DDT and endosulfan was higher in the month of September and HCH in December.

- The effect of decontamination processes in reducing the pesticide residues from contaminated vegetables was studied. It was found that simple washing of vegetables with tap water reduced residues from 30 to 50 per cent. Therefore, it is recommended that the vegetables should be washed thoroughly before consumption.

PLANT PATHOLOGY

- Anthracnose/marginal blight caused by three spp. of *Collectotrichum*, phytophthora leaf and foot rot incited by *Phytophthora parasitica* and bacterial leaf spot (*Xanthomonas compestris*) were the major diseases infecting betelvine crop. These disease start with the on set of monsoon (Ist week of June) and persisted till November with varying degrees of intensity.

- Out of twenty two germplasm available at the centre, none of them was found resistant to these diseases under artificial inoculation.

- Four sprayings of Bordeaux mixture (0.5%) or Copper oxychloride (0.1% a.i.) at 20 days interval starting just after pre-monsoon significantly reduced anthracnose and bacterial leaf spot disease of betelvine.

- Sanitation integrated with drenching of Bordeaux mixture (1.0%) followed by soil application of biological agent (*Trichoderma viride*) and one more drenching of Bordeaux mixture (1.0%) was found significantly superior to other treatments in respect of suppression of Phytophthora leaf and foot rot incidence.

- Four applications of oil cake inoculated with *Trichoderma viride* @ 2 kg/ha/split was found significantly superior and at par with three drenches of Bordeaux mixture (1.0%) at monthly interval and six sprays of Boreaaux mixture (0.5%) at fortnightly interval in reducing phytophthora foot rot incidence.

- Packing in bamboo basket with inside moist straw lining leaving hollow space at the centre significantly reduced percentage of spoiled leaves during all the seasons.

- Six sprays of $ZnSO_4$ (0.2% or 0.4%) at two months interval significantly increased vine elongation, number of branches and no. of leaves/plant.

- Soil application of neem coated urea (100 kg N/ha) in four splits significantly increased vine elongation, no. of leaves/plant and reduced disease incidence as compared to prilled urea (200 kg N/ha).

- Three sprays of Tricontanol (Miraculan) at 0.5% at 30 days interval effectively reduced vine elongation and no. of leaves/plant.

- IW : CPE of 1:5 cm significantly improved almost all the growth attributing characters of betelvine including keeping quality and nutrient uptake.

- 200 kg N in the form of compost or compost + urea (1:1) significantly increased growth attributing characters of betelvine inclusive of uptake of major nutrients.

- Survey of betelvine conservatory indicated that *Rotylenchulus reniformis* and *Meloidogyne incognita* were the dominating nematodes of betelvine.

- There was increase in root-knot index from 1.75 to 4.25 to 60 to 180 days after inoculation of *M. incognita*.

- Inoculation with *M. incognita* to 18 germplasm indicated that the root-knot index was highest (4.50) in Magahi and lowest (3.25) in Halisahar Sanchi and Harapatta.

- Soil application of Neem cake @ 500 kg/ha + Soil drench of Carbofuran @ 0.1 per cent and inoculation Neem cake with *Paecilomyces lilacinus* @ 500 kg/split/ha resulted in maximum suppression of nematode population.

- Inoculum level of 5000 and 10,000 nematodes/plant/pot gave the best result in the pathogenicity of reniform nematodes.

- Survey and surveillance works undertaken on diseases of Horticultural crops revealed that blight of tomato incited by *Phytophthora infestans* had the severity to the extent of 7 per cent whereas the fungus recorded 100 per cent severity.

- Carrot agar was found optimum for growth of *P. infestans* whereas potato dextorse agar was the best medium of *P. colocasiae*.

- *Trichoderma viride* had strong antagonistic activities against *P. infestans* exhibiting 54 per cent growth inhibition of the fungus.

- *Azadirachta indica* at 4 per cent concentration and *T. viride* completely inhibited mycelial growth, sorangial production, zoospore production and zoospore germination of *P. infestans*.

- Rajendra Alu-1 and Rajendra Alu-2 were found resistant to late blight of potato.

- Two sprays of Ridomil MZ (0.2%) at 20 days interval were found significantly superior to other treatments in percent disease incidence and PDI of leaf blight of colocasia.

- C-8, C-10, C-13, C-15, C-28 and C-135 varieties of colocasia were found moderately resistant whereas DL-1, DL-2, D-18, KS-17 and H-36 varieties of tomato were found resistant to leaf blight disease.

WEED MANAGEMENT

- A weed free period of initial 30 days was found very critical for direct seeded upland rice.

- In the two systems of upland rice culture (direct seeding/transplanting transplanting gave better weed control and higher yield than direct seeding. the crop in both the systems responded significantly upto 120 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha. For controlling the weeds effectively pre-emergence application of Butachlor (Machete) or Benthiocarb (Saturn) @ 1.5 kg a.i/ha found very effective.

- In medium land transplanted rice, application of herbicides till the weeds attained their 2-4 leaf stage (within a week after transplanting) gave better weed control and herbicides like Butachlor (1.5 kg/ha), Benthiocarb (1.5 kg/ha) or Anilophos (0.4 kg a.i/ha) were found to be equally effective.

- In lowland transplanted rice, Pendimethalin or Benthiocarb @ 1.5 kg a.i/ha was found to be very effective in controlling the weeds and giving higher yields.

- For controlling the algae weeds the use of copper sulphate @ 15-20 kg/ha was found promising in deep-water rice ecosystems.

- In maize pre-emergence application of Atrazine @ 1.5 kg a.i/ha followed by interculturing or earthing up gave effective control of weeds and higher crop yields. Atrazine when followed by post-emergence application of 2,4-D @ 0.8 kg a.i/ha have a season long control of weeds.

- Integrated control of weeds in maize was achieved by inter-cropping it with black gram (urd) as a smother crop and pre-emergence use of alachlor (lasso) @ 1.5 kg a.i./ha which gave the highest maize yield equivalence and monetary return per ha.

- In maize + groundnut inter-cropping system, pendimethalin or alachlor @ 1.5 kg a.i/ha or Oxadiazon @ 1.0 kg a.i/ha gave an effective control of weeds and higher yield.

- For maize + potato inter-cropping system, atrazine (pre-emg) @ 0.5 kg/ha) or alachlor or Pendimethalin @ 1.5 kg a.i/ha was found effective for controlling the weed and giving economic returns.

- Application of herbicide (traizines & 2,4-1) at recommended rates in Kharif maize had no residual toxicity in the soil to injure the susceptible rabi crops grown in succession.

- The new grassy weeds like Phalaris minor, *Avena fatue* etc. in wheat fields could be effectively controlled with the pre-emergemce application of pendimethalin @ 1.0 kg a.i./ha or post-emg application of Isoproturon @ 0.75 kg a.i./ha.

- The broad leaved weeds in wheat fields were effectively controlled with the post-emg use of 2,4-D (Na-salt) @ 0.8 kg a.i/ha applied 30 DAS. However, wheat variety HUW 206 was found to be susceptible to the higher dose of 2.4-D.

- Cross-sowing or using a higher seed-rate were found to give better weed control efficiency in wheat when accomplished in conjunction with the recommended herbicides.

- For chemical weed control in Indian mustard, pre-emergence application of Bifenox 1.0 kg a.i/ha and Ronstar @ 0.5 kg a.i/ha were found to be the promising herbicides which were statistically as good as hand weeding and hand hocing although less efficient than weed-free conditions.

- Pre emergence application of fluchloralin (1.0 kg a.i./ha) or Oxadiazon (0.5 kg a.i/ha) or tribunil (1.5 kg a.i./ha0 were as effective as hand weeding for controlling weeds in lentil. Unchecked weed growth reduced crop yield by abou 50 per cent. Soil incorporation of herbicides proved slightly superior than surfac spray.

- Soil incorporation of fluchloralin (1.0 kg a.i/ha) or Oxadiazone (0.5 kg a.i./ha) o tribunil (1.5 kg a.i./ha) or saturn (1.5 kg a.i./ha) were as effective as han weeding for controlling weeds in chickpea and these all were well comparable weed-free check.

- *Parthenium hysterophorus* was effectively controlled by using Glyphosate Paraquat (1 kg a.i/ha) along with 2,4-D @ 1 kg a.i./ha in the pre-flowering stag of the weed. Several demonstration for parthenium control were also launche and social awareness was created through various farmer's training programm and the mass media.

WATER MANAGEMENT

- The recommended practices of water management for rice, wheat, mustar rajmash and winter maize were demonstrated. In rice, yield increased by 20- per cent with water saving of 18.1 cm. In wheat on the basis of 5 years of studie the yield increase ranged between 5 to 12 q/ha with irrigation water saving of

to 11.7 cm. In mustard, two irrigations with canal + tubule gave higher yield than two canal irrigation due to untimely supply of 2nd canal irrigation.

- With the introduction of improved water management practices, the area under rice, wheat, mustard, rajmash and summer moong increased from 170, 23.5, 0.23, 0 and 40.1 hectares to 223, 86, 16, 4 and 64 hectares. The cropping intensity which earlier was 107.8 per cent, has increased to 180.6 per cent by now.

- The water requirement of early and medium duration of rice was evaluated and it was observed that 3 days drying after disappearance of 7 cm irrigation was suitable for optimum yield of rice. The water requirement varid between 80-90 cm.

- In case of paddy the loss due to percolation is about 60-70 per cent water. Puddling is one of the important operation towards the reduction of precolation loss.

- On the basis of 4 years experiments it was observed that wheat required 3 to 4 irrigations at IW/CPE ratio of 0.8, with 6 cm of irrigation each time. When the rainfall during winter exceded 4 cm, the number of irrigations came to 3 otherwise 4. For late sown wheat 2 irrigation was found to be optimum.

- Based on the experiments conducted using IW/CPE approach, irrigation calendar for wheat crop has been developed for the Gandak Command area for different dates of sowing.

- In case of boarder method of irrigation in wheat 80 per cent cut off ratio was found suitable which saved 10-15 per cent irrigation water without any loss of yield.

- Experiments were condeucted to evaluate the water requirement of winter maize. For optimum grain yield, the soil moisture during vegetative and reproductive phases may be around 70 and 50 per cent respectively which results in 5 to 7 irrigations during the crop period. On the basis of IW/CPE ratio; the optimum

yield was obtained at IW/CPE ratio of 1.0 with 5 to 6 irrigations each having a depth of 6 cm.

- Maize + potato system required 7 irrigations as compared to 6 irrigations in case of pure maize. This one additional irrigation resulted in increase in net return by Rs. 2700 per hectare.

- In winter maize sugarcane trash mulching was found beneficial in conserving soil moisture as well as increase in minimum temperature by 2 to 3^0C at the initial stage and reduced the maximum temperature by 4 to 5^0C at later stages of growth. This ultimately increased yield by 50 per cent as compared to no mulching.

- Experiments were conducted to evaluate the performance of different types of furrow irrigation on maize crop towards the water saving. Four irrigation method, namely, irrigation in each furrow, irrigation in alternate furrow. irrigation in paired row and irrigation in skip furrow were studied. In paired row. about 23 per cent of water can be saved but the yield is low and thereby the water use efficiency is at par with each furrow irrigation. However, alternate furrow and skip furrow methods help to save about 30 per cent irrigation water without any appreciable reduction in grain yield. Therefore, in case of deficit irrigation water supply either of these methods could be adopted.

- On the basis of several years of experiments in spring planting of sugarcane. 3-4 pre monsoon irrigations at an IW/CPE ratio of 0.8 resulted in maximum cane yield. However, from sucrose point of view 2 to 3 irrigations at an IW/CPE ratio of 0.6 was found beneficial.

- Summer sunflower responded upto 6 irrigation (0.8 IW/CPE) during summer season but from water use efficiency point of view 4 irrigations at IW/CPE ratio of 0.6 seems to be more beneficial. The crop responded upto 40 kg N/ha. The interaction between irrigation and nitrogen was absent.

- On the basis of experiments at Pusa, Winter sunflower required 3 irrigations at an IW/CPE ratio of 0.8. The crop require 18 to 20 cm of irrigation water.

- The Rajmash crop responded upto 3 irrigations applied either through IW/CPE ratio of 0.8 or at 2550 and 75 days after sowing. Response to nitrogen was recorded upto 80 Kg N/ha. Though rajmash. being a leguminous crop, responded upto 80 kg N/ha because of its non-nodulating nature.

- On the basis of 3 years of experiments it was observed that moong requires one irrigation at 30 days after sowing. If sufficient moisture is not available at the time of sowing, one pre sowing irrigation is also required.

- On the basis of 3 years of experiments it was found that mustard requires 2 irrigations at 30 and 60 days after sowing. The crop required 15 cm of water for its optimum yield.

- The water requirement of rice based crop sequences under constraints of irrigation water was evaluated for five years.

- Among the crop sequences Rice-potato green gram resulted in maximum yield and net return when sufficient quantity of water was available. This was followed by Rice-winter maize-black gram.

AGROMET

- Analysis of rainfall data for the last 48 years reveals that in majority of years (35.4%) monsoon arrives at Pusa in 24th meteorological week i.e. 11-17 June.

- When monsoon arrives late, its withdrawal is earlier.

- When monsoon starts from 23 to 24 met week, its distribution is favourable for successful cultivation of rainfed rice with one or two life saving irrigation.

- Incase monsoon starts in 25th met week ,the transplanting and tillering phase may receive good rainfall but there are chances of terminal drought during grain filling stage of rice crop. Under such situation short duration rice varieties may perform better.

- When monsoon starts in 26th week, there are chances of water scarcity for rice transplanting. The tillering and grain filling stage of rice may also suffer from water stress. Under such condition maize and Pigeon pea may perform better.

- With provision of one Scientist in this scheme, field experiment on rice wheat system has been started from Kharif 2001 to generate field data including the study on phenology of different cultivars of rice and wheat under this situation and also to develop crop weather relationship for testing the dynamic crop growth model.

E.C.F. (Experiment on Cultivator's Field)

- Highest grain productivity was observed with 'Rice-Sunhemp (G.M.)- Wheat' followed by 'Rice-Wheat'. However, maximum net profit was fetched with 'Rice-Toria-Wheat and 'Rice-Vegetable Pea-Wheat', but wheat yield declined due to very delayed sowing of wheat.

- For achieving sustainability in production, 'Rice-Wheat-Moong' proved economically better than other sequences.

- Medium duration Rice variety (Sujata) and timely sown wheat (Var. HUM 206) recorded the productivity of 8-9 t/ha in Rice- Wheat Cropping Sequence.

- Economically the chemical weed management practices proved better than the mechanical weeding due to high cost involved in manual weeding.

- Integrated nutrient supply comprising 75 per cent of recommended dose through fertilizers and rest through organic manure led towards higher productivity in rice-wheat sequence and took care of the soil health also.

- Rice variety Sujata followed by wheat varieties like HUW 206, UP 262 and HD 1761 gave higher total production and monetary return. Thus growing such a rice variety which facilitated timely sowing of wheat was found to be sustainable production from Rice-Wheat sequence.

- These response of rice to applied nutrients was observed in the order of NPK, NP, NK, N. The crop yields at different locations almost doubled with

application of 80 kg N/ha. Addition of P or K resulted in an increase in yield. The response to phosphorus gave higher yield than potassium. The yield increased by 2.5 times with the application of NPK @ 80:40:20 kg/ha.

- Nitrogen alone doubled the yield of maize variety Suwan on all the cultivators sites. Phosphorus application exhibited a better response than K and the combination of NPK; 100:60:40 kg/ha gave the highest yield.
- The most critical factors for improvement over the farmers practice in rice were identified to be as achieving the optimum plant population per unit area with shallow transplanting and the application of recommended dose of fertilizers.
- Under the maize-wheat system in maize variety Suwan, the yield increased over the farmer's practice with timely and efficient control of weeds. adequate crop stand and adoption of all other recommended package of practices in all the villages.

Intercropping Systems

- The most common intercropping system under rainfed condition in the three villages so far surveyed (viz: Rohua. Adharpur & Basaria) are - Pigeonpea + Turmeric; Pigeonpea + Kharif Maize; Kharif Maize + Black gram & Lentil/Lathyrus + Yellow Sarson. Besides, few farmers were found to grow Pigeonpea + Groundnut and Kharif Maize + Jute.

- The common intercropping system under irrigated conditions are :

a) Sugarcane + Potato/Coriander/Tobacco/Garlic/Mustard
b) Tubacco + Garlic
c) Winter Maize + Potato

- On suvey it was observed that farmers, in general, do not have idea about package of practices of intercropping system, as a result they are not getting benefits from the system
- It was also observed that the farmers were not applying full dose of phosphorous and potash to the base crop and also not accounting the requirement of component crop.

TECHNOLOGY ASSESSMENT AND REFINEMENT THROUGH I.V.L.P.

- Under upland conditions, Prabhat a recently released variety from RAU out yielded Saket-4 and local. The mean yield of Prabhat was 43.2 q/ha as against

24.3 q/ha in Saket-4 and only 21.0 q/ha in case of local one. From taste and adaptability point of view, farmers were of the opinion that Prabhat may be a good substitute against Saket-4.

- The performance of medium land rice with maturity of 135-140 days was tested in 40 farmers field of IVLP village. Among medium maturing group of rice, maximum grain yield (52 q/ha) was recorded in case of Kanak followed by Rajshree. The lowest yield (25.3 q/ha) was recorded incase of local variety (Bakol). The net return was also maximum in case of Kanak. However, from quality point of view, the farmers liked Rajshree which is relatively finer than Kanak.
- Under lowland eco-system, three varieties namely Rajshree, Sungandha and local (Bakol) were tested in 40 farmers field. The yield of RAU variety Rajshree was the highest (32.6 q/ha) as compared to Sugandha (15.8 q/ha) and local (23.8 q/ha). Though the yield of Rajshree was higher the net return was lower as compared to Sugandha, a scented variety whose market price was much higher than Rajshree.
- A verification trial on management of rice disease and insects in up land situation was conducted in 30 farmers field. Endosulfan @ 1.5 litre/ha and Bavistin @ 1.0 kg/ha twice during the growth period increased yield of rice as compared to farmer's practice where no insecticides were applied. Yield under former ranged between 30-36 q/ha whereas under farmer's practice it ranged between 20-28 q/ha.
- In case of medium land also the yield increase was recorded when Endosulfan and Bavistin were applied at the rate indicated above. The yield under improved practice ranged between 36-42 q/ha whereas in the farmer practice it ranged between 3-34 q/ha. Almost similar yield was recorded in case of low land rice.
- In order to increase water use efficiency in paddy, improved water management technology i.e. application of 7.0 cm irrigation after 3 days drying of pond water was tested in 20 farmers field. Under improved practice there was saving of 20-30% irrigation water and the yield increase ranged between 8-10 q/ha.
- The performance of three brinjal varieties namely Long Green, Pusa Kranti and Pant Rituraj was tested in 23 farmers field. Maximum yield of 225 q/ha

recorded in Pant Rituraj followed by Pusa Kranti with a yield of 200 q/ha. The minimum yield of 190 q/ha was recorded in Long Green variety. The colour and size of Pant Rituraj was also more attractive.

- For prevention and control of endo and ectoparasites in cattle. 50 animals belonging to adopted village Pilkhi were given subcutaneous injection of ivermectin (Indact. Wockardt Co.) @ 7 ml/animal for the treatment/prevention of ectoparasities (viz-ticks & lice) with excellent result. This has received wide appreciations from the farmers of the Pilkhi village. Efficacy is 95 per cent.
- In order to evaluate the performance of zero-till machine for sowing of wheat as compared to conventional method, 25 trials were conducted in IVLP village. The yield under zero tillage sowing ranged between 49 to 52 q/ha with a mean yield of 51 q/ha whereas in case of conventional method it was only 45 q/ha. The net return was also higher in case of zero-tillage sowing. The higher yield might have been due to increase in water retention owing to increase in micro-pores and addition of more organic matter in soil.
- Under late sown condition, four varieties of wheat namely UP 262, HUW-234, Sonali and HP-1744 were tested in 30 farmers field. Maximum yield ranging 32.8 to 38.00 quintal was recorded in case of sonali variety of wheat followed by UP-262, HP-1744 and HUW-234.
- Maize + Potato intercropping system was tested in 20 farmers field. The seed material of Laxmi, a composite maize, and Rajendra Aloo-2 were tested against the farmers practice of Suwan maize with yield of 37 q/ha and 128 q/ha. respectively In case of new interventions the yield of Laxmi maize was 48 q/ha and Rajendra Aloo-2 was 140 q/ha.
- In order to control blight in potato Ridomil @ 2 kg per hectare was tested against the farmers own practice of using Endofil M-45. The trial was conducted in 60 farmers field. The yield incase of Ridomil application varied between 160 to 180 q/ha whereas incase of Endofil M-45 it ranged between 150 to 170 q/ha. This was because of the fact that in some of the farmers fields there was no complete control due to Endofil M-45 application.
- In order to test three improved varieties of cauliflower namely Durga Pusi, Sangro Pusi and Century Pusi, 20 farmers were selected and were given seed of

these three varieties. The yield was maximum in case of Sangro Pusi followed by Durga Pusi. The lowest yield was recorded in century Pusi.

- Selected new mango trees responded positively to fertilizer application. The number of fruits in fertilizer treated trees was just double.
- Ten to twelve year isold litchi trees which were selected for study were found to respond positively to application of NPK fertilizer. The yield (number of fruits) varied between 800-1105 in case of those trees where no fertilizer was applied. This value increased up to 1106-1670 in case of those trees where recommended dose of NPK fertilizers were applied. The mean number of fruits per plant was found to be 979.5 and 1395.8 in case of no NPK application and in NPK application, respectively. From income point of view, NPK application was found superior. The additional net return per rupee of investment was found to be Rs. 4.19 as compared to no NPK application.
- Two kinds of interventions are part of bee-keeping work under IVLP. One is research and the other is training of bee-keeping. Research component under TAR is on "Comparative yield potential of Apis cerana indica and Apis mellifera' for which mellifera bee-boxes have been kept at the size of IVLP village Pilkhi (Muzaffarpur district) which has shown an yield potential of 40 kg per colony during litchi period, the main honey flow period during litchi season 2000. Under bee-keeping training for domestication of Apis mellifera bees, five trainings formed the part of IVLP during the academic year 1999-2000 and conducted successfully for about 150 women of IVLP village.
- Apart from OFT and VT, training in the fields of bee-keeping, mushroom, fruits and vegetables, disease control in livestock and poultry and water management in crops were conducted.

AGRICULTURAL ECONOMICS

- Fish farming is practised by poor households in north Bihar. Average size of fish ponds is 0.74 ha. However 38 per cent ponds are below 0.5 ha and average size of these fish ponds is 0.30 ha. Fish farming is still practised with traditional technology. Rohu and Common carps constituted two third of total stocking fish seeds in north Bihar. Three-fourth of fish farmers used lime and 2 per cent used toxicants in fish production in north Bihar. Dung is applied in about

per cent of fish ponds and supplementary feeds to 24 per cent of fish ponds in north Bihar.

- The flood is the main constraint which discourages farmers to invest in fish production. Fish farmers are unaware of recommended package of fish production practices. However good quality fish seeds are not available in north Bihar. There is complete absence of extension services. and fishery co-operative is a dead organization which is engaged in only facilitating leasing of ponds from Govt.
- Salient findings of the project on "Marketing of rice in eastern India' conducted and completed recently on behalf of MANAGE, Hyderabad revealed that in Bihar the compound growth rate of area under rice during the period from 1981-82 to 1996-97 has shown declining trend where as growth of production and productivity are observed to be positive and significant during the same period.
- The demand of rice is likely to be 12.26 million tonnes in the year AD 2010 whereas the supply is expected to be 10.15 million tonnes indicating that Bihar is likely to be deficit state till the end of this decade. The marketable and marketed surplus was estimated to be 69.75 and 40.05 per cent respectively of the total production.

AGRICULTURAL ENGINEERING

POST HARVEST TECHNOLOGY (P.H.T.)

* While studying the post harvest processing of litchi fruit, it was found that untreated litchis cold last highest 8 days at 14^0 C and 13 days at 2^0 C in bamboo basket. Treated litchi (Sulphur fumigation) could last highest 20 days at 14^0 C at 32 days at 2^0 C in polyethylene bags whereas 16 days at 14^0 C and 28 days at 2^0 C in bamboo basket.

* For studying the post harvest management of maize crop, experiments were conducted on shelling of maize crop, by power operated maize sheller at different levels of crop/grain moisture content. Best results were obtained at 14.20% cob moisture content and 1384.62 Kg/ha feed rate.

* For undertaking research on process technology of turmeric and ginger, a 20 Kg capacity boiler has been designed and fabricated using 2.3 gauge G.I. sheet for parboiling/curring turmeric rhyzomes as well as ginger. The boiler was tested for different variables (viz; rhyzome water ratio temp. of curring & curring time) to estimate the optimum cooking of rhyzome. Statistical, analysis of data is in progress for deducing final conclusions.

* Studies conducted on performance evaluation of hand operated papad making machine revealed that a net profit of Rs.200/day with 8 hours of working may be gained by a village women or youth with a hand papad press.

* Studies conducted on performance evalualtion of mini dal mill revealed the capacity of the machine for milling Arhar (Pigeonpea) as 98 to 100 Kg/hr depending on the size of Arhar, feed rate and moisture content at the time of milling.

* Testing of Akola waste fired crop dryer was done for chilli and maize. Maixmum drying period for chillies was found to be 16 hrs. and 14 hrs. for 90 m.m. and 60 m.m. bed thickness respectively. The maximum drying time for maize cobs was found to be 6 hrs. and 4 hrs. for 75 % and 50% loading conditions under the machine while 6 days for sundrying. The machine has also been tested for dryihng of par-boiled turmeric. Maximum drying time was

found to be 14 hrs. for 60 m.m. bed thickness, 11 hrs. for 30 m.m. bed thickness under the machine whereas 6 to 10 days for different bed thickness (30 m.m. & 60 m.m.) under sundrying.

* Testing of grain puffing machine for corn. rice & Bengal gram was done. A Chulha was desisgned and fabricatd for this machine.

* The P.K.V. mini dal mill was tested for milling of pigeonpea. green gram. lentil and black gram. The maximum dehusking efficiency for Bengal gram was found to be 67.69% at 11% moisture content. 2.0 m.m. cleareance & 35 Kg/hr. feed rate. In case of green gram. it was found to be 67.70% at 12.10% moisture content. 1.25 m.m. clearance and 42 Kg/hr. feed rate. The highest milling efficiency was observed to be 71.66% for lentil at 11.01% moisture content. 2.3 m.m. clearance and 50.5 Kg/hr feed rate. The unit cost of operation was found to be Rs.0.15 /Kg and Rs.0.19/Kg. for lentil and black gram respectively.

* A prototype machine for makhana processing has been developed. The performance of this makhana popping machine was found satisfactory at 15 Kg/hr. feed rate and compeller speed of 2650 rpm. Its efficiency is 84.5%. The unit cost of makhana processing per kg was found to be Rs.0.75/kg & Rs.10.0 /kg by newly developed machine & traditional method respectively.

FARM MACHINERY

* Zero till dril machine was tested in the farmers field at various location in Samastipur. Muzaffarpur. Begusarai. Patna and Barh districts. The field capacity was found to be 0.65 ha/hr. Cost of sowing with this machine was Rs.247 per ha whereas with desi plough it was Rs.1807 per ha. The populations of weeds like *Phalaris minor* and *chinopdium album* were counted to be 46 and 175 per sq. meter respectively in the fields sown with zero till drill which is about 10 times leasser than the fields sown with traditional method i.e. 416 and 421 per sq. meter. On the basis of such observations. it was also estimated that about 30% of Chaur & Tal areas can be added for wheat cultivation.

* Bullock drawn inclined plate multi crop planter was tested for sowing of maize crop. The seed rate was found to be 23.45 Kg/ha. Seed damage was nil. Wheel skid was within permissible range.

* Testing of pheumatic planter for sowing of sunflower and wheat crops was done. Seed rate was found to be 3.18 kg and 120 kg/ha respectively. There was no seed damage.

* Testing of self propelled rice planter was done and the performance was found satisfactory. The field capacity was found to be 0.12 ha/hr. Testing of the machine in the farmers' field is in progress.

* Raised bed planter has been tested for sowing of 13 varieties of wheat. For comparison 2 varieties were sown with seed drill. Data collection and evaluation works are under progress.

* Disc plough, mould board plough, ridger and seed drill were fabricated.

* Till plant machine (Chinese model) was tested for sowing wheat crop in farmer's field. The farmer's were satisfied with the performance of the machine. The field capacity of the machine was found to be 0.2 ha/h. There was a net saving of Rs.1326.50 /ha.

* Light weight power tiller "Little Master" was tested for interculturing in tobacco, sugarcane and maize crops in the farmer's field in different villages of Samastipur and Begusarai districts. The weed mortality was found to be 70%. The field capacity was determined to be 0.2 ha/h. There was net saving of Rs.1070.00 per haectare.

* Power tiller operated varietal conveyor reaper was tested for harvesting of wheat in the fields of farmers of Samastipur, Muzaffarpur and Begusarai districts. The farmers were well satisfied with perforamnce of the machine. The field capacity of the machine was found to be 0.3 ha/hr.

* Power tiller operated Jyoti Planter was tested for sowing of wheat, maize, gram, pea, razma and sunflower. The performance of the machine was quite well. The field capacity of the machine was found to be 0.11 ha/hr. The cost of sowing was Rs.1625.00/ha.

* TNAU modified axial flow pump was tested at different heads and speeds. The performance of the pump was quite well.

* Testing of seating attachment with Mitsubishi Power Tiller was done. The power tiller was able to operate easily at 6 Km/hr. forward speed with seat & 4 Km/hr. without seed under dry land condition. The forward speed reduced to 5.5 km/hr. & 3 km/hr. in wet land condition with & without seat respectively.

Irrigation & Drainage

* Irrigation hydraulics of zero-till borders was studied. Wheat crop was sown with zero till machine in boarders for evaluating the irrigation system performance under different cut off ratios i.e. 60%, 70%, 80% and 90%. The crop has been irrigated with an inflow rate of 15^{-1} m^{-1}. Pertinent data such as infiltration, soil moisture status before each irrigation, water advance pattern, normal depth of flow at upstream end have been collected. Analysis of data is under progress.

* Crop co-efficient for evaporation was studied. Maize, wheat, rai and lentil were sown for determination of the crop co-efficient values. A total of 5, 4, 1 & 7 irrigations were applied in wheat, rai, lentil & maize crops respectively. Observations such as daily pan evaporation, soil moisture status prior to each irrigtion, stream flow rate, depth of water application have been recorded & analysis of data is under progress.

Soil & Water Conservation

* A low cost (Rs. 153/meter) polyhouse using bambo splits was fabricated. This provides good amount of natural cooling during summer. During rains it can be very successfully used as rain shelter and seedling as well as vegetables that are sensitive to submergence can be grown. During the winter, on the other hand, the inside temperature is higher by about 6 to 10^0C when sides are closed and there by it can be used for growing seedlings and vegetables that other wise will grow only during February/March.

* Under NATP entitled " Crop growth and water use models to improve the water use efficiency under different water supply situation", models of Paddy and Wheat and Model CROPWAT having weather data base and Soil properties are also being studied.

Farm Power and Renewable Energy

* Evaluation of cooking energy requirements of different foodstuff for simulation modeling of solar pressure cooker was undertaken to generate data on cooking energy requirements of different foodstuffs commonly used by North Bihar people. Date thus generated would be used to develop a computer program for simulation, which in turn will be used to design and develop solar cooker to suit the locality. In order to generate more reliable data some percision instruments are being purchased.

* Testing and performance evaluation of solar still was done. Solar still is a device to obtain distilled water using solar energy as source of heating. Distilled water is a present day requirement. It is used in lead acid batteries to maintain proper level of electrolyte in batteries. Now a days such batteries are getting popular to run TV sets in rural areas where there is no power supply. Distilled water obtained through solar still is also good to remove all types of hardness of water and can be used to obtain good quality water for household application. Discharge rate was observed to increase with increase in inside temperature as well as temperature difference between inside and out side temperature. The capacity of solar still was observed to vary from 2.115 liter per day in April 2000 to 2.541 liter per day in June,2000.

Instrumentation centre

* An indigenously designed, fully and solid, state and versatile microprocessor – based temperature controller was developed.. Temperature is controllable within $\pm 0.5^0$ C. The machine is highly accurate, precise and sensitive costing very low i.e. Rs.5,000.00. It is capable for drying various types of grains. It has automatic cut off below and above the users desired temperature. It can also monitor the sample's moisture content. The machine is absolutely versatile for use in several other areas viz; soil testing, chemical laboratory, domestic cooking etc.

* Two comprehensive programmes in c/c ++ i.e. one for pay bill of employees of RAU, Pusa & other for U.G. examination & result publication of students were developed.

Basic Science & Humanities

Botany & Plant Physiology

* Salt stress studies in rice revealed Kamini and Sugandha as susceptible genotypes showing maximum reduction in germination (43-45%), GRI (79%) & Vigour index (82-83%) at 16 ds m^{-1} salt stress in 7 days old plants. However, Pusa 2-21 and Saket-4 were found to be the salt tolerant rice genotypes having lesser reduction percentage values in all the above indices. Such salt tolerant rice genotypes maintained higher reducing & non-reducing sugar contents (25.42 mg/g & 26.84 mg/g respectively) as well as amylase activity (114.30 units/mg protein) & lower starch. The soluable protein contents & peroxides activity values were also maintained at higher level in these tolerant genotypes in stress situation. It seems that these tolerant rice genotypes could show better performance in saline soils by maintaining efficient osmoregulation mechanism and protein synthesizing systems.

* Salt stress studies conducted from germination to growth (seedling stage) in Chickpea revealed Pusa – 256 and Phule G-5 as susceptible while SG-11 and DG84-11 as tolerant genotypes. The salt stress caused less degradation of starch, lower amylase activity , less protein and more phenol content values. The above noted telerant genotypes showed lower starch content (242.10 mg /g) .higher amylase activity (117.7 unit/gm) and total phenol content (6.10 mg/g) in stress situations. Thus the possible mechanism of tolerance seems to be by activating hydrolytic and antioxidising systems . Besides the reason for tolerance of these chick pea genotypes to salinity stress may be ascribed to the fact that tolerant genotypes retained more Na+ in root system and permitted little transport to shoot , thereby avoi ling the toxic effects of Na + in shoot and other parts. Moreover more K+ in shoots of tolerant genotypes was found which may be beneficial by way of osmotic adjustment under saline condition.

* Screening of maize genotypes against salt stress revealed Jogia local (X),S3-12-1-16,Sabour sel g.(a) and Mg (X) S4-37-1-52 to be relatively tolerant at 12ds in salt stress.

* Screening of chickpea genotypes against zinc and iron stress in calciorthent soil (Adhoc scheme funded by ICAR) was done. Out of 47 chickpea genotypes tested so far, 22 could be rated as most tolerant genotypes which may successfully be grown in Zn deficient soil without addition of Zn fertiliser with a loss of yield only up to 5% . This is indicative of the fact that these genotypes derived their zinc requirement from nutritive source of the soils. High yielding genotypes are generally more susceptibile to Zn stress as compared to low yielding genotypes. However, these are high yielding genotypes tolerant to Zn stress viz; BG-1084, WCG-95-50, CSJ3-151, PBG-126,FG-897, GCP-9605, Phule G- 95126 and could be grown successfully under Zn deficient condition without Zn application.

* Effect of submergence on the physiology of rice genotypes was studied. Submergence causes high plant mortality, low production & severe yield loss. Out of 5 rice genotypes tested, Janaki & FR-13A were found to be tolerant to submergence. Maintenance of high N.S.C. (Non structural carbohydrate) and gradual increase in amylase activity appear to favour submergence tolerance in them.

Genetics

* Under NATP on **"Sustainable Management of Plant Bio-diversity"** germplasms of rice (32), maize (33), pigeonpea (42), other pulses (121), millet (26), mustard (9), other oil seed (25), fodder (4), barley & Oat (14), spices (14), wild sugarcane (2), wild pumpkin (1) and medicinal/ aromatic plants (52) were colected. Black Bakla, Parwa Pankh rice, Muskdana, wild pumpkin, Sonatikkar Makka, Jounpuria Makka, opum poppy, sarpgandha, Liver plant, Kamraj/safed musli, kwatch/kaunch & Satawar are some of the unique materials collected. List of existing germplasm materials of different crops maintained at RAU, Pusa was prepared & submitted to Zonal leader of allotment of IC No.

* Under NATP on **"Genetic Evaluation & Improvement of sesbania (Dhaincha) & Crotolana (Sunhemp) for green Manuring"**, 20 and 6 germplasms of sesbania & crotalaria respectively were collected during2000-2001. 53 germplasms of sesbania along with 2 local chack variety namely Rajendra Dhaincha-1 & 2 were evaluated. Neither of the genotype were

superior than check variety i.e. Rajendra Dhaincha-1 for average weight of green biomass at 45 days after sowing. Evaluation of sesbania (6 germplasms) for their performance as green mannure indicated that the entries MD(S)-1 and NDUAT(S)-1 were superior to Rajendra Dhaincha-2 for total biomass productivity. For yield character of rice crop, plant sesbania-1 was found statistically at par with the check varieties. None of the entries recorded superior performance over check varieties for number & weight of nodules/plant at 45 days after sowing. Similarly evaluation of 4 germplasms of Crotolaria including one local check for their performance on green manuring revealed that none of the entries was superior to local check.

Studies were conducted on **"Diversification of Pigeonpea gene pool through introgression of traits from Atylosia platycarpus"**. Eleven germplasm accessions of Atylosia platycarpus & ten accessions of *Cajanus cajan* were evaluated for different morphological & resistance characters. The genotype differs significantly for different characters. Pant A-3 was earliest to flower and mature in 130 days. Genotypes Pusa –9, Bahar, ICP-6344, ICP-83001 & ICP-7119 also showed lowest pod fly infestation. Genotype Bahar showed the largest grain size. Hybrid embryos obtained from Atylosia platycarpus x cajanus cajan var. Bahar gave the best response.

Under I.C.A.R.'s sponsored adhoc scheme entitled **"Development of Hybrid Boro Rice for North Bihar"**, fifty one cross combinations were effected involving six WA-Cms rice lines and 10 pollen parents. The cross combination are being evaluated to identify maintainers & restorers of these WA – Cms lines among the cultures/cultivars suitable for boro ecologies. Thirty three mutant rice lines were evaluated in randomised block design with three replications. Among these lines 3 mutants of Pusa 33, 2 mutants of Pusa 2-21, 3 mutants of Ragi & 2 mutants of Saket-4 appeared to be more promising for multi-locational testing.

Twenty five aromatic varieties/cultures of rice were evaluated for various agronomic & grain quality characters. The entries namely Kasturi, IET-13548, IET-14131, Travde basmati & Champaran local-1 recorded superior performance with respect to grain yield. In addition to superior yield, IET-

13548 & IET14131 had dwarf plant type. Champaran local exhibited non-lodging property.

* Micropropogation protocol was developed for multiplication of elite sugarcane clones.

* Morphological characterisation of seven strains of pleurotus (mushroom) was done. Their yield potential and yield contributing characters were analysed.

Microbiology

* Study was conducted under Achoc scheme funded by I.C.A.R.on **"use of natural carrier (biomass) for equality & shelf life of cyanobacterial biofertilizers"**. Conventionally soil has been based as a carrier but soil based inoculum proved to be disadvantageous because of poor quality & bulky nature. Therefore insecticidal property bearing plant material like neem, bel, moringa, gurich, chudrabedi were selected and their effect on growth & nitrogen fixation was measured. It was observed that in all cases 0.5 % have stimulatory effect on these parameters.

* Impact of Pesticides of Agro-Microbes in Bihar soils was studied (ICAR) funded Achoc Project). Analysis of soil samples from vegetable field indicate that indiscriminate use of pesticides have more adverse effect on fungi than bacteria. Cyanobacterial nitrogen fixation is more sensitive to carbofuran. the effect being more pronounced under moist rather than water logged conditions. The dominance of westiollopsis prolifica in pesticide burdened soil and that of Nostoc in control soil suggested that the presence of mucilage is no guarantee of protection of cyanobacteria against pesticide toxicity.

* Successful cultivation of **button mushroom (*Agricus bisporus*)** was achieved. Technology for compost preparation was standerdised by using chopped paddy straw, chicken manure, urea & gypsum. Spawn of button mushroom was also supplied to one of the grower of Samastipur.

* Mushroom cultivation on mango sticks was tested. The experiment was carried out in mango orchard with P. astreatus. Excellent growth of mycelium was recorded.

Biochemistry

* Studies were conducted on production of lignocellulolytic enzyme profile on plurotus species and their use to achieve faster crop residue recycling (ICAR funded Adhoc scheme). Supplementation of soil with straw or mycostraw resulted in increased plant height, fresh weight per plant, panicle length, chlorophyll content & yield of paddy. However, no difference was found in data of flowering or dry weight per plant between plants from treated & untreated plots. Treated soils had higher organic carbon content.

* Among the various carbon sources tried sucrose was found to be the best in promoting growth of the mushroom fungi. It was followed by carboxymethyl cellulose *Pleurtus ostreatus* exhibited highest cellulolytic activity followed by P. sajor caju.

Statistics, Mathematics & Computer Application

* Pre-harvest prediction equation of Litchi based on biometrical characters was developed.

* Under the project on **"Agromet spectral yield modelling of rice-wheat in north Bihar"** sponsored by space Application centre, ISRO Ahmedabad & Bihar Remote Sensing Application Centre, Patna; a Software for model development has been tested & updated. Regression model for predicting rice yield of 15 districts of north Bihar has been developed. However, for rest of the districts it is under progress.

* The prediction model based on agro-meteorological informations such as minimum & maximum temperature, rainfall & relative humidity have been further improved and the already prepared programs have been modified for removing certain computational errors occurring during the process of operation. Weather data for more districts have been collected. With new data prediction model for rice has been prepared and presently is under testing.

HOME SCIENCE

* An ICAR Research Project entitled "Development of Nutrition Training Package and Assessing its Effectiveness on Rural Women of "Samastipur District" under Dr. (Mrs.) Meera Singh is almost at final stage of completion. The salient findings, which are emerging out of the analysis, are that after the nutritional training there were significant increase in the level of knowledge, attitudes, skill and adoption level of nutritional practices by the rural women. The increase in mean source was 46.16, 31.46, 49.44, 38.50 and 40.01 respectively in case of gain in knowledge, retention of knowledge, change in attitude, improvement in skill, performance and adoption of recommended nutritional source.

* Achievements of NATP and IVLP Research Projects being conducted by Dr. Punam Kumari on Honey Bee in terms of **Improved Apiculture Technology package impact of bee activities on honey production** during and after litchi period and sequential plantation of bee loving crops vis-à-vis management of bee colonies and above all testing the effect of bee pollination on seed yield as well as quality of drop with a focus on the effect of biotic land abiotic stresses over the honey production efficiency may be considered as land marks in research activities of the College. Further, Dr. Punam Kumari has successfully completed the first phase of an International Collaborative project of IRRI on **"Impact of Male Labour Migration of Gender Role and Productivity of Rice in Eastern India"**. The second phase of the project based on household survey is also in progress.

* In an another collaborative project of IRRI on the theme "Involvement of Women in Farmer's participating Breeding Programme". Data analysis in the first stage undertaken by Dr. Punam Kumari focuses on important emerging findings related to gender-wise difference in famrers perception in participatory varietal selection.

* Collaborating actively in research programme conducted under ATMA (Agricultural Technology Management Association) – she has developed

strategic research and extension plan beneficial for devlopemnt of Muzaffarpur district.

Similarly, impressive outcomes of research projects of Dr. (Mrs.) Usha Singh under ICAR CYMMIT collaboration and under NATP of ICAR on the themes of "Supporting quality Maize Improvement" as well as on "Utilization of underutilized foods for Nutritional Security" are :

Five weaning foods were developed for 4 to 6 month old infants, nine producets including mix, toffees and chocolates prepared for general consumption and for patients under stress. Seventeen nutritious snack, savoury products and convenience food developed and quality protein mix from maize with which rural masses are being apprised are the highlights of productive research being conducted in the college.

"Health care practice of Pre-school children of farm and non-farm Women" Project has been undertaken by Dr. (Mrs.) Arti Sinha in collaboration with Patna based NGO. Experiment has been conducted on the secondary data base in two village Basudeopur (District Samastipur) and Raghunathpur (District East Champaran). It was found during survey that eductional facilities particularly for girls and welfare services were poor in both of villages. Public Health Care Centre were not functioning properly.

Veterinary & Animal Sciences
Veterinary Microbiology

"Epidemiological & immunological studies on Aflatoxicosis in animals & men in Bihar including its tribal areas (Adhoc Scheme sanctioned by I.C.A.R.)" revealed that the level of aflatoxin was highest in rice grains & ground nut cakes & detected beyond permissible level in various other animal feeds (viz : maize. pulses.oat etc.). human food. cowmilk, buffalo milk. goat & poultry meat samples. biological fluids etc. Hence utmost precaution is required to be taken while feeding animals & men since now a days aflatoxin is the important cause of hepatitis & liver cancer. It has also been detected from the patients suffering from neonatal jaundice & mastitis.

"Epidemiological studies on F.M.D." (AICRP sanctioned by I.C.A.R. New Delhi) revealed the incidence of the disease as 30.73% and 30.73% in animals below & above one year of age respectively. The overall incidence was 28.84% and the per cent mortality was 3.31%. The serotype identification revealed 9 of the isolates as type "0" and one each as "A" and "Asia-1". The prevalance of serotype "C" remained nil during the period under report.

"Studies on comparative evaluation of different agents in controlling immunosuppressive effects of IBD virus in chickens" (Adhoc Scheme financed by ICAR) revealed the overall incidence of the disease (IBD) as 59.17%. The incidence in commercial broiler chicken was 65.01% whereas it was only 25.03% in backyard chicken. A total of 15 virus isolates were obtained from different outbreaks of IBD in the State. The characterisation of the isolates have been done & further work is in progress.

Altogether 2266 animals (1477 cattle. 724 buffaloes & 65 goats) belonging to 33 villages were surveyed under the NATP entitled "Animal Health Information System Through Disease Monitoring & Surveillance". Local Vety. Doctors. villagers & Livestock owners were interrogated for passive surveillance. For active surveillance 5% animals of the total population were selected & blood samples collected from 123 animals taking all aseptic precautions. Sera were seperated & stored at -20^0 F for further serological test to reach at definite diagnosis. Active surveillance work will be done after receiving different kit.

Veterinary Physiology

Studies were conducted on I.C.A.R. sponsored Adhoc Scheme entitled "Augmentation of Reproduction in Buffaloes". 15 lactating anoestrus buffaloes (10 having C.L. & 5 without C.L.) and 5 late maturing heifers were treated I/M with PGF_2 (Prosolvin, 15 mg Luprostial). Six out of 15 buffalo cows having distinct C.L. and 2 buffalo cows and one buffalo heifer without having palpable C.L. exhibited behavioural estrous symptoms between 4 to 8 days after prostaglandin treatment. They were allowed for natural mating & conceived. Similarly out of 20 anoestrus buffaloes treated with CIDR (M/S Inter Vet., Newzeland) intravaginally, 16 exhibited estrus symptoms & 10 conceived while pregnancy diagnosis of 6 is still to be done.

Studies were conducted on hematology, circulating minerals & trace mineral constituents in normal and infertile wild animals in captivity. Five tigers, 3 lions, 9 leopards, 1 clouded leopard & 6 hyenas maintained in captivity in Sanjay Gandhi Biological Park, Patna were included in the experiment. Their hemograms, serum protein, albumin, globulin, blood sugar, SGOT, SGPT, serum alkaline phosphates, serum uric acid, serum creatine, blood urea, BUN, sodium, Potassium, calcium & inorganic phosphorus were estimated. This will from the base line data for wild animals kept in captivity.

Studies were conducted on hemogram, circulating blood constituents & growth rate from birth to sexual maturity in crossbred animals maintained at Cattle Farm, Pusa. A baseline data on hemograms & biochemical constituents have been generated which will be useful as a reference material for clinician, research workers & academician in future.

Veterinary Pharmacology

Pharmacokinetic studies conducted on Pefloxacin, a newer member among fluoroquinalones, indicated that the drug may be administered at the dose rate of 4mg/Kg body weight every 4 to 6 hours in febrile goat for treating systemic infection. For treating udder & urinary tract infections, the drug should be administered 8-12 hour & 12-24 hour intervals respectively by I/V or I/M route at the same dose rate. The drug is eliminated at a faster rate in febrile state than healthy state but has more or less similar rate of absorption & distribution into different tissue & body fluids under healthy & febrile conditions.

Pharmacokinetic studies conducted on Cefazoline (10mg/kg, I.V.) in health & febrile condition in buffaloe calf (under ICAR sponsored Adhoc Scheme) revealed that the mean therapeutic concentration of 1ug/ml was maintained for a comparatively shorter time (1 hour) in plasma and upto 8 hours in urine under febrile condition as compared to longer period of 1.5 and 12 hours in plasma and urine respectively under healthy condition. Data regarding distribution rate constant and distribution half life denote faster distribution of this drug under febrile condition. The required loading and maintenance doses are higher under febrile condition for maintaining therapeutic concentrations (1ug/ml) as compared to that of healthy animals.

Pharmacokinetic study of Amikacin (7.5mg/kg, I.V.) in buffalo calves revealed that the mean therapeutic concentration of 2ug/ml was maintained for a short period (i.e. only 2 hours) in plasma while it was maintained for a longer time (30 hours) in urine under febrile condition. In healthy condition, the therapeutic concentration was maintained for 6 & 24 hours in plasma and urine respectively.

Livestock Products Technology

Studies were conducted under the project entitled "Development of products from Goat meat ' sponsosred by Ministry of Food Processing Industries, Government of India. Goat meat balls & nuggets were prepared from 9 month old goats and spent goat meat. Various levels of Soya proteins i.e. 0,10,20 & 40% were incorporated in different trials. The vegetable oil was also added at 5,10 & 15% levels in minced meat. The sensory evaluation score indicated that irrespective of different

Soya levels. the goat meat nuggets with 15% hydrogenated vegetable fat (HYF) were having higher score in comparison to other levels. The juiciness. tenderness. appearance. flavour and overall acceptability scores were higher in the products with meat: fat as 85:15. The sensory evaluation score also revealed that the 20% Soya protein group were having better appearance. flavour. juiciness. tenderness and overall acceptability than other group. Fact sheet was prepared and sent to the Ministry of Food Processing Industries for commercialization of the product.

Research works have also been conducted on quality enhancement of buffalo meat and its unit packaging for export sponsored by ICAR.New Delhi.

Very recently a project has also been sanctioned by the Ministry of Food Processing Industries, Government of India under the Department entitled "Slaughter house by-products processing. packaging and shelf life evaluation for pet food". The survey work to evaluate animal by-products throughout Bihar has been initiated.

Animal Nutrition

Under NATP entitled "urban and periurban system of milk production through use of concentrate based feeding system". survey work was conducted for existing feeding practices and locally available feed resouorces. their type and quality. 32 farmers of Patna. 21 of Vaishali and 36 of Bhojpur districts were approached and prescribed proforma was filled up and feed samples collected. Analysis of result is under progress.

Animal Breeding & Genetics

Genetics analysis of performance records of purebred and crossbred livestock and bird species was done. Heterosis in body weight was observed to the extent of 34% exhibited by the crosses envolving Asseel & Dahlam Red (a German breed) and 28% bythe crosses involving Nacked neck & Dahlam Red in poultry. However. it declined gradually till the age of 20 week. Such data analysis work was also done in case of Quails. A high positive genetic correlation between confirmation traits (i.e. body depth. breast angle. shank. thigh & keel lengths) & body weight was observed. Therefore. selection for confirmation traits may be recommended over body weights for broiler production in Quails.

Very recently research works have been started under NATP entitled "Net work Project on Animal Genetic Resources". 3 main districts for survey of Bachaur cattle have been selected i.e. Sitamarhi. Madhubani & Darbhanga. One supervisor & 4 ennumerators in each district have been appointed and enagaged in determining the demographical & geographical distribution of Bachaur breed of cattle.

Veterinary Epidemiology & Preventive Medicine

Studies were conducted on "Epidemiology treatment & prevention of Gangrenous Syndrome in rural buffaloes & cattle in Bihar." A total of 35 samples of paddy straw was collected from the different Khatals in and around Patna districts. The incidence of Fusarium ovaminearum was found to be highest (55%) whereas F. Poal to be least associated (12%). Similarly a total of 222 samples of straw (paddy straw. maize straw. wheat straw) were analysed for occurance of different

mycotoxins. Besides aflatoxins, zearalenone, ochratoxin A & citrinin were also recorded either alone or as contaminants.

Veterinary Clinical Medine

20 gms of pentasulf (Magnesium sulphete, Ferous sulphate copper sulphate, zinc sulphate & cobalt sulphate), 20 gms of promin vit (minerals, traceminerals, vit A, E & D_3); 2.5 gms of probiotics (lactosacc & Biotone) & 2.5 gms of UTPP-5 (a product of Vet Care Co.) orally twice daily for 40 days gave almost 90% recovery rate in gangrenous syndrome (Degnala disease) of cattle & buffaloes. In some of the chronic cases, it requires 60 days treatement to get complete recovery in addition to regular antiseptic dressing of infected wound. Critically deficient level of Arsenic in blood of affected buffaloes was found. Hence in addition to the above regimen of treatment, a 10 ml. I/M injection of Acetylaran (M & B) was also given alternate day continuously for eight or more injections in case of buffaloes. This supportive treatment gave still better result of early recovery since arsenic is a well known skin & hair tonic also.

Milk samples were collected from subclinical and clinical cases of mastitis to establish suitable & easily operable diagnositc aid under field condition & suitable thereby following sensitivity test.

Veterinary Parasitoloty

Studies were conducted on helminth parasites of pig with special reference to seasonal incidence. The incidence of Fasciolopsis buski was observed to be highest in Autmn (86.66%) and lowest during Summer (44.23%). The incidence of Cysticercus Cellulose was observed to be highest during spring (8.33%) followed by Winter (7.69%), Summer (5.76%) & Autumn (5%). The incidence of Hydatid Cyst was was observed to be highest in Summer & Winter (7.69% each) followed by Autumn (6.66%) & Spring (2.77%).

Animal Reproduction, Gynocology & obstetrics

Cervical mucus samples obtained from 46 repeat breeding cases brought by the farmers at the clinics of B.V.C. Patna were examined and isolation of micro organisms was done. Corynebacterium, streptococci, staphylococci, Anthracoids & other Gram (+) & Gram (-) Bacilli were recovered from the cervical mucus samples of such repeat breeder cows. In Viro drug sensitivity of different isolates of bacteria varied greatly. The treatment was done based on the pattern of drug sensitivity & then A.I. of such treated animals was done. Very good conception rate was obtained.

Veterinary Surgery

Studies were conducted on "Septic Arthritis in Buffaloes"; "Comparative study on the utility of Prosthetic materials for ventral hernia in bovines" and "Haematological as well as biochemical changes in uraemia after urethral obstruction. Besides works on surgical correction of induced intussusception in bovine" were also done.

Every year on and average 1950 new and 900 old surgical cases were treated by the scientists of the department.

Livestock Production & Management

Studies were conducted under curricular research on the "Effect of probiotics on certain economic traits of Japanese Quail" and also on "Performance of different breeds of pig under different system of management."

Veterinary Anatomy

Research work were conducted on histological and histochemical studies on parotid and mandibular salivary glands of goat. Besides studies on the macro & microscopic structures of the tongue of goat were also done. The tongue of goaty contained filiform, lenticular, conical, fungiform & vallate papillae.

A.P.R.I., Pusa

Under NATP entitled "Evaluation of locally available feeds & fodders to improve quality & formulate complete economic ration in rice-wheat production system": ten economic & balanced rations (cattle feed) were developed by using different locally available ingredients. Thirty percent level of stylo with wheat straw was found to be optimum for ruminal microbial activity which resulted in increased intake and digestibility. Napier, Bajra-21 & green sorgum fodder were better utilized than guinea grass in adult calf.

A goat research unit has been establishsed.

Fisheries

One research project entitled " Commercial farming of Giant freshwater Prawn" has been submitted to the ICAR for saction under revolving fund scheme.

III. EXTENSION EDUCATION

Extension Education is one of the triple functions of the University along with teaching and research. The extension education activities of the University can be grouped under three categories, namely, Farm Advisory Service, Training and information communication. A brief account of achievement under three activities is given below :

Farm Advisory Service

The Farm Advisory Service comprises of scientists' visits to villages farmers visits to research stations and replies to farmers' queries through correspondences.

* **Village Adoption Programme** : A number of villages have been adopted around each campus for intensive extension work and all round development of adopted villages. A team of scientists periodically visited the adopted villages and provide technical guidance and solutions to farmers' problems on the spot. Group discussion and training programmes were organised in the adopted villages. Trials and demonstrations were also conducted in the adopted villages and field days were organised at the sites of successful trials and demonstrations. As a result of scientists visits to the adopted villages, production and productivity of different crops in the adopted villages have increased considerably.

* **Farmers' visits to the University** : A group of 20 progressive farmers from Sakuwa and V.D.C. of Rauthal, Nepal visited the University Campus from 11th to 14th April'96 and a team of 10 progressive farmers from Lohit and Debarg valley district of Arunachal Pradesh visited the University Campus from 11th to 15th May 96. Besides IFFCO, NABARD and Sugar factories also sponsored the visits of farmers under which the farmers from different districts of the State visited the Campus. Farmers were taken round the research farm, dairy, kitchen garden and apiary and acquainted with latest technologies in those field.

* **Replied to farmers' queries** : Farmers queries on various aspects of Agriculture, Animal Husbandary, Horticulture, Fisheries, Poultry, Agricultural Engineering and other related fields were replied through correspondences.

* **Training** :

Training programme for extension personnel and farmers. Farm women and farm youths Commercial Banks and input manufacturing firms were organised at the different campuses of the University Training programmes for farmers. Farm women and farm youths were mostly organised at Krishi Vigyan Kendras.

* **Training Programme for Extension Personnel** : A three day training-cum-discussion programme from 16.9.96 to 18.9.96 on Kharif pulses production technology was organised at Sabour campus in which 18 Extension Officers of Department of Agriculture, Bihar participated. An interstate training programme on Jute and Mesta sponsored by the Directorate of Jute Development, Govt.of India was organised at Jute Research Station, Katihar in which Jute Extension Officers from

Bihar and U.P. participated. A training programme on Boro rice production was organised at Pusa campus in which 25 Extension Officers had participated.

* **State/District level Training Programme** : Crop Scientists of University participated in State/District level kharif and Rabi production workshop organised by the Department of Agriculture in which field problems for increasing production of Kharif and Rabi crops were discussed and useful technologies were communicated to approximately 150 senior Extension Officers.

* **Training programmes for Rural Youth for self-employment** : Training programmes for rural youth for self-employment in mushroom production and bee-keeping were organised at the University headquarters. Training programme for rural youths for self-employment are self financed by the trainees and duration of training course is one week. A number of rural youths have established mushroom production and bee-keeping units in their own villages. Training under TRYSEM were organised in Bee keeping as well as repair & maintenance of farm machinary and diesel pump sets and electric motors.

* **Information – communication :**

Technical communication through All India Radio and T.V. publication of Adhunik Kisan Diary, Adhunik Kisan Magazine, Bulletins and folders. organisation of Kisan Mela and participations in fairs and exhibition are some of the important activities under information communication.

* **Radio/T.V. Programmes** : Schedules were prepared for Radio broadcast and T.V. telecast under "Ghar Grihasti" of A.I.R., Darbhanga and 'Mera Gaon Mera Desh' programmes of T.V. centre, Muzaffarpur respectively. According to the schedules, the University scientists broadcast/telecast their talks on suitable topics according to the season. The Vice-Chancellor's fortnightly messages on farm production were broadcast regularly from All India Radio, Darbhanga.

* **Publications :** Adhunik Kisan Diary, Adhunik Kisan Magazine and a number of bulletins and folders on package of practices of crops, livestock production, fisheries etc. were published.

* **Kisan Mela and Kisan Gosthies** : A Kisan Mela was organised at the University headquarters regularly. Besides, the Kisan Melas at the University headquarters, Kisan Mela cum Exhibitions were also organised at Bihar Agricultural College, Sabour, K.V. Ks at Jale (Darbhanga), Ariari (Sheikhpura), Munger and at Manjhaul (Begusarai).

The scientists of the University participated in Kisan Gosthies at Patna, Barhiya, Naugachia, Khagaria, Begusarai, Jale (Darbhanga) and Sheohar and exposed farmers and field functionaries to improve technologies for increasing crop production and provided solutions to farmers' problem.

* **Farmers' visit to the University** : Farmers' from different parts of the State regularly visited the University headquarters and they were apprised of the latest production technology of different crops. Approximately 100 farmers alongwith three officers under going training in Watershed Development Project Arsa (Chaibasa)

visited the campus on 23.3.96. They were made aware of the scientific methods of compound Water Management.

* **Krishi Vigyan Kendras :** Four new Krishi Vigyan Kendras – one each at Jale (Darbhanga), Saraiya (Muzaffarpur), Hariharpur (Vaishali) and Ariari (Sheikhpura) were inauagurated from Dec. 96 to March. 97.

The six old K.V.Ks organised vocational training programmes for practising farmers/farm women and rural youths, on-farm research for assessment and refinement of technology, front-line demonstrations on oilseeds and pulses and other extension activities.

* **Vocational training for farmers, farm women and rural youths:**
A number of training courses in crop production, horticulture, plant protection, dairy, poultry and home science were organised for farmers, farm women and rural youths at different K.V.Ks. On an average 1500 farmers, farm women and rural youths were trained at each K.V.K. The K.V.Ks scientists also conducted training programme in the villages. Out of 10 K.V.Ks under the Unsiversity, 4 K.V.Ks namely Jale (Darbhanga), Ariari (Sheikhpura), Hariharpur (Vaishali) and Saraiya (Muzaffarpur) were established at the fag end of the year 1996-97. The six old K.V.Ks namely Munger, Banka, Agwanpur (Saharsa), Harnaut (Nalanda), Khodawanpur (Begusarai) and Agwanpur (Banka) on an average trained 1000 farmers and farm women at the Campus in agricultural and allied fields. Training programmes were also organised in the villages for farmers and farm women. A mumber of vocational training courses in seed production, preparation of grafts and gooties, preservation of fruits and vegetables, mushrooms etc. were organised for rural youth for self-employment. A number of rural youths have started mushrooms production, bee-keeping, seed production etc. in their own villages for self-employment. A number of training programmes for farmers were organised under the sponsorship of voluntary organisations like C.G.C. Vaishali, Paroo, P. B. Paryyozane, Gokhula (Muxaffarpur), Saraisa Seva Kendra, Kauachawk (Samastipur); Mahila Vikash Kendra, Bhusara (Muzaffarpur), Antuodya Ashram Pandaul (Madhubani) Nehru Yuva Kendra, Muzaffarpur, Hajipur and Madhubani..

* **On Farm Research:** On-station trials and on farm trials were conducted to assess the sustainibility of different high-yielding varieties of crops, fertilizers schedules, plant protection measures in the particular agro-climatic zone in which the K.V.Ks was functioning. On the basis of results of on-farm trials, technologies were refined and recommended to the farmers for adoption.

* **Front-line Demonstrations on oilseed and Pulses :** Fron-line demonstrations on recently released varieties of pulses and oilseeds were conducted in farmers fields to acquaint farmers and field functionaries about recently released varieties of pulses and oilseeds and associated production technologies and to get feed back from them.

* **Other Extension Activities :** Diagnostic surveys, Kisan Gosthies, field days and other extension activities were conducted by K.V.Ks in the villages. Kisan Diwas at the K.V.Ks and field days at the sites of demonstration were also organised.

* **Seed Production** :_Recommended high yielding/improved varieties of seeds of different crops were produced in K.V.K. farms. Seeds were sold to the farmers and were also sent to the Seed Processing Plant at Dholi for processing and sale.

* **Sale of Grafts & Gooties :** Thousands of grafts & gooties of fruit trees prepared at the K.V.Ks having horticultural nursaries were sold to the farmers.

IV. UNIVERSITY PRESS

The university press has been functioning as an aid to the extension activities of the University by publishing various booklets. magazine. Journals. Diaries etc. The press also fulfil the printing requirements as and when asked by the different departments/units/colleges etc. During the reporting period the press published the following articles /magazines etc.

- **"Adhunic Kisan"** a monthly magazine of farmer's utility printed regularly.
- The printing of **Adhunic Kisan Diary** consisting of useful informations on Agriculture and Animal husbendary for the farming community was also done.
- Agriculture crop bulletines were printed like **"Dhan Ka Naya Praved, Masroom Ki Kheti, Jeewanu Khad, Pawdha rog Nuskha, Faloan Ki package Practices, Sabji Ki package practices, Masala phasloan ki package practices, Garma mung ki kheti, Kharif Dhan ki Kheti, Neel harit Shayval culture, Garma Dhan ki Kheti, Garma mung ki Unnat Kheti, Til ki Kheti etc. Information builetines' on Litchi, pan, Bamboo, Forestry, Cow, Popular etc.** were also printed.
- Other printing works like cash memo. coupon. cover pages of different reports. office use forms letter pads. cards, thesis and other urgent requirement were also done.
- Thirty two information bulletin in 2000-2001 and twenty nine information bulletin in 1999-2000 on Agriculture. Fisheries. Home Science and Animal husbandry were published by the Technical cell.
- Printing of application forms, milk coupon. dispatch register. pay bill gazetted. CNC form. T.A. bill. Provisional degree certificate. registration cards. Bus ticket. Money receipt etc. were also printed.
- News letter and R.T. form of cost of cultivation scheme in twenty six items were also printed.

V. University Library System

Acquisition of Books

Year	Book purchased	Books Recd. By Gift.	Total No. of books added	Expenditure on purchase of books	Remarks
1996-97	02	266	268	Rs.2420.00	
1997-98	637	292	929	Rs.437671.10	(NARP)
1998-99	441	285	726	Rs.363458.14	(NARP)
1999-00	199	252	451	Rs.201540.46.	(NARP)
2000-01	343	214	557	Rs.115679.52	Inc. NARP

Subscription of Journals

Year	Indian Journals	Expenditure on Indian Journals	Foreign Journals	Expenditure of Foreign Journals	Journals recd. On Gratis
1996	92	31853.00	02	51486.35	18
1997	87	35875.20	-	-	18
1998	83	40877.00	12	335094.00	21
1999	127	61733.60	28	516142.83	20
2000	112	64736.00 (NATP)	11	420711.00 (NATP)	22

Reprography

Period	Full Rate	Conc. Rate	Total cash Receipt	On Credit
1996-97	2456	20836	17274.75	3466
1997-98	2689	30570	2207.50	977
1998-99	4171	32890	25443.25	497
1999-00	4565	51797	34766.50	1624
2000-01	1606	46253	30924.50	47021

Circulation of Books

Year	Books issued	Books Returned	Books Issued in Book bank	Book Bank charge	Overdue fine charge
1996-97	7107	7125	173	2052.90	965.00
1997-98	5296	NA	151	1209.90	755.00
1998-99	9256	5141	126	1226.90	630.00
1999-00	5941	5510	112	2859.50	560.00
2000-01	3723	NA	98	923.60	490.00

Other activities

Besides above the university library has been equipped with a computer system (Pentium II) and Xerox Photostat-5837 by the ICAR, New Delhi under NATP programme.

University library has also purchased one water cooler for drinking water, one paper cutting machine, one stitching machine, one spiral binding machine and coir mat (for flooring) to reduce the noise at its minimum. This purchase has been done from the grand received from ICAR, New Delhi under NATP programme.

VI. GAMES & SPORTS

- Initially the games and sports activities were confined to College level of RAU only i.e. : College of Agril. Engineering, Pusa ; College of Basic Science & Humanities, Pusa ; College of Home Science, Pusa, Tirhut College of Agriculture, Dholi, College of Fisheries, Dholi, Bihar Agriculture College, Sabour ; Bihar Veterinary College, Patna and Sanjay Gandhi Institute of Dairy Technology, Patna. These units conducted such activities round the year by holding "Inter Class Foot-Ball, Volley Ball and Cricket Championships" besides "Annual Athelatics and Indoor Games Meet" under the supervision of President. Games & Sports of each College patronaged by Dean/Assoc. Dean-cum-Principal of each College. Later on under the guidelines of the University. Officer in-Charge RAU Games & Sports took over the responsibility and started organising "Inter College Tournaments" every year in various games and sports items, viz. Foot-Ball, Volley Ball, Cricket (for men only) and Athelatics (Men & Women) in out-door section and Badminton and Table-Tennis (for both men and women) under indoor games as per the rules and regulations laid down by I.U.S.B. (Inter University sports Board). These tournaments became systematic programme of the University and finally paved the way for our University to became member of the Association of Indian Universities (AIU) grouped under East Zone. Under the banner of "East Zone Inter University Tournament", RAU team participated in various games like Foot-Ball at Raipur (M.P), Cricket at Calcutta (W.B.), Badminton at Bokaro (Bihar), Table Tennis at Dibrugarh (Assam) and many more. In 1994 our University for the first time was selected to host "East zone Inter University Table Tennis Tournament" at Pusa which was successfully organised. Similarly in 1997 RAU once again hosted " East Zone Inter University Volley Ball Tournament 1997-98" organised successfully at Pusa in which teams from 26 Universities participated. A 12 (twelve) member Volley-Ball Team of this University participated, although the achievements of our University team in these tournaments was not satisfactory but still the trend of progress was promising.

- From 1997 onwards to middle of 1999 the games and sports activities were mainly confined to Under-graduate College level only, due to paucity of sufficient funds. But sooner. with the very strong positive attitude of the Hon'ble Vice-Chancellor of our University Dr. V.P. Gupta, the Games and Sports society once again look an "U" turn and will the full financial support of the University. "Inter College Volley-Ball (Men) and Table-Tennis (Men and Women) Tournaments" were organised at Pusa in November. 1999. Later on "Inter College Badminton (Men and Women) and Athelatics Meet (Men and Women) were held at T.C.A., Dholi during March. 2000.

- In December, 2000 B.A.C., Sabour hosted "Inter College cricket Tournament" in which five College of our University participated. BVC. Patna was declared champion.

- On the pattern of AIU and IUSB. in 1999 Indian Council of Agricultural Research (New Delhi), formed a separate sports unit responsible to hold "All India Inter Agricultural Universities Sports and Games Meet". The first such meet was hosted by C.C.S. Haryana Agril. University, Hissar (Haryana) in November 1999 in which 12 member RAU team comprising 8 Volley Ball (Men) and 4 Table-Tennis (Men) players with a team manager participated. In the following year the 2nd A.I.I.A.U. Games and Sports Meet 2000-2001" was held at ANG Ranga Agril. University, Hyderabad (A.P.) from 25-28th November. 2000. in which a team of 19 students consisting of 8 Volley Ball (men). 4 Table-Tennis (Men), 4 Badminton (Men) and 3 Athelatics (Men) besides one sports boy and a team manager participated. The performance of all the players as exceedingly good. They even reached to the hight of quarter final stage in the Table Tennis event, giving boosted morale to clinch medals in the coming such tournaments.

VII. **Annual Statement of Account of Rajendra Agricultural University, Pusa Bihar for the year 1995-96**

(Rs.)

Sl. No.	Particulars	Amount of Received	Sl. No.	Particulars	Amount spent
1.	Non plan grants	13,99,92,000.00	1.	Non plan	16,06,42,582.15
2.	University receipt	76,43,283.72	2.	State plan	3,33,95,559.94
				(+) 25% ICAR share	54,57,604.00
3.	Plan grant (state)	3,45,90,080.00		Total Plan	3,88,53,163.94
4.	I.C.A.R.	1,70,54,239.00	3.	I.C.A.R.	3,50,19,229.70
		49,34,330.00		(-) 25% Univ. share	54,57,604.00
5.	Govt. of India & Other sources	2,18,63,423.58		Total ICAR Grants	2,95,61,625.70
6.	Revolving fund	24,04,904.53	4.	Govt. of India & other sources	59,05,930.90
7.	Stock	1,92,317.50	5.	ICAR Plan	4,54,523.54
8.	Deposit	5,57,110.00	6.	Revolving fund	21,89,308.78
	Total	22,92,31,688.33	7.	Stock	19,83,878.00
	Add opening balance (-)	2,49,30,625.09	8.	Deposit	31,885.00
	Grand Total	20,43,01,063.24	9.	Miscellaneous	85,26,042.40
			10.	Allotment (-)	4,49,97,839.72
				Total	20,31,51,100.69
				(+) Closing Balance	11,49,962.55
				Grand Total	20,43,01,063.24

Annual Account of Rajendra Agricultural University, Bihar, Pusa, Samastipur for the year 19996-97

Sl. No.	Receipt	
	Particular	Amount of Receipt
1	Non-Plan Grant	16,85,52,392=00
2	University Receipt	83,77,008=85
3	State plan grant	4,11,00,000=00
4	ICAR	3,42,55,257=00
5	Misc. Grant	74,79,122=82
6	Others Miscellaneous	1,87,14,792=32
7	Revolving fund Account	31,32,078=60
	Total Receipt	**28,16,10,651=59**
	Add O.B. as on 1.4.96	**2,59,20,929=52**
	Grant Total	**30,75,31,581=11**

Sl. No.	Expenditure	
	Particulars	Amount of Expenditure
1	Non-Plan Expenditure	18,08,60,126=71
2	State plan expenditure	3,94,12,267=18
	Add 25 % state share of ICAR Scheme (+)	62,19,117=00
	Net plan expenditure	**4,56,31,384=18**
3	ICAR	3,74,40,836=02
	Less University share of ICAR scheme (-)	62,19,117=00
	Total	**3,12,21,719=02**
4	ICAR plan	5,60,914=87
5	Misc. Scheme	59,31,117=18
6	Other Misc.	1,04,66,723=44
7	Revolving fund Account	22,93,359=97
8	Special Fixed Deposit	6,52,000=00
9	Remittance adjustable in next year account	78,35,921=03
	Total expenditure	**28,54,53,266=40**
	Closing Balance as on 31.3.97	2,20,78,314=71
	Grand Total	**30,75,31,581=11**

Annual Account of Rajendra Agricultural University, Bihar, Pusa, Samastipur for the year 1997-98

Sl. No.	Receipt	
	Particular	Amount of Receipt
1	Non-Plan Grant	23,31,84,000=00
2	University Receipt	44,11,51,518=82
3	State plan grant	4,50,00,000=00
4	ICAR Grant	3,40,43,732=00
5	Miscellaneous scheme	1,36,89,850=12
6	Others	2,68,13,446=40
7	Revolving fund A/c	29,52,385=84
	Total Receipt	**36,00,94,933=18**
	Add O.B. as on 1.4.97	**2,20,78,314=71**
	Grant Total	38,21,73,247=89

Sl. No.	Expenditure	
	Particulars	Amount of Expenditure
1	Non-Plan Expenditure	20,78,14,985=60
2	State plan expenditure	4,22,20,982=47
	Add 25 % state share of ICAR Scheme	70,39,569=10
	Total	**4,92,60,551=57**
3	ICAR expenditure	4,35,11,395=78
	Less University share of ICAR scheme	(-) 70,39,569=10
	Total	**3,64,71,826=68**
4	ICAR plan expenditure	22,65,667=95
5	Misc. expenditure	89,00,209=82
6	Other	1,02,98,965=53
7	Revolving fund A/c	24,05,184=48
8	Remittance adjustable in next year A/c	(-) 3,75,094=00
	Total expenditure	**31,77,92,485=63**
	Closing Balance as on 31.3.98	6,43,80,762=26
	Grand Total	**38,21,73,247=89**

Annual Account of Rajendra Agricultural University, Bihar, Pusa, Samastipur for the year 1998-99

Sl. No.	Receipt	
	Particular	Amount of Receipt
1	Non-Plan Grant	19,00,00,000=00
2	State plan grant	5,55,66,650=00
3	ICAR Grant	5,12,35,249=00
4	ICAP Plant Grant	1,57,00,000=00
5	University Receipt	61,91,117=91
6	Miscellaneous	80,21,248=35
7	Others Miscellaneous	3,07,32,396=53
8	Revolving fund A/c	22,69,123=00
	Total	**35,97,15,784=79**
	Add O.B. as on 1.4.98	6,43,80,762=26
	Grand Total	**42,40,96,547=05**

Sl. No.	Expenditure	
	Particulars	Amount of Expenditure
1	Non-Plan Expenditure	20,91,62,771=18
2	State plan expenditure	4,08,96,216=01
	Add 25 % state share of ICAR Scheme	77,87,318=93
	Total	**4,86,83,534=94**
3	ICAR expenditure	5,20,78,433=92
	Less University share of ICAR scheme	(-) 77,87,318=93
	Total	4,42,91,114=99
4	ICAR plan expenditure (Estt. & Development of SAU)	99,01,223=73
5	Misc. expenditure	1,01,73,628=57
6	Other misc. Expenditure	1,21,67,336=09
7	Revolving fund	20,35,709=01
8	Remittance adjustable in next year A/c	70,62,208=35
	Total expenditure	**34,34,77,526=86**
	Closing Balance as on 31.3.99	8,06,19,020=19
	Grand Total	**42,40,96,547=05**

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Annual Account of Rajendra Agricultural University, Bihar, Pusa, Samastipur for the year 1999-2000

Sl. No.	Receipt		Sl. No.	Expenditure	
	Particular	Amount of Receipt		Particulars	Amount of Expenditure
1	Non-Plan Grant	21,00,00,000=00	1	Non-Plan	19,74,61,284=22
2	University Receipt	79,12,203=05	2	State Plan	3,78,67,285=11}
3	State Plant	5,34,00,000=00		Add 25 % state share of ICAR Scheme	79,85,829=89}
4	ICAR Grant	6,02,98,064=00		**Total**	**4,58,53,115=00**
5	Miscellaneous	89,22,096=00	3	ICAR Expenditure	4,86,41,970=35
6	Others	2,94,73,195=71		Less 25% University share of ICAR Scheme	(-) 79,85,829=89
7	Revolving fund A/c	56,61,994=31		**Total**	**4,06,56,140=46**
			4	ICAR Plan Expenditure	1,35,38,951=80
			5	Misc. Expenditure	90,61,339=15
			6	Other Misc. Expenditure	2,62,33,966,=51
			7	Revolving fund A/c	36,24,927=78
			8	Remittance adjustable	59,33,342=48
	Total	**37,56,67,553=07**		**Total**	**34,24,13,067=40**
	Add. O.B. as on 1.4.99	***8,06,19,020=19***		**Add C.B. as on 31.3.2000**	**11,38,73,505=86**
	Gran Total	***45,62,86,573=26***	**Gran Total**		**45,62,86,573=26**