

સંશોધન નિયામકશ્રીની કચેરી આણંદ કૃર્ષિ યુનિવસિટી આણંદ - ૩૮૮ ૧૧૦

ર્ડા. કે.બી.કથીરીયા સંશોધન નિયામક અને અનુસ્નાતક વિધ્ધાશાખાધ્યક્ષ



આણંદ કૃષિ યુનિવર્સિટીનો **વર્ષ ૨૦૧૪–૧૫નો વાર્ષિક અહેવાલ** તૈયાર કરવા માટે આણંદ કૃષિ યુનિવર્સિટીના સંશોધન કેન્દ્ર તેમજ કોલેજના તમામ વિભાગની સંશોધનને લગતી માહિતી (રીસર્ચ ચેપ્ટર–૪) તૈયાર કરવાની થાય છે. તે માટેનું નિયત પ્રફોર્મા સામેલ રાખી મોકલી આપવામાં આવે છે. તો તે મુજબ જે તે યુનિટ અધિકારીએ માહિતી સંકલિત કરી અત્રેની કચેરીને મોકલવાની રહેશે. તદૃ ઉપરાંત રીસર્ચ ચેપ્ટર–૪માં દર્શાવેલ આપને સલંગ્ન મુદૃાઓની માહિતી પણ ટૂંકમાં આપવાની રહેશે. જે સંશોધન કેન્દ્ર / વિભાગની માહિતી નિયત પ્રફોર્મા પ્રમાણેની નહી હોય તે માહિતી પરત મોકલવામાં આવશે જેનું તમામ વિભાગના વડાએ ખાસ ધ્યાન રાખવું. સદર માહિતી <u>દિન–૧૦</u> માં હાર્ડ કોપી તેમજ સોફ્ટ કોપીમાં "Microsoft Office Word" માં તૈયાર કરી t<u>3dr@aau.in</u> માં મોકલી આપવી. આ સાથે વર્ષ ૨૦૧૩–૧૪ના વાર્ષિક અહેવાલના રીસર્ચ ચેપ્ટરની નકલ રેફરન્સ માટે સામેલ કરેલ છે.

જા.નં.આકૃયુ / સંશો / ટી–૩ / *૯૬૧* / ૧૫ તા.૭ .૦૫.૨૦૧૫ સંશોધન નિયામક અને અનુસ્નાતક વિદ્યાશાખાધ્યક્ષ

नडल २वानाः

- આણંદ કૃષિ યુનિવર્સિટીના તમામ યુનિટ / સબ યુનિટ અધિકારી તરફ જાણ તેમજ ઘટતી કાર્યવાહી સારૂ.
- ૨. કુલસચિવશ્રી, આણંદ કૃષિ યુનિવર્સિટી, આણંદ તરફ જાણ સારૂ.
- ૩. આયોજન અધિકારીશ્રી, આણંદ કૃષિ યુનિવર્સિટી, આણંદ તરફ જાણ તેમજ મુદૃા નં. ૪.૬ની માહિતી ટૂંકમાં તૈયાર કરી હાર્ડ અને સોફ્ટ કોપીમાં ટી–૩ બ્રાન્ચમાં આપવા યોગ્ય કાર્યવાહી કરવી.

Information to be supplied by each Unit for their Centre / Department / College

- Importance of Research Centre / Department alongwith work carried out during year 2014-15 (in brief). 1.
- Research recommendations with photographs. (Year 2014-15) 2.
- Output during 2014-15 [No. of Trials allotted (new/ongoing) and conducted successfully] 3.
- Salient achievements during the year with photograph and information (other than approved recommendation) 4.
- Variety / Breed / Machinery etc. Released / developed with brief information and photographs. 5.
- For Breeding: Generation wise detail and new crosses made during the year. 6.
- Seed production information (Target and Achievement) / Seedling / Sapling / Cutting / Graft. 7.
 - Nucleus seed 1.
 - ii. Breeder seed
 - iii. Foundation seed
 - iv. Certified seed
 - Truthful seed v.
- Project title and financial outlay under projects of -8.
 - i. ICAR ii. GOG

 - iii. GOI iv. Other Agency
 - Awards / Honours etc. information with photographs
- 9 10. Important events

10 (A) Seminar / Symposia / Conference / Training organized during the year 2014-15 eo.

Title	Duration	Sponsoring Authority
Advanced Training on Seed	23-30 September,	Directorate of Seed Research(DSR)
Pathology for Capacity Building	2013	(ICAR), MAU, UP

10 (B) University Teacher who participated in Seminar / Symposia / Conference / Training during the year 2014-15

Sr. No.	Name of Teacher /	Participated	Duration		Participated Duration	
1.	Dr. A.D.Patel	Plant protection in Fruit, Vegetable and oil seed, JAU, Junagadh	20.09.2013			

Purpose of visit

10 (C) Names and details of the dignitaries	s visited	4
CD! Hanted	Data of visit	Centre visited

Name of Dignitaries Sr. No. Date of visit

Research paper Published during year 2014-15. (Category Wise) 11.

- i. International journal
- National journal ii.
- iii. local journal / other journals

eg; Mevada KD, Patel JJ and Patel KP (2014) Effect of micronutrients on yield of urdbean. Indian J. Pulses 214-216.

12. Research paper presented at Seminar / symposia etc. for 2014-15. (Category Wise)

- International level 1.
- ii. National level
- iii. local / others

- eg: Shah SN, Usadadia VP, Koshiya DJ and Rabari HJ (2014). Effect of different stage of picking on quality, seed production and economics of chilli (*C. annuum* L.). A paper presented in national symposium on current trends in onion, garlic, chillies and seed spices- production, marketing and utilization, held at Rajgurunagar, Pune during 25-27 November, 2014.
- 13. Books / Book chapter published. Sr. No. Name of Book / Book Chapter Name of Publisher Name of Authors

નોંધ : ૧. પ્રફોર્મા મુજબ Sr. No. 1 to 10 અને Sr. No. 11 to 13 ની બે વર્ડ ફાઈલ અલગ બનાવવાની રહેશે. ર. સદર અહેવાલ અંગ્રેજીમાં નીચેની વિગતે માઈક્રોસોફ્ટ વર્ડમાં તૈયાર કરવાનો રહેશે.

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COMMON STATUTES FOR AGRICULTURAL UNIVERSITIES OF GUJARAT, 2011

S.112.0 Preparation and submission of Annual Report [Section-49]

S.112.1 Dates of submission of the Annual Report :

The Annual Report of the University for each year ending 31st March shall be prepared under the direction of the Vice-Chancellor and submitted to the Board of Management on or before 31st October of the said year. The same alongwith the Annual Accounts shall be forwarded to Government before 31st January of the next year.

S.112.2 Contents and details of Annual Report :

- (1) Introduction
- (2) Management and Administration
- (3) Education
 - (3.1) Under Graduate Education
 - (3.2) Post Graduate Education

(4) Research

- (4.1) New crop varieties, Farm implements, Management technologies
- (4.2) Agricultural Crops
- (4.3) Horticultural Crops
- (4.4) Forestry
- (4.5) Centre for Plant Molecular Biology
- (4.6) Planning and Monitoring
- (4.7) Water Technology
- (4.8) Agricultural Rural Development Studies
- (4.9) Agri-business Development
- (4.10) Veterinary Science and Animal Husbandry
- (4.11) Dairy Science
- (4.12) Engineering & Technology
- (4.13) Fisheries Science
- (4.14) Home Science
- (4.15) Other faculties
- Extension Education
- Students' Welfare

(5)

(6)

(7)

University Library

COMMON STATUTES FOR AGRICULTURAL UNIVERSITIES OF GUJARAT, 2011

Appendices

- 1. Civil works completed
- 2. Civil works on hand
- 3. Details of University schemes
- 4. List of Research papers Published
- 5. List of Thesis submitted
- 6. List of Seminars, Symposia, Conferences organised
- List of University teachers who participated in Seminars, Symposia, Conferences and training programmes organised by the other Institutions

8. Names and details of the dignitaries visited

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The main objective of Anand Agricultural University, Anand is to enhance production and productivity of agricultural and related commodities as well as to improve socio-economic standards of farmers and animal keepers through qualitative research.

Researchable issues which normally Indian agriculture faces such as increasing demand of food, feed and fodder for growing human and livestock populations, degradation of natural resources, decreasing soil fertility, climate change, introduction and development of new pests and parasites, slow growth of farm income etc. are identified and considered as main agenda of multi dimensional research activity of Anand Agricultural University.

Research approaches covering high quality seed production for important crops of Gujarat, plant saplings for horticultural crops, post harvest technology, value addition in agricultural crops as well as milk and milk products, plant and animal biotechnology, tissue culture, liquid biofertilizer etc. are emphasized and executed considering the present demand of market.

Scientists of Animal Science group mainly focus on improvement of local breeds of cattle, buffalo and poultry, improvement of production efficiency and health of the animals as livestock contributes considerably in agriculture development and economics. In Dairy Science, thrust areas viz. dairy business development, productivity and prolonged shelf life of milk and its products, and quality improvements are focused for research.

Sincere efforts are made by scientific

community of Anand Agricultural University to achieve excellent results as per the objectives and goals of the university to make agriculture locally, regionally and globally competitive.

This chapter portrays details of research work carried out by the scientists of Anand Agricultural University during 2013-14.

Seasonal Features and Crop Condition

Spatial distribution of monthly rainfall during June-October 2013 along with seasonal and percentage departure from normal rainfall in the middle Gujarat Agro-climatic zone are depicted in Fig 6.1 to 6.7. During the month of June, parts of Vadodara and Panchmahals districts received higher rainfall (150-250 mm). Other parts received rainfall in the range of 50-150 mm. Parts of Mahisagar district received lowest rainfall (50 mm). In the month of July, entire zone received rainfall in the range of 200-500 mm. August received lower rainfall as compared to July. Parts of Mahisagar district received highest rainfall (700mm). Other parts received rainfall in the range of 100-300 mm. During September, Vadodara district received highest rainfall (700 mm). Other parts received rainfall to the tune of 100-300 mm. During October, rainfall activity slowed down. Only some parts of Anand, Vadodara and Mahisagar districts received rainfall between 100 to 300 mm. Vadodara district recorded highest seasonal rainfall (1750 mm).

As far as per cent departure from normal is concerned, Vadodara district recorded 150 per cent of the normal rainfall. Thasara of Kheda district and Limkheda of Panchmahals district received normal rainfall (100 %). Other parts received rainfall in the category of 125 to 150 per cent of normal rainfall. Thus, 2013 monsoon remained favourable for various agricultural crops.

Total rainfall and its percentage departure from normal in Middle Gujarat

No.	District Name	Total rainfall (mm)	Normal rainfall (1982- 2012)	% against normal
1	Chhota Udepur	1570	991	158
2	Vadodara	1335	890	150
3	Panchmahals	1191	883	135
4	Anand	1156	766	151
5	Kheda	1040	824	126
6	Ahmedabad	984	698	141
7	Mahisagar	939	739	127
8	Dahod	851	753	113
	Average	1115	798	140



Fig.6.2 Rainfall of Middle Gujarat Agro-climatic Zone during July 2013







Fig.6.3 Rainfall of Middle Gujarat Agro-climatic Zone during August 2013









Fig. 6.6 Seasonal total Rainfall of Middle Gujarat Agro-climatic Zone during 2013

Rainfall % against normal for Monsoon 2013



Fig. 6.7 Percentage departure of rainfall of Middle Gujarat Agro-climatic Zone during monsoon 2013

4.0 Research Council

The Research Council has been constituted as per the provision of Gujarat Agricultural Universities Act – 5 of 2004, under Section-26 and Common Statute for Agricultural Universities of Gujarat, 2011, Section-26, S.27.

Sr.		Name, Designation & Address	
No.			
Α	Dr	A. M. Shekh, Vice Chancellor, AAU, Anand	Chairman
В	Dr	K. B. Kathiria, Director of Research & Dean, PG Studies, AAU, Anand	Secretary
С	1	Dr.D. M. Korat, Associate Director of Research, (Agri.), AAU, Anand	Member
	2	Dr. M.M. Pathak, Associate Director of Research (Vet.), AAU, Anand	Member
D	Fa	culty Deans	
	1	Dr. K. P. Patel, Dean, Faculty of Agriculture, BACA, AAU, Anand	Member
	2	Dr. B. P. Shah, Dean, Faculty of Dairy Science, SMC Dairy Sci. College, AAU, Anand	Member
	3	Dr. A. M. Thakar, Dean, Faculty of Vety. Science, College of Vety. Sci. & A.H., AAU, Anand	Member
Sr.		Name, Designation & Address	
No.			

Constitution of Research Council

AAU						
	4	Dr. D. C. Joshi, Dean, Faculty of Food Processing Tech. & Bio-energy, AAU, Anand	Member			
	5	Dr. D. R. Kathiriya, Dean, Agricultural Information Technology, AAU, Anand	Member			
	6	Dr. M. L.Gaur, Dean, Agricultural Engineering & Technology, AAU, Godhra	Member			
	7	Dr. G.B.Valand, Dean, International Agri-business Management, AAU, Anand	Member			
Ε	Dr	Member				
F	Co	nveners of the AGRESCO Sub-committee				
	1 Dr. J. A. Patel, Convener of Crop Improvement Research Sub Committee and Research Scientist, Regional Research Station, AAU, Anand					
	2	Dr. V.R.Bhatt, Convener of Crop Production Research Sub Committee and Prof. & Head, Dept. of Agril. Chemistry, BACA, AAU, Anand	Member			
	3	Dr. R. N. Pandey, Convener of Plant Protection Research Sub Committee and Prof. & Head, Dept. of Pl. Pathology, BACA, AAU, Anand	Member			
	4	Dr. J. S. Patel, Convener of Social Science Research Sub Committee and Professor, Dept. of Ag. Statistics, BACA, AAU, Anand	Member			
	5	5 Dr. R. V. Prasad, Convener of Dairy Science, Food Processing Technology & Bio- energy, AIT and Agril. Engg. Research Sub Committee and Prof. & Head, Dept. of Food quality Assurance. College of FPT & BE., AAU, Anand				
	6	Dr. Ashish Roy, Convener of Animal Health Research Sub Committee and Professor, Dept. of Vet. Microbiology, College of Veterinary Science & A.H., AAU, Anand Member				
	7	Dr. D.N. Rank, Convener of Animal Production Research Sub Committee and Prof. & Head, Dept. of AGB, College of Veterinary Science & A.H, AAU, Anand	Member			
G	Tv Vi	vo Eminent Scientists outside the University nominat ce Chancellor in consultation with Director of Research	ed by	the		
	1	Dr. G.Gururaja Rao, Principal Scientist & Head, Central Soil Salinity Research Institute, Regional Research Station, P.O.Maktampur, Bharuch - 392012	Member			
	2	Dr. K.S.Patel, Retd. Associate Director of Research, GAU, Ahmedabad, 11, Suryodaya Bunglow, Near Gulab Tower, Sola, Ahmedabad – 380 061	Member			
Н	Or Re	ne progressive farmer nominated by the Vice-Chancellor in consultation with esearch	Director of			
	1	Shri. Devesh Rameshbhai Patel, Satva Organic, Subhash Chowk, Boriavi, Ta. Dist. Member Anand				
Ι	Fiv CO	ve Professors or their equivalent from the university nominated by the Vice-C nsultation with Director of Research	hancellor in			
	1	Dr. N. Subhash, Professor, Tissue Culture Lab, AAU, Anand	ue Culture Lab, AAU, Anand Member			
	2	Dr. A.J.Dhami, Professor & Head, Dept. of Gynaecology, Vety. College. AAU. Anand	Member			
	3	Dr. J.B.Prajapati, Professor & Head, Dept. of Microbiology, DSC, AAU, Anand	Member			
	4	Dr. R.F.Sutar, Professor, FPT & BE, AAU, Anand	Member			
	5	Dr. M.L.Gaur. Professor & Head. Soil & Water Engineering & Dean / Principal	Member			
		College of Agril, Engineering & Technology, AAU, Godhra				

Research Sub-Committies

To evaluate the research work and to finalize the technical programmes for research in particular direction, the research areas of different subjects have been sub-grouped in nine research sub-committees, as follows:

Faculty of Agriculture

Crop Improvement : Plant Breeding
 & Genetics, Plant Biotechnology,
 Nanotechnology, Plant Physiology and
 Biochemistry



- **Crop Production** : Agronomy, Soil Science, Horticulture, Meteorology and Bio-fertilizer
- **Plant Protection** : Ag. Entomology, Plant Pathology and Nematology
- **Social Sciences:** Agril. Statistics, Agril. Economics, Extension Education and International Agril. Business Management

Faculty of Veterinary Science

- Animal Production : Animal Biotechnology, Animal Breeding and Genetics, Animal Physiology & Bio-chemistry, Livestock Production and Management, Animal Nutrition, Reproductive Biology, Poultry Sciences and Fisheries
- Animal Health: Vet. Medicine, Vet. Microbiology, Vet. Pharmacology, Vet. Parasitology, Vet. Surgery, Vet. Pathology, Gynaecology & Obstratics, Veterinary Public Health, Vet. Clinics and Anatomy

Faculty of Dairy Science

• **Dairy Science** : Dairy Microbiology, Dairy Engineering, Dairy Technology, Dairy Economics, Food Bio-technology, Dairy Chemistry

Faculty of Food Processing Technolgy & Bioenergy

• Food Processing Technology & BioEnergy : Post Harvest Technology, Food Processing and Packaging Technology and Bio-Energy

Faculty of Agril. Engineering

• **Agril. Engineering:** Soil and Water Conservation, Farm Power Machinery, Agril. Product Processing and Renewable Energy

Faculty of Agril. Information Technology

• Agril. Information Technology and Agricultural Sciences

4.1 New Crop Varieties, Farm Implements and Various Agricultural and Allied Science Technologies Developed

Research Sub-Committees meet to discuss the work done and to finalize different research programmes considering the feedback received from farmers through extension machinery and to cater educational needs as per today's global requirement in agricultural sciences. The result of sincere efforts and hard work of the scientists, i.e., crop varieties generated, farm implements developed and technologies recommended for crop as well as livestock management during the reporting year are given below.

	No. of recommendations finalized				
Discipline/Subject	For farmers	For scientific community and entrepreneurs			
Crop improvement					
Variety released	05	-			
Basic science	01	03			
Crop production					
Cultural practices	01	-			
Nutrient management	07	01			
Water management	01	-			
Weed management	01	-			

No. of recommendations finalized **Discipline/Subject** For scientific community For farmers and entrepreneurs Horticulture 03 • **Plant protection** 11 Entomology 18 • **Plant Pathology** 02 01 • Dairy science, Food processing, Agril. engineering 07 02 **Animal health** -03 **Animal production** 06 08 Social science 01

The details of above recommendations approved in the combined AGRESCO meeting of SAUs of Gujarat held at SDAU, Sardarkrushinagar are given here.

Recommendations for farming community

Crop Improvement

Variety Released

1. Rice : Variety GAR-3 (Gujarat Anand Rice-3)





The genotype NWGR-4005 (GAR-3) derived from a cross Gurjari x IET 14714 showed an

overall 11.1% yield superiority over the check variety GR-11. This genotype possesses long slender grains, which mature earlier by 7-10 days than GAR -13. It is moderately resistant against major diseases and pests besides having better cooking and milling qualities.

Maize : Variety GAYMH-1 (Gujarat Anand Yellow Maize Hybrid-1)







The GAYMH -1 is the first public bred single cross hybrid with early maturity for the rainfed condition of the tribal belt of the Gujarat state. This hybrid possesses orange flint grained cob like that of the local cultivars. It revealed 12.9 and 24.2% yield superiority over HQPM-1 (single cross hybrid) and GM-2 (variety), respectively under *Kharif* rainfed conditions. It also out yielded all the national checks in Zone-V of the country. The grains of this hybrid contain 70.8% starch, 12.2% protein, 3.9% oil, 0.329% tryptophan in protein and 2.855% lysine in protein.

3. Fodder Sorghum : Variety CoFS-29 (Coimbatore Fodder Sorghum-29)





This genotype is a multicut, profusely tillering perennial grass called as grassy sorghum. It has tall plant stature with more leaf number. It revealed higher green fodder, dry matter and crude protein yield than the national check variety SSG-59-3. It is a highly palatable genotype, showing very less disease incidence. It is recommended for endorsement in Gujarat.

4. Guinea Grass : Variety JHGG – 8-1



Guinea grass variety JHGG – 8-1 is a tall growing, high tillering and newly introduced forage crop showing very quick and fast regeneration ability after every cut. It revealed 28.8, 71.0 and 47.1 per cent higher green forage yield and 16.9, 59.7 and 43.2 per cent higher dry matter yield over the national check varieties Bundel Guinea-1, PGG 616 and Riversdale, respectively. It is recommended for endorsement for irrigated conditions of the Gujarat state.

5. Brinjal : Variety GAOB-2 (Gujarat Anand Oblong Brinjal -2)



Brinjal variety Gujarat Anand Oblong Brinjal -2 exhibited 35.73 and 28.74 per cent higher fruit yield over the check varieties GOB-1 and GJB-2, respectievly. The variety contained higher vitamin C, anthocyanin and total soluble sugars, with lower amount of total phenols as compared to the check variety GOB-1. It also revealed lower incidence of little leaf disease and low population of whitefly as compared to both the checks. It is recommended for cultivation in the Middle Gujarat conditions.

Basic Science

1. Effect of growth regulators on fodder quality and yield in lucerne (*Medicago sativa L.*) var. A-2

The farmers of middle Gujarat Agro-climatic Zone III are advised to spray gibberellic acid (GA_3) @ 40 milligram/litre to the lucerne (var. Anand-2) crop at 30 days after sowing for achieving higher forage yield, better quality and more net realization.

Crop Production

Cultural Practices

1. Yield of soybean as influenced by dates of sowing and cultivars

The farmers of middle Gujarat agro climatic zone - III growing soybean are advised to sow NRC 37 at the onset of monsoon to get higher yield and net return.

Nutrient Management

2. Efficacy of NADEP compost in agro-climatic zone-III in improving yield and quality of pigeonpea

The farmers of middle Gujarat agro climatic zone – III growing vegetable pigeon pea (var. AVPP 1) are advised to apply 2 t/ha NADEP compost fortified with 500 kg castor cake along with 1 litre *Rhizobium* culture at sowing to meet the nitrogen requirement as well as getting higher green pod yield, net return and better quality, besides maintaining soil health.

3. Agronomic managements of pigeon pea for yield maximization

The farmers of middle Gujarat agro climatic zone – III growing pigeon pea (var. AGT 2) are advised to apply 20 kg S/ha in the form of gypsum (150 kg/ha) in addition to the recommended dose of fertilizer (25:50:0 N:P:K kg/ha) for obtaining higher seed yield, net profit and better quality.

4. Assessment of organic farming and inorganic nutrient supply system on yield and quality of pigeon pea

The farmers of middle Gujarat agro climatic zone - III growing vegetable pigeon pea (var. Gujarat Tur 1) are advised to apply 25 kg N/



ha through FYM at sowing for getting higher green pod yield and net return, besides maintaining soil health.

5. Response of *bidi* tobacco variety ABT 10 to nitrogen and topping

The farmers of middle Gujarat agro climatic zone - III growing *bidi* tobacco (var. ABT 10) are advised to apply 180 kg N/ha, of which 45 kg N as basal through ammonium sulphate and remaining N through urea in 3 equal splits at 20, 40 and 60 DATP and topping the crop after 24th leaf to get higher cured leaf yield and net return.

6. Effect of integrated nutrient management on productivity of transplanted pearlmillet in summer season

The farmers of middle Gujarat agro climatic zone - III growing hybrid transplanted pearl millet during summer season are advised to apply vermicompost @ 2 t/ha and 120 kg N/ ha in two equal splits i.e. at transplanting and 30 DATP for securing higher yield, net return and better quality.

7. Effect of multi-micronutrients mixture grades on seed yield of lucerne

The farmers of middle Gujarat agro climatic zone - III growing lucerne (Anand 2) on soils with marginal Zn and deficient Fe status are advised to apply 25 kg $ZnSO_4$ and 50 kg $FeSO_4$ per hectare every year besides application of 20:40:40 N.P.K. kg/ha to obtain higher seed yield and net return.

8. Varietal response of pigeon pea to organic manures

The farmers of middle Gujarat agro climatic

zone - III those who are interested to grow pigeon pea organically are advised to prefer mid late variety BDN 2 and apply either vermicompost @ 1 t/ha or pressmud @ 5 t/ ha or FYM @ 5 t/ha to get higher yield and maintain soil health.

Water Management

9. Effect of irrigation schedules and nitrogen levels on seed production of oat

The farmers of middle Gujarat agro climatic zone - III growing oat (var. Kent) for seed purpose are advised to apply six irrigations(each of 50 mm) i.e. the first five irrigations at 15-20 days interval and the 6th irrigation at 13-15 days interval after the fifth irrigation. Further, they are advised to apply N @ 75 kg/ha (50 % N at the time of sowing and remaining 50 % N in two equal splits at 30 and 60 days after sowing in equal splits) for getting higher seed yield and net realization.

Weed Management

10. Weed management in *Bt* **cotton**

The farmers of middle Gujarat agro climatic zone - III growing *Bt* cotton are advised to carry out inter - culturing (IC) and hand weeding (HW) at 15, 30 and 45 days after sowing. Under labour shortage situation, pre-emergence application of pendimethalin @ 900 g/ha is recommended, followed by IC+HW at 30 and 60 DAS or post emergence application (15-20 DAS) of either fenoxapropp-ethyl or quizalofop-ethyl @ 50 g/ha, followed by IC+HW at 30 DAS for effective weed management. Horticulture

11. Response of plant density and integrated nutrient management in cowpea cv. AVCP-1

Farmers of middle Gujarat agro climatic zone-III growing vegetable cowpea (AVCP – 1) in *kharif* season are advised to apply 5 tonnes FYM per hectare along with basal fertilizer 10:20:0 NPK kg/ha with the seed treatment of *Rhizobium* (cowpea AAU isolate) and PSB culture (PBA-16) (each at 5 ml per kg seed) and sow the seed at 45 x 45 cm spacing to obtain higher green pod yield and maximum net return.

12. Response of plant growth retardants and pinching on growth, flowering and flower yield of African marigold (*Tagetes erecta* Linn)

The farmers of middle Gujarat agro-climatic zone III growing African marigold are advised to spray the foliar application of cycocel 750 mg/l in two intervals (the first spray at 30 days after transplanting and the second at 45 days after transplanting) for getting higher flower yield per hectare, enhancing vase life of flowers and higher net realization.

13. Nutrient and water management through fertigation in potato

The farmers of middle Gujarat Agro-climatic zone III growing potato are advised to irrigate the crop through drip for 21 minutes during November to January and 32 minutes during February to March at alternate days for getting higher potato tuber yield and net income with saving of 28 % water.

For drip irrigation potato crop should be planted in pair rows (60×30) x 10 cm. The system should be laid out with lateral distance

of 90 cm (in pair rows) and dripper (4 LPH) spacing of 30 cm. The system should be operated at a pressure of 1.2 kg/cm^2 .

Plant Protection

Entomology

1. Pest control in mustard

Farmers of middle Gujarat growing mustard are advised to spray any of the following insecticides twice, first at 1.5 aphid index and second after 15 days.

- a. Dimethoate 30 EC @ 0.03% (10 ml/ 10 litre of water) [150 g a.i./ ha]
- Imidacloprid 70 WG @ 0.014% (2 g/ 10 litre of water) [70 g a.i./ ha]
- c. Thiamethoxam 25 WG @ 0.01% (4 g/ 10 litre of water) [50 g a.i./ ha]

The pre-harvest interval of 30 days is recommended for imidacloprid and thiamethoxam. As per CIB recommendation, dimethoate is safe at harvest from residue point of view.

2. Sucking pests control in *Bt* Cotton

The farmers of middle Gujarat growing *Bt* cotton are advised to spray any of the following insecticides on initiation of sucking pests (aphid, leafhopper, whitefly and thrips) and subsequently two sprays at 15 days interval.

- a. Imidacloprid 17.8 SL @ 0.009 % (5 ml/ 10 litre of water) (44.5 g a.i./ha)
- b. Diafenthiuron 50 WP @ 0.05% (10 g/ 10 litre of water) (250 g a.i./ha)

The pre-harvest interval of 30 days is recommended for imidacloprid and diafenthiuron.



3. Pest control in black gram

- The farmers of middle Gujarat growing black gram are advised to spray emamectin benzoate 5 WG @ 0.0025 % (5 g/ 10 litre of water; 7.5 g a.i./ha) or flubendiamide 480 SC @ 0.01% (2 ml/10 litre of water; 28.8 g a.i./ha) at the initiation of pest incidence for the control of pod borers.
- The pre-harvest interval of 20 and 11 days is recommended for emamectin benzoate and flubendiamide, respectively.

4. Termite control in wheat

The farmers of middle Gujarat growing wheat are advised to treat the seeds before 12 hours of sowing with any one of the following insecticides for the control of termite.

- a. Chlorpyriphos 20 EC @ 4 ml in 50 ml water / kg seed (0.8 g a.i./ kg seed)
- b. Fipronil 5 SC @ 5 ml in 50 ml water /kg seed (0.025 g a.i./ kg seed)

5. Control of mango hopper

For the control of mango hoppers, the farmers of middle Gujarat are advised to spray any one of the following insecticides at 5 nymphs per inflorescence.

- a. Imidacloprid 17.8 SL @ 0.009 % (5 ml/ 10 litre of water)
- b. Acetamiprid 20 SP @ 0.01% (5 g /10 litre of water)
- c. Thiamethoxam 25 WG @ 0.0125% (5 g /10 litre of water)

The pre-harvest interval of 45 days is recommended for imidacloprid, acetamiprid and thiamethoxam.

6. Pest management in chickpea

Farmers of middle Gujarat growing chickpea are advised to follow below mentioned Bio-Intensive Pest Management module for the management of pod borer and wilt disease.

- a. Seed treatment with *Trichoderma viride* (2 x 10⁶ cfu /g) @ 8 g /kg seed at the time of sowing against wilt disease.
- b. Use of FYM @ 1 ton/ha enriched with *T. viride*(2 x 10⁶ cfu /g) (2 kg/ ton of FYM) for wilt disease.
- c. Planting marigold (*Tagetes erecta*) on the borders of chickpea field as trap crop for *Helicoverpa armigera*
- d. Installation of pheromone traps @ 40 traps/ ha at 15 days after sowing for trapping *H. armigera* moths
- e. Installation of 'T' shaped bird perches @ 100 / ha at 15 days after germination.
- f. Alternate spray of HaNPV @ 250 LE/ha and Neem Seed Kernel Extract @ 5 % during vegetative stage, at flowering stage and at pod formation stage for the suppression of *H. armigera*.

7. Pest management in okra

Farmers of middle Gujarat growing okra are advised to follow below mentioned biointensive pest management module for the management of pests of okra.

- a. Sowing of the crop during first week of May.
- b. Soil application of *Paecilomyces lilacinus* (2 x 10⁶ cfu /g) @ 25 kg /ha (Talc base formulation)
- c. Seed treatment with thiamethoxam 70 WS @2.8 g/kg seed (2 g a.i./kg seed).



- e. Regular clipping of the shoots infested by spotted bollworm.
- f. Need base alternate spray of NSKE @ 5 %, *Bt* [5 x 10⁷ spores /mg] @ 1.5 kg /ha and *Beauveria* bassiana (2x10⁸ cfu /g) @ 30 g /10 litre water.

8. Pest control in cowpea

Farmers of middle Gujarat growing cowpea are advised to spray any one of the following insecticides for the control of pod borer, *Maruca vitrata* at the initiation of flowering and subsequent two sprays at 15 days interval.

- a. Flubendiamide 480 SC @ 0.014 % (3.0 ml/ 10 litre water)
- b. Chlorantraniliprole 18.5 SC @ 0.006 % (3.0 ml/ 10 litre water)

The pre-harvest interval of one day is recommended for flubendiamide and chlorantraniliprole.

9. Control of thrips in chilli

For the control of thrips in chilli up to 45 days after transplanting, the farmers of middle Gujarat are advised to treat the seeds with imidacloprid 70 WS @ 7.5 g /kg (5.25 g a.i. /kg seed) before seeding in nursery and dipping roots of the seedlings in imidacloprid 17.8 SL @ 10 ml /10 litre water or thiamethoxam 25 WG @ 10 g /10 litre water for two hours before transplanting.

10. Control of pod borers in pigeon pea

The farmers of middle Gujarat growing pigeon pea are advised to give any of the following insecticides on initiation of lepidopteran pod borers and subsequently two sprays at 20 days interval.

- a. Chlorantraniliprole 18.5 SC @ 0.006 % (3 ml/ 10 litre water)
- Emamectin benzoate 5 WG @ 0.0025 % (5 g/ 10 litre water)
- c. Flubendiamide 48 SC @ 0.01 % (2 ml/ 10 litre water).

The pre-harvest interval of 29, 14 and 10 days is recommended for chlorantraniliprole, emamectin benzoate and flubendiamide, respectively.

11. Pest control in paddy

Farmers of middle Gujarat growing paddy are advised to apply cartap hydrochloride 4G @ 25 kg /ha (1 kg a.i. /ha) and monocrotophos 36 WSC @ 0.04% (10 ml /10 liter of water) alternately in infested spot /patch for the control of yellow stem borer and leaf folder.

As per the CIB recommendations, both the insecticides are safe from residue point of view.

Plant Pathology

12. Management of reddening of leaves and physiological wilting of *Bt* cotton

The farmers of middle Gujarat growing *Bt* cotton are advised to apply 280 kg N/ ha in four equal splits i.e., 70 kg N as basal application at the time of sowing and at 30, 60 and 90 days after sowing. In addition, foliar spray each of 50 g urea, $FeSO_4$, $ZnSO_4$ and $MgSO_4$ in 10 litre of water is also suggested for the management of reddening of leaves and physiological wilting of *Bt* cotton.

13. Nematode management in vegetables

The farmers of middle Gujarat growing vegetables in nematode sick fields are advised to grow root knot resistant varieties *i.e.* cowpea variety - Anand Vegetable Cowpea-1 in *Kharif* and tomato variety Hisar Lalit in *Rabi* for three years to manage root-knot nematode population.

Dairy Science, Food Processing and Agricultural Engineering

1. To study feasibility of most suitable mechanical power sources for farm operations in Panchmahal district

Small and medium farmers of Panchmahal district are recommended to use mini tractor (15 hp) for seed bed preparation using rotavator (0.8 m) to save 35 per cent fuel per ha as compared to medium size tractor (30-40 hp) operated rotavator (1.6 m).

2. Adaptive research oriented comparative evaluation of mechanical crop harvesting through on-farm investigation in Panchmahal district of middle Gujarat region

> The farmers of Panchmahal and adjoining region are recommended to use mini tractor front operated reaper as first choice or self propelled reaper as second choice for timely harvesting of paddy and fodder sorghum as compared to manual harvesting to save cost and man-hours during the soil moisture condition of 13.50 and 10.50 per cent for paddy field and sorghum field, respectively.

Animal Production

1. Reproductive behavior in goats along with ethology study in goats and hormonal profile

Goats are more comfortable under tree shade during daytime in the summer season

as compared to agro net (95% density) or asbestos shed roofed housing system.

2. Effect of feeding bypass fat on milk production from buffaloes of tribal areas of Panchmahal and Vadodara districts

In tribal areas like Kadana taluka of Panchmahals and Chhotaudaipur taluka of Vadodara district during 90 days of early lactation, inclusion of bypass fat @ 15 g/kg milk yield in the ration of buffaloes yielding 6 to 7 kg results in improvement in yield of whole milk, percentage of fat and the efficiency of feed conversion and increase in income by 21 to 23%.

3. Effect of feeding bypass protein on milk production from buffaloes of tribal areas in Panchmahal and Vadodara districts

In tribal areas like Kadana taluka of Panchmahals and Chhotaudaipur taluka of Vadodara district during 90 days of early lactation, inclusion of concentrate mixture with bypass protein in the ration of buffaloes yielding daily 6 to 7 kg milk, results in improvement in yield of whole milk, percentage of fat and the efficiency of feed conversion and increase in income by 40 to 42 %.

4. Animal Nutrition Survey in Vadodara district

In Vadodara district the farmers are advised to feed additional daily 1 to 1.25 kg compound concentrate mixture to buffaloes in order to fulfill their nutrient requirement.

5. Animal Nutrition Survey in Vadodara district

The farmers of Vadodara district are advised

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to feed additional daily 500 g compound concentrate mixture or 3.0 kg leguminous fodder for working bullocks during summer and winter in order to fulfill their nutrient requirement.

6. Draftability assessment of Kachchhi camel under middle Gujarat agro climatic condition

> It is advisable to give 1 hour rest to Kachchhi camels after every 2 hours work under 2500 kg pay load.

Recommendations for scientific community and entrepreneurs

Basic Science

1. Effect of different nitrogen levels on green leaf yield, protein and phyto-chemicals of different tobacco varieties and their residual effects on wheat (Joint study with Agronomy Department)

> Bidi tobacco variety MRGTH 1 transplanted during the 2nd week of September and fertilized with 220 kg N/ha and harvested at 90 DAT produced high protein yield from green leaf of tobacco. This system was found suitable to cultivate wheat crop during the 3rd week of December with recommended dose of fertilizers.

2. Evaluation of different genotypes of brinjal for their biochemical traits

Brinjal cv. Doli-5 has higher amount of vitamin-C and anthocynin and lower amount of phenol and glycoalkaloids and AB-09-1 has higher total carbohydrates as well as total soluble sugars. Both the genotypes are more suitable for consumers' use as compared to other brinjal genotypes.

3. Tetraploid cotton derived SSR markers that can be exploited for marker assisted breeding for enhancing fibre quality.

> Tetraploid (*G. hirsutum*) derived SSR markers showed transferability in diploid cotton (*G. herbaceum and G. arboreum*) and thus can be successfully utilized for marker assisted breeding in diploid cottons for fibre quality enhancement.

Crop Production

Nutrient Management

1. Effect of K, Mg and S on growth and yield of *Bt* Cotton

The *Bt* cotton crop grown on medium K and deficient S status soil may be fertilized with 100 kg K (KCl), 100 kg $MgSO_4$ and 30 kg S (gypsum) per hectare each in two equal splits at 30 and 60 DAS besides recommended dose of N.

Plant Protection

Entomology

1. Preharvest intervals (PHI) of acephate on brinjal

Two foliar sprays of acephate in brinjal at 10 day interval @ 560 g a.i./ha starting from fruiting stage resulted in its residue below Maximum Residue Levels (MRL) 0.1 μ g/g Limit of Quantitation (LOQ) in brinjal, if fruits are harvested from/on the 10th day after the second spray. Therefore, PHI of 10 day could be suggested if acephate is recommended on brinjal.

2. Preharvest intervals (PHI) of profenophos on brinjal

Two foliar sprays of profenophos in brinjal at



10 day interval @ 500 g a.i./ha starting from fruiting stage resulted in its residue below European Union (EU) MRL of $0.05 \mu g/g$ in brinjal fruits, if harvested from/on the 15^{th} day after the second spray. Therefore, PHI of 15 day could be suggested if profenophos is recommended on brinjal.

3. Preharvest intervals (PHI) of triazophos on brinjal

Two foliar sprays of triazophos in brinjal at 10 day interval @ 500 g a.i./ha starting from fruit initiation stage resulted in its residue below the MRL of 0.05 μ g/g (LOQ) in brinjal, if fruits are harvested from/on the 15th day after the second spray. Therefore, PHI of 15 day could be suggested if triazophos is recommended on brinjal.

4. Preharvestintervals(PHI)ofchlorpyriphos on cabbage

Two foliar sprays of chlorpyriphos in cabbage at 10 day interval @ 300 g a.i./ ha starting from head formation stage resulted in its residue below EU/Codex MRL of 1.0 μ g/g in cabbage if harvested even one hour (0 day) after the second spray. Therefore, PHI of 1 day could be suggested if chlorpyriphos is recommended on cabbage.

5. Preharvest intervals (PHI) of profenophos on cabbage

Two foliar sprays of profenophos in cabbage at 10 day interval @ 500 g a.i./ha starting from head formation stage resulted in its residue below EU MRL of $0.05 \ \mu g/g$ in cabbage if heads are harvested from/on the 7th day after the second spray. Therefore, PHI of 7 day could be suggested if profenophos is recommended on cabbage.

6. Preharvest intervals (PHI) of acephate on capsicum

Two foliar sprays of acephate in capsicum at 10 day interval @ 560 g a.i./ha starting from fruit initiation stage resulted in its residues below MRL of $0.1 \,\mu\text{g/g}$ (LOQ) in capsicum fruits if harvested from/on the 15th day after the second spray. Therefore, PHI of 15 day could be suggested if acephate is recommended on capsicum.

7. Preharvest intervals (PHI) of profenophos on capsicum

Two foliar sprays of profenophos in capsicum at 10 day interval @ 500 g a.i./ha starting from fruit initiation stage resulted in its residue below 0.05 μ g/g (LOQ) in capsicum if fruits are harvested from 10th day after the second spray. Therefore, PHI of 10 day could be suggested if profenophos is recommended on capsicum.

8. Preharvest intervals (PHI) of quinalphos on capsicum

Two foliar sprays of quinalphos in capsicum at 10 day interval @ 250 g a.i./ha starting from fruit initiation stage resulted in its residue below EU MRL of 0.05 μ g/g in capsicum if fruits are harvested 1 day after the second spray. Therefore, PHI of 1 day could be suggested if quinalphos is recommended on capsicum.

9. Preharvest intervals (PHI) of triazophos on capsicum

Two foliar sprays of triazophos in capsicum at 10 day interval @ 500 g a.i./ha starting from fruit initiation stage resulted in its residue below the MRL of 0.05 μ g/g (LOQ) in capsicum if fruits are harvested from/on the 7th day after the second spray. Therefore, PHI of 7 day could be suggested if triazophos is



recommended on capsicum.

10. Preharvestintervals(PHI)ofchlorpyriphos on cauliflower

Two foliar sprays of chlorpyriphos in cauliflower at 10 day interval @ 300 g a.i./ha starting from curd formation stage resulted in its residue below EU MRL of 0.05 μ g/g in cauliflower if harvested from/on the 15th day after second spray. Therefore, PHI of 15 day could be suggested if chlorpyriphos is recommended on cauliflower.

11. Preharvestintervals (PHI) of cypermethrin on cauliflower

Two foliar sprays of cypermethrin in cauliflower at 10 day interval @ 50 g a.i. /ha starting from curd formation stage resulted in its residue below EU MRL of 0.05 μ g/g in cauliflower curd if harvested from/on the 5th day after the second spray. Therefore, PHI of 5 day could be suggested if cypermethrin is recommended on cauliflower.

12. Preharvest intervals (PHI) of profenophos on cauliflower

Two foliar sprays of profenophos in cauliflower at 10 day interval @ 500 g a.i./ ha starting from curd formation stage resulted in its residue below EU MRL 0.05 μ g/g in cauliflower curd if harvested from/on the 7th day after the second spray. Therefore, PHI of 7 day could be suggested if profenophos is recommended on cauliflower.

13. Preharvest intervals (PHI) of acephate on chilli

Two foliar sprays of acephate in chilli at 10 day interval @ 560 g a.i./ha starting from fruiting stage resulted in its residue below the Codex MRL of 5.0 μ g/g harvested one hour after application. Therefore, PHI of 1 day could be suggested if acephate is recommended on chilli.

14. Preharvestintervals (PHI) of cypermethrin on chilli

Two foliar sprays of cypermethrin in chilli at 10 day interval @ 50 g a.i./ha starting from fruit initiation stage resulted in its residue below EU MRL of 0.5 μ g/g in chilli if fruits are harvested on even 1 hour (0 day) after the second spray. Therefore, PHI of 1 day could be suggested if cypermethrin is recommended on chilli.

15. Preharvest intervals (PHI) of profenophos on chilli

Two foliar sprays of profenophos at 10 day interval @ 500 g a.i./ha starting from fruit initiation stage resulted in its residues below the MRL of 0.05 μ g/g (LOQ & EU MRL) in chilli fruits if harvested from/on the 10th day after the second spray. Therefore, PHI of 10 day could be suggested if profenophos is recommended on chilli.

16. Preharvest intervals (PHI) of cypermethrin on tomato

Two foliar sprays of cypermethrin in tomato at 10 day interval @ 50 g a.i./ha starting from fruiting stage resulted in its residues below EU MRL of $0.5 \mu g/g$ in tomato if fruits are harvested even one hour (0 day) after the second spray. Therefore, PHI of 1 day could be suggested if cypermethrin is recommended on tomato.

17. Preharvest intervals (PHI) of profenophos on tomato

Two foliar sprays of profenophos in tomato at 10 day interval @ 500 g a.i./ha starting from

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fruit initiation stage resulted in its residue below EU MRL of $10.0 \ \mu g/g$ in tomato even if fruits are harvested one hour (0 day) after the second spray. Therefore, PHI of 1 day could be suggested if profenophos is recommended on tomato.

18. Preharvest intervals (PHI) of triazophos on tomato

Two foliar sprays of triazophos in tomato at 10 day interval @ 500 g a.i./ha starting from fruit initiation stage resulted in its residue below the MRL of 0.05 μ g/g (LOQ) in tomato if fruits are harvested from/on the 10th day after the second spray. Therefore, PHI of 10 day could be suggested if triazophos is recommended on tomato.

Plant Pathology

19. Multiple resistant rice genotypes

Rice genotypes viz., IET- 21267, IET- 20937, IET- 20594, IET- 20923, IET- 21463, IET- 20235, IET- 20334, IET- 21176, IET-21216, CB 05-031, CB-07-115, NWGR-5072 and CR-2428-9 were found to have multiple resistant reaction against bacterial blight (*Xanthomonas oryzae* pv. oryzae), blast (*Pyricularia grisea*) and sheath rot (*Sarocladium oryzae*) diseases under artificial inoculation and high disease pressure conditions in the field. These genotypes can be used in breeding programme for developing resistant varieties.

Dairy Science, Food Processing And Agricultural **4**. Engineering

1. Shelf life study of *Thabdi* employing different packages

Shelf life of *Thabdi* can be extended by filling the product in a PVC tray, inserting in Met-

Polyester/PE pouch (106 μ m) or Polyester/ PE pouch(74 μ m) followed by heat sealing the pouches. Under the ambient storage (30±2°C), the *Thabdi* packaged as above has shelf life of 10 days, while under refrigeration temperature (7±2°C), the product can be safely stored for almost 49 days.

2. Shelf life study of Halvasan employing different packages

Shelf life of *Halvasan* can be extended by filling the product in a PVC tray, inserting in Met-Polyester/PE pouch (106 μ m) or Polyester/ PE pouch (74 μ m) followed by heat sealing the pouches. Under the ambient storage (30± 2°C), the *Halvasan* packaged as above has shelf life of 10 days, while under refrigeration temperature(7± 2°C), the product can be safely stored for almost 42 days."

3. Enhancement of Shelf life of paneer

It is recommended to dip paneer in vinegar or lactic acid (4%) for 30 minutes, followed by partial removal of moisture under vacuum (36-38°C) as per AAU protocol and packaging in LDPE bags of 90 μ m thickness, which could enhance the shelf life of paneer up to 90 days under refrigerated (7±2°C) storage. Upon rehydration in warm water (55-60°C), the paneer obtained had similar phenological properties compared to that observed in fresh paneer. This paneer is suitable for use in various Indian cuisines.

Standardization of technology for manufacture of "Low Fat" and "Sugar Free" *shrikhand*

A process is standardized to manufacture low fat, sugar free *Shrikhand* as per AAU protocol with Sucrose as intense sweetener and using either Isomalt or Fructo-oligosaccharide (FOS) as bulking agent. The Shrikhand thus obtained has better sensory attributes.

5. Production technology of freeze dried *aonla* slices

The entrepreneurs and food processors interested in production of dried aonla slices are advised to use freeze drying protocol developed by Anand Agricultural University. The technology enables production of ascorbic acid rich (above 90% retention) dried aonla slices.

6. Production technology of vacuum dried ginger flakes

The entrepreneurs and food processors interested in production of dried ginger slices are advised to follow the vacuum drying protocol developed by Anand Agricultural University. The technology enables production of gingirol rich dried ginger flakes.

7. Supercritical fluid extraction of volatile oil from basil leaves

For production of superior quality volatile oil rich in eugenol and higher yield from basil leaves, the super critical fluid extraction technology developed by Anand Agricultural University is recommended.

Animal Production

1. To study the effect of hormonal and managemental factors on reduction in age at first calving in heifers under field conditions

In anestrous crossbred cow heifers CIDR

application results in estrus induction and successful conception.

2. Detection of early pregnancy in goats by using Ultra sonography and to develop package of practices

Using Ultra Sonography (USG) with 3.5 MHz rectal, trans abdominal transducer as a tool following ultra sonographic findings can be observed with the progress of gestation period in goats:

Gestational days	USG Findings
19-30 days	Gestational sac
22-25 days	Area of heart beats
31 days	Fluid filled sac
	surrounding conceptus
42 days	Area of heart, neck, thorax
64 days	Fore limb, hind limb buds
84 days	Vertebral column and rib
	cages

3. Development of area-specific mineral mixture formulations for Kheda district

Based on the prioritization of limiting minerals in Kheda district, the area specific mineral mixture has been formulated which would makeup the deficiency when fed @ 30g/head/day to adult dairy animals in addition to the current feeding practices.

				frees of Acoust
Sr.No	Mineral element	Requirement (%)	Mineral salt	Quantity (kg)
1	Calcium	20.000	Calcite powder	14.53
2	Phosphorus	12.010	Di Calcium Phosphate	66.72
3	Magnesium	4.890	Magnesium oxide	9.06
4	Sulphur	1.000	Sodium thiosulphate	2.56
5	Copper	0.100	Copper sulphate	0.40
6	Zinc	1.400	Zinc sulphate	4.24
7	Manganese	0.332	Manganese sulphate	1.07
8	Iron	0.400	Ferrous sulphate	1.33
9	Cobalt	0.012	Cobalt sulphate	0.06
10	Iodine	0.026	Potassium iodide	0.03
			Total	100.00

4. Study on compensatory growth in crossbred calves fed crop residue based total mixed ration (TMR) with strategic approach using bypass fat

With/By restricted feeding to 8 to12 months old growing crossbred calves at the rate 75% of NRC (1989) standard for 60 days followed by re-alimentation of 60 days at the rate of 125% of requirement, the calves gain higher rate (646.56 g/d) as compared to the calves fed 100% (595.89 g/d) of requirement during re-alimentation.

5. To study the effect of Solid State Fermented (SSF) biomass supplementation on growth performance of weaner Surti kids

Supplementation of solid state fermented (SSF) biomass @ 4 % in Jowar straw: Amul dan (50:50) based total mixed ration improves feed efficiency by 16 % in weaner Surti kids.

6. Draftability Assessment of kachchhi camel under middle Gujarat agro climatic condition

Kachchhi camel generates 0.58 and 0.69 horse power under 2000 and 2500 kg payload as compared to 0.50 at 1500 kg payload during work.

7. Draftability Assessment of kachchhi camel under middle Gujarat agro climatic condition

The speed (m/sec.) and stride length (m) of Kachchhi camel remains same under 2000 and 2500 kg payloads in work (W)-rest (R) cycle [(1h(W)-15 min (R) -1h (W)-15 min (R)-1h(W)- 1h(R)- 1hr(W)-15 min (R)- 1h(W)-15 min (R)- 1h(W)].

8. Draftability assessment of kachchhi camel under middle Gujarat agro climatic condition

At GPx and TBARS biomarkers levels, Kachchhi camel remains high during hot and humid seasons as compared to summer and winter seasons, suggestive of stress to the animal.

Animal Health

1. Use of recent molecular techniques to reduce economic losses incurred due to bovine mastitis by evolving diagnostic, therapeutic and preventive measures

Intramammary infusion of 10 ml of 1 % *Prosopis juliflora* alkaloids formulation in

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normal saline once a day for 5 consecutive days is an effective treatment for bovine subclinical mastitis.

2. Etiopathological studies on mortality in broilers

Adulteration of melamine in broiler feed for 21 days at the level of 0.25 and 0.50% was found nephro-toxic causing 4 and 16 % mortality, respectively, with deposition of melamine uric acid crystals in the kidneys. Dead birds had yellow turbid bile with presence of melamine crystals. Field veterinarians should be aware of intentional adulteration of melamine as a protein in the poultry feed and feed ingredients.

3. Etiopathological studies on mortality in broilers

Ketoprofen administered orally to broiler chicks @ 5, 15 and 25 mg/kg body weight for 21 days was found nephrotoxic, causing 8, 20 and 40 % mortality respectively by inducing lesions of visceral gout.

Social Science

1. Scale to measure attitude towards farmers' training programmes

The following scale to measure attitude towards farmers' training programmes organized by SAUs of Gujarat State is recommended.

			-			
No.	Final format of selected Statement	SA	Α	UD	DA	SDA
1 *	I think that farmer's training programmes organized by SAUs help in increasing confidence among farmers.					
2 *	In my opinion the training programmes provide the needful infor- mation regarding improved agricultural practices.					
3	I recognize that hand outs provided during training programme make it difficult to understand the agricultural practices.					
4 *	In my belief, off campus training programmes organized by SAUs are more beneficial to rural women.					
5	I think that for progressive farmers attaining of training pro- grammes organized by SAUs are wastage of time.					
6	In my belief farmer's training programmes organized by SAUs are not advisable for experienced farmers					
7 *	I agree that conducting visits to successful organizations during training provides adequate information to the farmers.					
8 *	I think that vocational training programmes conducted by SAUs develop skilled entrepreneurs.					
9 *	Information given during training programmes builds innovative ideas among farmers.					
10 +	SAUs training programmes create interest among farmers regard- ing modern farming technology.					

Scale to measure attitude towards farmers' training programmes organized by SAUs of Guiarat State

SA : Strogly agree, A : Agree, UD : undicided, DA : Disagree, SDA : Strongly disagree



The reliability of above scale was calculated to understand consistency; it was 0.74 in the previous year and 0.76 during last year.

4.2 Agricultural Crops

Cereals

Rice

Crop Improvement

- Rice is the predominant crop of central Gujarat. A large number of varieties have been developed by the Main Rice Research Station, Nawagam, Gujarat. Presently, the centre is working for the development of new varieties/hybrids in rice. In addition, various breeding activities like development of fresh crosses, handling of segregating generations, screening of germplasm and different categories of varietal trials are regularly conducted at the station.
- LSVT and SSVT trials were conducted at Navagam, Thasra and Dabhoi centres. Under LSVT-E-C trial, the entry IET-22212 (5125 kg/ha grain yield) emerged as best genotype at Nawagam station which has out yielded 13.6, 32.2 and 14.8 % higher over checks Gurjari, GR-7 and GAR-3, respectively. In Small Scale Varietal Trial (SSVT ML), the genotype IET-23258 (6816 kg/ha grain yield) gave 23.3, 68.8 and 6.3 % higher grain yield in comparison to checks Jaya, GR-11 and GAR-13, respectively.
- Under AICRIP, 15 trials viz., IVT-IME, AVT-I-IME, AVT-II-1ME, IVT-1M, AVT-I-IM, AVT-II-IM, IVT-L, AVT-I-L, ALSTVT, IVT-ASG, IVT-BIO, AVT-NIL, IVT-E, AVT-I-E and AVT-II-E were conducted at Nawagam and Dabhoi centres. Large number of genotypes (455) were evaluated in these trials. Of these, top

performing six genotypes for grain yield were 1601 (8182 kg/ha grain yield), 1817 (7986 kg/ha), 1707 (7889 kg/ha), 1605 (7778 kg/ ha), 1819 (7569 kg/ha) and 1540 (7153 kg/ ha).

- Under drilled paddy cultivation, different trials were conducted at Derol centre. The genotype IR 82635-B-B143-1 was found promising giving the grain yield of 2391 kg/ ha.
- In *Kharif*-2013, 1897 plant progenies of different generations were evaluated at Navagam from which 1772 IPS and 183 bulks were further selected. In addition to this, total 61 fresh crosses were made to develop high yielding, quality rice variety possessing multiple resistance to major pests and diseases.

Hybrid Rice Trial

During summer-2013, nine trials viz., IHRT-E (24 entries + 1 check), IHRT-ME (36 + 1), IHRT-M(34 + 1), IHRT-MS (19 + 1), MLT(19 + 2), HRT GSSC (10 + 1), HRT Pvt.(27 + 8), HRT Pvt.(6 + 3) and HRT Pvt. (27 + 8) were conducted at Nawagam, Dabhoi, Thasra and Vyara centres. The top ranking three hybrids for grain yield were IHRT-ME-4 (7398 kg/ ha), IHRT-ME-8 (7325 kg/ha) and IHRT-ME-29 (6948 kg/ha).

Crop Production

Apart from Main Rice Research Station, Nawagam, two other centres Dabhoi and Derol also conducted research experiments on transplanted rice and drilled rice, respectively.

During the reporting period, Nawagam centre has conducted nine experiments in transplanted rice while Dabhoi and Derol centre AAU

conducted three experiments at each center. Some of them are :

- Culture IET-21267 produced 46.3 % higher grain yield than local check Krishna Kamod and found promising as nitrogen responsive culture.
- Cultures IET 22752 and IET 22753 produced higher grain yield under high and low input management.
- GAR-13 and Dandi gave higher yield when transplanted during second fortnight of June (advanced transplanting) as compared to transplantation in July.
- SRI method (All the principles as per the SRI) and direct seeding method (Use of drum seeder/ dibbling of sprouted seed at 25x25 cm) fb SRI principles were proved superior to conventional method of paddy cultivation.
- Flucetosulfuron 10 WG + Bispyribacsodium 10 % SC at 2-3 fb 15-20 DAT produced higher grain yield and found better for controlling weeds.
- Application of 100 % RDN in organic form produced higher grain yield of paddy than 50 % RDN through FYM / compost + 25 % RDN through vermicompost + 25 % through castor cake / bio fertilizer in paddy -wheat crop sequence.
- Application of FYM @ 5 t/ha along with 80 kg N + 15 kg P_2O_5 /ha produced significantly higher grain yield of drilled paddy.
- Grain and straw yield of paddy increased significantly with increase in nitrogen levels up to 50 kg N/ha and phosphorus level up to 12.5 kg/ha.
- Pre emergence application of Oxidiagryl @

90 g a.i./ha followed by Bisbyribac sodium @ 25 g a.i./ha at 20 DAS was found effective in controlling weeds in drilled paddy.



SRI method in paddy

Plant protection

The studies on effect of transplanting period on pest incidence in paddy, screening of paddy genotypes for their resistance to major pests, monitoring of pest and their natural enemies, studies on activity of insect pests through light trap and evaluation of newer insecticides for the management of paddy pests were carried out by Nawagam centre.

Moreover, studies were also conducted on screening of genotypes for their resistance to leaf blight, blast and sheath rot diseases, field monitoring of virulence of major causal organisms and evaluation of newer fungicides against major diseases of paddy.

Maize

Crop Improvement

Kharif 2013

• 265 hybrids/varieties developed by different centres of AICRP on maize and private sectors were evaluated for yield and quality under rainfed and low fertility conditions. The entries P3580 and JH 31601 (AET entries); Bajuara and ADVSW-2 (sweet corn); JH 3 and EHQ 64 (QPM); and CMH 11-659 (baby corn) were found promising.

- In a multi-location trial conducted at Godhara, Dahod, Khedbrahma, Bhiloda, Devgarh Baria, Jabugam and Derol, 73 single cross hybrids developed by Ghodra centre were tested, of which 29 entries were found promising for grain yield.
- In normal yellow and white maize, 225 and 115 single cross hybrids were developed, respectively. For QPM, high oil, sweet corn and baby corn, 15, 20, 15 and 24 single crosses were attempted to develop the hybrid variety for specific purpose.
- At Dahod centre, 97 genotypes were evaluated for yield and the top three high yielding genotypes were GWC-0912, GWC-0316 and GWC-0919.

Rabi-2013

At Dahod centre, 51 genotypes were evaluated for yield and the better performing top three genotypes were GYH-0965, GYH-0653 and GYH-0370.

Crop Production

Under crop production, 9 experiments conducted at Godhra, 3 experiments at Devgadhbaria and 1 each at Thasra, Department of Agronomy and Weed Control Project during the year. The salient findings of the experiments are as under:

- Higher green cob yield of sweet corn obtained with application of vermicompost 2 t/ ha and castor cake 1.2 t/ ha.
- Productivity of winter maize vavriety
 GM-3 and HQPM-1 was higher with 50

% detassling and fertilization of alternate rows or 50 % detassling and fertilization of alternate plants.

- Soaking of seed in 1.25% NaCl for 4 hrs before sowing gave higher grain yield of maize under rainfed condition.
- Nitrogen application @ 150 kg/ha scheduling as 10:30:30:20:10 % (split at different stages) gave higher yield of variety HQPM-1.
- Application of nitrogen 90 kg/ha and phosphorus 45 kg/ha recorded higher grain yield of maize variety GM-6 under rainfed condition.
- Application of 100% RDN from FYM gave higher yield of maize in Maize – gram cropping sequence.
- In maize-wheat cropping system, tank mix of pendimethalin (0.25 kg/ha) with atrazine (0.50 kg/ha) or atrazine alone @ 1.00 kg/ha as preemergence was equally effective to IC + HW, carried out at 20 and 40 DAS in maize. In succeeding wheat crop pre-emergence application of pendimethalin @ 0.50 kg/ha or post-emergence application of MSM @ 4.0 g/ha or hand weeding at 30 DAS were found effective.
- In maize-amaranths cropping sequence, higher grain yield of maize produced with the application of 100 % RDF along with 1 tonne castor cake/ha, while, higher grain yield of amaranthus was recorded under treatment 100 % RDF + 10 tonne FYM/ha.

Plant protection

 At present, the work on screening of maize genotypes for their resistance to major insect pests and diseases, evaluation of



biofungicides and newer fungicides for management of leaf blight and leaf spot diseases in the region is in progress. Among the various biofungicides evaluated, low urine (10%) spray along with *Trichoderma viride* @ 7g/kg seed was found to be the best treatment for the control of leaf blight and leaf spot diseases in maize.

Wheat

Crop Improvement

T. durum

 At ARS Dhandhuka, 80 crosses were attempted for development of high yielding varieties suitable under rainfed condition. 784 plant progenies of various generations were raised. Out of these progenies, 693 IPS were selected.

T. aestivum

- At Arnej, 194 genotypes were tested in ten different trials. Of these, 14 genotypes were found promising which will be promoted in respective trials.
- At RRS, Anand, 13 genotypes including one local check were evaluated for grain yield. Three entries viz., CZ-TS-10 (5647 kg/ha), CZ-TS-09 (5625 kg/ha) and CZ-TS-07 (5565 kg/ha) recorded significantly higher yield than the best check variety GW-496 (4452 kg/ha).

Crop Production

- Research experiments for production technology in wheat were conducted at Arnej, Department of Agronomy and RRS during the reporting period.
- ✤ Application of NADEP compost @ 2.5 t/

ha fortified with castor cake (80 kg / ha) at the onset of monsoon gave highest yield of durum wheat (GW 1) under conserved moisture situation at Arnej station.

- The experiments on long term effect of organic manures on soil, yield and quality on wheat (*Triticum aestivum* L.) groundnut (*kharif*) crop sequence and response of nitrogen, phosphorus and bio-fertilizer on wheat were conducted at the Department of Agronomy, Anand.
- At RRS, Anand, higher grain yield of wheat was obtained with application of 100 % RDF + FYM + Biofertilizer AAU PGPR Consortium. Wheat seed rate of 150 kg/ha recorded higher grain yield of wheat under rice-wheat cropping system.

Bajra

Crop Improvement

Kharif 2013 (RRS, Anand)

- Under Advanced Hybrid Trial (AHT-M), hybrid AHT-401A (2822 kg/ha) gave significantly higher yield than the check hybrid GHB-558 (1978 kg/ha).
 - 13 hybrids were evaluated under Advanced Hybrid Trial (AHT -L) including check GHB-558 for grain yield performance. Of these hybrids, AHT–503A (2711 kg/ha) and AHT-502A (2622 kg/ha) significantly out yielded the check hybrid GHB-558 (2067 kg/ha).
 - Under state and Co-ordinated trials, 7 hybrids were evaluated for grain yield against check GHB-558. Of these, hybrid AHT-401A (2822 Kg/ha) significantly out yielded the check hybrid GHB-558 (1978 Kg/ha).
 - 26 hybrids including one check GHB-



558 (2266 kg/ha) were evaluated under Initial Hybrid Trial (IHT-M) for their grain yield performance. Among the hybrids evaluated, IHT-203 (3067 kg/ha) was found significantly superior than the best check GHB-558 (2266 kg/ha).

 Among 540 hybrids evaluated in a single row unreplicated trial under Preliminary Row Trial, 85 hybrids were found superior for grain yield in comparison to the best check GHB 558. Among the high yielding hybrids, 36 hybrids recorded more than 40 per cent higher yield than the check GHB 558.

Summer 2013 (RRS, Anand)

 Under Summer Hybrids Trial (SHT), 25 genotypes were evaluated for grain yield against check GHB-538. Among the hybrids evaluated, ten hybrids viz., SHT-104 (5872 kg/ha), SHT-102 (5833 kg/ha), SHT-111 (5820 kg/ha), SHT-110 (5807 kg/ha), SHT-107 (5717 kg/ha), SHT-105 (5192 kg/ha), SHT-109 (5187 kg/ha), SHT-101 (5093 kg/ ha), SHT-103 (5090 kg/ha) and SHT-124 (4987 kg/ha) significantly out yielded the check hybrid GHB-538 (4042 kg/ha).

Crop Production

The following experiments were carried out during the reporting period.

- Higher pearl millet equivalent yield was obtained under Pearl millet + Soybean (2:2) row ratio.
- In pearl millet-wheat cropping system, hand weeding at 30 DAS or pre emergence application of atrazine @ 0.5 kg/ha was effective to manage weeds with higher yield of pearl millet. In wheat, pre-emergence application of pendimethalin @ 0.5 kg/ha

was equally effective of hand weeding at 30 DAS for better yield and weed management.

Long term use of atrazine @ 0.5 kg/ha in pearl millet and pendimethalin @ 0.5 kg/ha in wheat did not develop residues in soil and hence, both are safe.

Finger Millet and Kodo Millet

Crop Improvement

Kharif-2013

- At Hill millet Centre, Dahod, nine experiments of finger millet were conducted under AICRP and state trials. Total 104 genotypes of finger millet were evaluated. Of these, 11 genotypes viz., AVT (E&M)-7, AVT (E&M)-4, AVTL-16, WN-259, WN-548, WN-244, WN-578, WWN-28, WWN-25, WN-559 and WN-558 were found promising for grain yield.
- Four varietal trials were conducted in Kodo Millet and 50 genotypes were tested. Of these, genotype DK-127 was found promising for yield.

Pulses

Mungbean

Crop Improvement

Summer 2013

- At Pulse Research Station, Vadodara, Small Scale Varietal Trial comprised of 10 entries including check GM-4 was conducted. Four genotypes viz., GM-11-02 (1910 Kg/ha), GJM 1104 (1739 Kg/ha), GJM 1102 (1721 Kg/ha) and GM-11-06 (1693 Kg/ha) gave significantly higher yield than the best check GM-4.
 - At Agricultural Research Station, Derol,

AAU

among the different genotypes tested under LSVT, GM-05-08 (570 kg/ha), GJM-1105 (568 kg/ha) and GM-11-05 (503 kg/ha) recorded 42.9, 42.4 and 26.1%, respectively higher yield than the best check GM 4 (399 kg/ha).

- At Pulse Research Station, Vadodara, fifteen genotypes along with check GM-4 were evaluated under PET and genotype VMS-13-1 (2419 Kg/ha), which significantly out yielded the check GM-4 (1736 Kg/ha).
- At Derol centre, among 36 genotypes screened against Bean Common Mosaic Virus (BCMV), lowest number of diseased plants were observed in GM-02-09 (7.50%) followed by LGG-460 (10.63%), TMV-37 (15.63%), Saptari Local (18.13%) and GM-3 (18.75%).
- At Vadodara centre, screening of genotypes against wilt and Yellow Mosaic Disease (YMD) under LSVT revealed that entry VMS-6 was found resistant to wilt (2.07%) as compared to check GM-4 (5.33%). This genotype was also found resistant to YMD incidence (0.30%) as compared to check GM 06-08 (4.26%).

Pigeonpea

Crop Improvement

- At PRS, Vadodara, under LSVT, the grain yield differences among genotypes were found significant and genotype AAUVT-2007-10 (2137 Kg/ha) gave 37.8% higher yield than the best check AGT-2 (1551 Kg/ha).
- At Vadodara centre, the grain and green pod yield differences among the entries were observed to be significant under LSVT trial for Pigeonpea-Dual purpose. The genotype BP-10-08 (761 Kg/ha) gave significantly

more grain yield than the check GT-1 (579 Kg/ha) to the tune of 31.4 per cent.

179 individual plants (IPS) were selected from F_1 to F_7 generations.

Crop Production

- Inter cropping system pigeonpea + soybean produced higher pigeon pea equivalent yield as compared to pigeonpea + maize and pigeonpea alone.
- Suitable sowing time for summer season green gram is 1st March at Vadodara station.

Chickpea

Crop Improvement

- At Pulses Research station, Vadodara, 76 genotypes were tested under different trials. Of these, 5 genotypes of Arnej centre were found promising and will be promoted in respective trials.
- At Dahod centre, five different trials were conducted. The genotype GJG-08-14 was found significatly better than the check.

Crop Production

• A trial on seed priming and foliar spray of stress mitigating chemicals for ameliorating moisture stress in conserved moisture condition was conducted in chick pea at Dhandhuka station. A total of 20 treatments combination were used, among which seed soaking with Thio-urea (500 ppm) + foliar spray of Thio-urea (1000 ppm) at vegetative stage (30 to35 DAS) and at pod filling stage (45 to 50 DAS) was found better for proline content in leaves & grain yield of chickpea.



96 accessions were collected from different villages of Dahod, Panchmahal and west MP border as well as Amreli and Almora centres.

wilt disease in chickpea and enhanced the

Plant Protection

vield.

Crop Improvement

Soybean

Kharif 2013

Soybean has been introduced as new crop in the tribal belt of Gujarat. The crop is attacked by few lepidopterous pests. It needs to be controled by use of newer insecticides. As such, there is no research based recommendation to manage the lepidopterous pests in soybean. Hence, a new experiment to evaluate the newer insecticides for the management of major lepidopteran pests has been formulated at College of Agriculture, Jabugam, Dist. Chhotaudepur.

Cluster Bean

Crop Production

• First week of February is found to be optimum sowing time for summer cluster bean at Derol station.

Black Gram

Crop Production

Pre emergence application of pendimethalin
 @ 1000 g/ha or pre emergence application
 of imazethapyr + pendimethalin @ 800 to
 1000 g/ha or hand weeding carried out at 20

Plant protection

- Seasonal occurrence of *Helicoverpa armigera*in chickpea and pigeonpea as well as survey
 on damage due to leaf fodder and stem
 borer in drilled paddy is going on. Screening
 of blackgram and greengram genotypes
 against yellow mosaic and bean common
 mosaic disease, respectively is in progress
 at Derol station. It was found that the larval
 population of *Helicoverpa armigera* attained
 its peak during 51st standard week in chickpea
 as well as pegionpea crop. Population of
 grasshopper in drilled paddy was very low
 during the season.
- Experiments on screening of pigeonpea, mungbean and urdbean genotypes for their resistance against major insect pests and bioefficacy of newer insecticides against pod borers are in progress at Vadodara station. Screening of pigeonpea genotypes against *H*. armigera SSVT and PET trials showed that BP-06-38, SKNP-1230 and AAUVT-13-36 were found to be promising genotypes. Similarly, mungbean and uradbean genotypes viz. VMS-6 and SKNU-07-03 registered minimum incidence of legume pod borer, Maruca vitratata, respectively. In insecticidal evaluation trial, Rynaxypyr and flubendiamide were found effective in controlling pod borer complex in pigeonpea as well as greengram.
- Field demonstration trials on seed treatment as well as soil application of *Trichoderma viride* as biofungicide for the management of wilt disease in chickpea have been carried out at KVK, Devataj. Results revealed that seed treatment with carbendazin 50% WP (2 g/kg seed) + soil application of Trichoderma viride (2.5 kg/ha) effectively controlled the

AAU

and 40 DAS was effective to manage weeds with higher yield of black gram. There was no carry over/residual phytotoxic effect observed on succeeding mustard crop at • DWSR, Anand.

Oilseeds

Castor

Crop Improvement

- At RRS, Anand, IHT was conducted with 13 hybrids including three check hybrids. Out of hybrids under testing, SHB 896, SHB 942, SHB 951 and Avani 11 were found to be significantly high yielding than the best check DCH 177 (3509 kg/ha).
- At RRS, Anand, 15 genotypes including five check hybrids were evaluated under IHVT and genotype JI 39 (3095 kg/ha) was significantly high yielding than the best check DCS 107 (2615 kg/ha).
- At RRS, Anand, under LSHT, 14 hybrids were tested against two checks. Three hybrids SHB 942, SHB 945 and SHB 951 were found significantly superior than the best check GCH-7 (2293 kg/ha).
- At RRS, Anand, 136 hybrids supplied by DOR, Hyderabad along with 2 checks were tested under Common Evaluation Hybrid Trial -1 and hybrid CEH 108 was found significantly superior with 57% yield increase over the best check GCH-7.
- At RRS, Anand, 60 hybrids supplied by DOR, Hyderabad, were tested under Common Evaluation Hybrid Trial –II, with 2 checks and hybrid RHCH 50 showed significant yield increase of 15% over the best check GCH-7.

Mustard

Crop Improvement

- At Dept. of Genetics and Plant Breeding,
 Anand, 60 genotypes of *B. juncea* were
 screened against aphid and sawfly and the
 highest yield was observed in the genotype
 RAYAD-9602 (36.14 g) in the untreated sets.
 However, in the treated sets, HUM-9801 gave
 the highest yield (46.06 g). The aphid index
 revealed that eight genotypes viz., Vardan,
 TM-28, IC 491446, GM-2, B-1281, PBR-357,
 CSR-100 and SKm-0124, were found to be
 highly resistant.
- In another experiment, 8 varieties of *B. rapa*, 5 of *B. napus* and 2 of *B. carinata* were screened for aphids and whitefly under field conditions along with three checks GM 1, GM 2 and GM 3. The genotypes Neelam, GSL-1, IC-560699, IC-399790, IC-399819, Pusa Swarnim and Kiran were found resistant to aphids.
- At RRS, Anand, 20 genotypes of mustard were tested under PVT. Out of these, SKM 1310(2320 kg/ha), SKM 1314(2137kg/ha) and SKM 1303(1940 kg/ha) were found promising for higher yield.
- At RRS, Anand, 28 coded entries were tested under irrigated condition under IVT-1. The top three entries were, MCN-13-27(1901 kg/ ha), MCN MCN-13-9 (1786 kg/ha) and MCN-13-17(1626 kg/ha), whereas, under AVT-I, top three high yielding entries were QM-13-16 (2025 kg/ha), QM-13-18 (2024 kg/ha), and QM-13-13(1819 kg/ha).



Groundnut

Crop Improvement

Summer 2013

- 6 different varietal trials were conducted at RRS, Anand. Under Initial Varietal Trial-II, 21 genotypes were evaluated against check GG-6. The dry pod yield was recorded maximum by genotype INS-I-2011-05 (2718 kg/ha), followed by INS-I-2011-06 (2528 kg/ha), INS-I-2011-32 (2521 kg/ha) and INS-I-2011-10 (2505 kg/ha).
- The Zonal Varietal Trial comprising of 18 genotypes including four checks was conducted at Anand, Thasra and Jabugam. The genotype AG-2012-04 (3871 kg/ha) gave higher pod yield over the check TG-37-A (3081 kg/ha).
- 23 genotypes including four checks were evaluated under Preliminary Evaluation Trial at RRS, Anand. The genotypes AG-2012-11 (3686 kg/ha) and AG-2012-04 (3572 kg/ ha) were found to be significantly superior for pod yield over the check TG-37A (2793 kg/ha).

Kharif 2013

10 genotypes including three checks were evaluated under LSVT at Anand and Derol. The genotypes J-80 (1718 kg/ha) and JB-1231 (1984 kg/ha) were found promising for pod yield than the check GJG-9.

• At Anand, 18 genotypes including three checks were evaluated under SSVT for pod yield. The genotype JB 1240 (2076 kg/ha) found significantly superior than the best check GJG-9 (1463 kg/ha), while under ZVT, 18 genotypes including 4 checks were evaluated for pod yield at Anand, Thasra and Sansoli. On the basis of mean pod yield, two genotypes ICGV-00429 (2461 kg/ha) and ICGV-97079 (2386 kg/ha) were found superior for pod yield than the check GJ-HPS-1 (1933 kg/ha).

At Anand, 18 entries including two checks were tested under PVT. Four entries viz., AG-2013-13, AG-2013-10, AG-2013-02 and AG-2013-03 were found significantly superior than the check GJG-9 (1909 kg/ha).

Crop Production

Summer groundnut

Higher pod yield of summer groundnut was obtained with application of RDF + FYM + bio-fertilizer + NOL (Natural Organic Liquid) drenching @ 500 l/ha + NOL foliar @ 50 l/ha spraying at 30 and 45 DAS.

Fibre Crops

Cotton

Crop Improvement

Hybrid Trials

Preliminary Hybrid Trial (H x B) comprising of 12 coded test hybrids (H x B) was conducted at RRS, Anand. Of these, hybrid 536 (1509 kg/ha) had the highest seed cotton yield followed by 541 (1464 kg/ha) and 534 (1394 kg/ha). Moreover, 10 coded H x B interspecific hybrids were evaluated under Coordinated Hybrid Trial (Zonal Trial). Of which, the hybrid 3175 (1870 kg/ha) yielded highest seed cotton yield followed by 3177 (1800 kg/ha) and 3179 (1759 kg/ha).

Varietal Trials

In deshi cotton (G. herbaceum) 17 different



trials including AICCIP, State and Station Trials were conducted for seed cotton yield performance at Viramgam, Dhanduka and Arnej centres. Eleven genotypes viz., G Cot 21 (2443 kg/ha), GVhv 684 (2436 kg/ha), GVhv 693 (2306 kg/ha), GVhv 673 (2223 kg/ha), GVhv 626 (2247 kg/ha), GVhv 666 (2155 kg/ha), GVhv 655 (2026 kg/ha), GVhv 684 (1955 kg/ha), GVhv 626 (1834 kg/ha), ADC-1 (1828 kg/ha) and GVhv 602 (1813 kg/ha) were found to be promising for seed cotton yield.

- 12 genotypes were evaluated under SSVT, out of which three genotypes GVhv 684 (1955 kg/ha), GVhv 693 (1864 kg/ha) and G Cot 21 (C)(1690 kg/ha) were found to be promising over the locations.
- 44 new crosses were made at Viramgam centre, during the year to develop deshi cotton varieties especially for fibre quality attributes.
 182 IPS were selected for fibre quality from 376 progenies from various generations (F₁ to F₆).

Crop Production

Research work on cotton production technology was carried out at Viramgam, Arnej, RRS, Anand and Thasra stations. At Viramgam station, three experiments were carriedout. The findings of the experiments are as follows:

- Different plant densities have significant effect on yield of newly released herbaceum cotton variety Anand Desi Cotton-1 (ADC-1).
- An application of nitrogen in the form of FYM / compost (100% RDN) and application of 75% RDN from fertilizer + 25% RDN from vermicompost were superior than 100% RDN from various organic sources 50% FYM

+ 25% vermicompost + 25% castor cake for yield and quality of cotton variety G Cot 21.

At Arnej station, two experiments carried out during the year viz. Response of cotton (ADC1) to nitrogen and sulphur under limited irrigated condition in *Bhal* region were vitiated due to heavy and continuous rainfall during monsoon and Response of Bt. Cotton to nitrogen and phosphorus under irrigated condition in *Bhal* region.

The results of two experiments conducted at RRS, Anand under irrigated condition were:

- Integrated nutrient management treatments viz., 75% RDN + 1.0 t castor cake, 75 % RDN + 10.0 t FYM/ha, 75 % RDN + 3.0 t vermicompost/ha and 75% RDN + 1.5 t vermicompost/ha + 0.5 t castor cake/ha are found responsive for obtaining higher yield of seed cotton in cotton- wheat crop sequence. Higher grain yield of wheat was obtained with the application of 75 % RDF + 10.0 t FYM/ha.
- Drip irrigation applied at 0.8 FPE recorded higher seed cotton yield in Bt. Cotton.

Experiment on cotton-castor relay cropping in goradu soil of middle Gujarat conditions was conducted at Thasra station.

Plant Protection

Studies were conducted on population dynamics of key pests of cotton, surveillance of lepidopterous pests through sex pheromone, survey of insect pests in *Bt* as well as Non *Bt* cotton and screening of deshi cotton varieties for their resistance to key pests under rainfed condition.

Survey was made of diseases of deshi as well as *Bt* cotton and screening of deshi cotton



varieties for resistance to various diseases under • rainfed condition.

Cash Crops

Bidi Tobacco

Kharif-2013

Crop Improvement

- Under AVT-1, 9 genotypes were evaluated for root-knot disease and cured leaf yield. The entries ABD 119 and ABD122 were found to be showed significantly superior for cured leaf yield over both checks GT 5 and GT 7. Line ABD 120 was found tolerant to tobacco mosaic.
- Under varietal trial for normal planting, the cured leaf yield differences were significant. The entry ABD 146 was found to be significantly superior for cured leaf yield over GT 7.
- In hybrid *bidi* tobacco trial, the cured leaf yield differences were significant. Three hybrids BTH 315, BTH 318 and BTH 322 gave significantly higher yield over check MRGTH 1.

Crop Production

Under crop production 11, experiments were conducted during the year and following outcome of experiments emerged.

- Effect of irrigation and topping levels on Variety ABT 10 and GABT 11, 0.9 IW/CPE ratio and topping at 18 and 24 leaves is better for yield.
- The highest yield and least weight of Orobanche in variety MRGTH 1was observed under surface irrigation as compared to all the drip irrigation treatments.

- Research work on effect of different planting dates and long term manuring on yield and quality of different varieties of bidi tobacco was carried out.
- Covering of 90 % green net gives higher germination count and maximum number of transplantable seedlings/m2 in nursery.
- Cropping sequences for bidi tobacco were tried and Tobacco – Pearlmillet (summer) cropping sequence was found better.
- Work on drought tolerance in bidi tobacco genotypes under different moisture regimes was carried out.
- Screening of drought tolerance genotypes using PEG 6000 was carried out.
- Pendimethalin @ 0.45% + 2 % urea just after
 topping controlled the axillary as well as
 ground suckers and gave highest yield than
 hand desuckering in variety GT 7.
- Biological means (AAU PGPR consortium as root dipping and soil application) works as good as physical means (spear and hand desuckering) for management of Orobanche in bidi tobacco.

Plant Protection

In biditobbaco research, the field experiments on monitoring of resistance development in Pythium spp. to metalaxyl MZ, screening for resistance to damping off disease, severity and evaluation of fungicides for frog-eye spot disease are in progress. Similarly, screening for resistance to RKN and effect of seeding period on occurrence of RKN is also carried out.



• The importance of Entomophage diversity in management of pests in different crops was demonstrated. The association of various weather parameters with various biocontrol agents was determined. In addition to this, population dynamics of important pests of tobacco has been studied during the year.

Forage Crops

Crop Improvement

A total of 14 trials were successfully conducted under Main Forage Research Station, Anand.

Rabi-2012

OAT

- Under IVT, 16 entries were evaluated (single cut) including 3 checks. The yield differences were found significant. The entry IVTOSC-3 produced significantly higher GF (909 q/ha) and DM (160.9 q/ha) yield. For per day productivity, entry IVTOSC-17 ranked first for GF (13.03 q/ha/day) and DM (2.09 q/ha/day) yield.
- 12 entries were evaluated under Advance Varietal Trial-I (Single cut). The genotype AVTOSC-1-14 gave significantly higher GF yield (667 q/ha), while, the entry AVTOSC-1-1 ranked first by producing significantly high DM (119.6 q/ha) and CP (13.29 q/ha) yield.
- Under Advance Varietal Trial-II, 12 genotypes were evaluated. The entry AVTOSC-2-14 produced significantly higher GF (601 q/ha), DM (93.8 q/ha) and CP (9.85 q/ha) yields. Same entry also gave the highest per day productivity of GF (6.91 q/ha/day) and DM (1.08 q/ha/day) yields.
- In IVT Oat (Multicut), two cuts were

harvested and the genotype IVTOMC-4 produced significantly higher GF yield (628 q/ha) as well as highest per day GF yield (6.41 q/ha/day), while, the entry IVTOMC-2 gave the highest DM yield (88.4 q/ha/day) as well as highest per day production of DM (0.88 q/ha/day). The entry IVTOMC-9 gave highest CP yield (12.80 q/ha).

Lucerne

- Under varietal trial in Lucerne (Perennial) 4thyear, seven cuts were harvested within a period of 303 days. The entry LP-10-9 gave the highest GF (433 q/ha), DM (91.5 q/ha) and CP (20.95 q/ha) yields. This variety was also identified for North West Zone of India by the variety Identification Committee in Annual Group Meeting of AICRP on Forage Crops held at JNKV, Jabalpur during September 7-8, 2013.
- Under varietal trial in Lucerne (Perennial) 3rd year, eight cuts were harvested within a period of 327 days. The pooled data revealed that the entry VTL-11-9 showed significantly higher GF (493 q/ha), DM (109.5 q/ha) and CP (23.72 q/ha) yield as well as highest per day production of GF (1.51 q/ha/day) and DM (0.33 q/ha/day) yields.

Barley

20 genotypes were evaluated for yield under IVT. The entry IVTRISDP-5 was found significantly superior for GF (136. q/ha) and DM (22.8 q/ha).

Kharif-2013

Sorghum

The yield differences were found to be significant in 12 genotypes of Forage

Sorghum (SC) under LSVT. The entry SRF-283 stood first by producing significantly higher GF (356 q/ha), DM (99.7 q/ha) and CP (7.08 q/ha) yields.

• Under Preliminary Yield Trial, 7 entries including checks were evaluated for forage yield. The entry AFS-50 was found significantly superior for GF (219 q/ha), DM (56.4 q/ha) and CP (4.49q/ha) yields than check variety SSG-59-3 GF.

Maize

• In IVT, significant differences among the entries were observed for green forage yield. The entry IVTM-5 had produced significantly higher green forage yield (393 q/ha), dry matter yield (80.5 q/ha) and crude protein yield (4.37 q/ha) as compared to check African Tall.

Pearl Millet

 Under IVT, 9 entries were evaluated for yield performance in Forage Pearl millet. The entries IVTPM-9, IVTPM-7 and IVTPM-1 were found significantly superior for GF (647 q/ha), DM (109.9 q/ha) and CP (13.08 q/ha) yield, respectively.

Cowpea

 9 entries were evaluated for yield in Forage Cowpea under IVT. The entry IFC-7 was found significantly superior for GF (470 q/ ha), whereas the entry IFC-4 was found significantly superior for DM (68.4 q/ha) and CP (9.24 q/ha) yields.

Crop Production

In the reporting year 6 experiments were

conducted for enhancement of fodder production. The outcome for these experiments is:

- The combination of *Cenchrus ciliaris* + *Desmanthus* grown in ridge and furrow techniques was found effective for higher total GF, DM and CP yields than flat bed techniques.
- Performance of dual purpose pearl millet variety GFB-1 was found to be good at different cutting management practices and 150 % RDN.
- Highest GFY, DMY and CPY and maximum Plant height and number of tillers per plant were found in unshaded condition, while leaf stem ratio was found maximum in shaded condition.
- Dual purpose oat recorded higher GFY, DMY and CPY when cut at 70 DAS.
- Higher GFY, DMY, CPY, DM %, CP % and number of tillers per meter row were observed with application of 160 kg N/ha and 60 kg P_2O_5 /ha in multicut sorghum *Cv*. CoFS-29.

4.3 Horticultural Crops

Vegetables Crop Improvement Kharif – Rabi: 2012-13

Brinjal

In brinjal crop, 8 experiments were conducted, which include 5 varietal trials and 3 hybrid trials. Among various genotypes tested, AB-09-1, ABH 10-8, AB 12-8, AB-12-2, AB-12-10, ABH -12-8 and AB-12-1 were found promising for fruit yield.



For heterosis breeding, 12 fresh crosses were made. Total 227 germplasm were evaluated and maintained. 189 segregating progenies were evaluated and individual plant selection was made for the next year. 20 bulks were assorted for PET.

Chilli

- Three varietal trials and four hybrid trials were conducted in chilli. In these trials 87 genotypes were evaluated. The genotypes ACS -08-9, ACS -07 -10, ACS -10-6, ACS -06-1, ACS -10-7, ACH- 716, ACH- 801 and ACH- 707 were found promising for fruit yield.
- 191 germplasm lines were maintained. Fourteen crossed were made for hybrid evaluation. 278 segregating progenies were evaluated and individual plant selection was made for the next year. Total 27 bulks were assorted for PET.

Tomato

- In tomato, 11 experiments were conducted that include five varietal trials, three hybrid trials and two resistant breeding trials. Among 123 genotypes tested, the genotypes found promising for fruit yield were ATL 08-21, ATH-307, ATH-309, ATL 10-04, ATH-3, ATH-2, ATL-11-11, ATL-11-08, ATH-334, 2012-TODVAR-6, 2012-TOLCVRES-1 and 10-TODHYB-10.
- Total 101 germplasm lines were maintained and evaluated. 44 fresh crosses were made for hybrid evaluation. 112 progenies of segregating materials were evaluated and individual plant selection was made for the next year.

Summer: 2013

Cucurbit Vegetables

Five experiments in bottle gourd were conducted including 49 genotypes. Out of these, the entries 2012/BOGVAR-5, 10 / BOG VAR-5, 2011/BOG HYB-3, 2011/BOG HYB-5 and 2011/BOG HYB-10 were found promising for fruit yield. Moreover, six crossed were made for hybrid evaluation in bottle gourd.

Kharif: 2013

Okra

- Total eight experiments were conducted, which include four varietal trials, two hybrid trials and two resistant breeding trials. Among 134 genotypes tested, the entries AOL 09-02, AOL 10-22, AOH 10-01, AOL 12-59, AOL 13-75, AOL 13-95, AOL 13-89, AOL 13-92, AOL 13-96, AOL 13-140, AOL-13-139 and AOL 13-136 were found superior than their respective checks for fruit yield tolerant to YVMV.
- For heterosis breeding, 14 crossed were made for hybrid evaluation trial. Total 642 germplasm were maintained, which comprised 100 new accessions added by collection from local area and procured from other institutes.
- More than 619 progenies of segregating materials were evaluated and individual plant selection was made for the next year. Total 72 bulks were assorted for preliminary evaluation trials.

Cucurbit Vegetables

Two trials in sponge gourd, three in ridge gourd, two in bottle gourd and one in pumpkin



crops were conducted during Kharif -2013. These eight experiments included total 68 entries of cucurbits for evaluation of yield and quality performance.

• The genotypes ASGS-06-30, ASGS-04-23, 2011/SPGVAR-3, 2011/SPGVAR-4 and 2011/SPGVAR-2 of Sponge gourd; 2012/RIGVAR-2, 2012/RIGVAR-1, 2012/RIGVAR-3, 2011/RIGVAR-4 and 2011/RIGVAR-8 of ridge gourd; ABGH 8-8, ABGH 8-1, ABGS 11-24 and ABGS 11-23 of bottle gourd and 10/PUMVAR - 4 of pumpkin were found promising.

Crop Production

- In cabbage-okra sequence, cabbage grown in rabi season recorded the highest cabbage yield with application 100 % RDN from chemical fertilizers, while application of 100 % RDN from recorded the highest green pod yield of summer okra.
- An application of 100 % RDN from NADEP fortified with castor cake and bio-fertilizer gave higher green fruit yield of tomato.

Plant Protection

Total nine different other agency projects are going on at Main Vegetable Research Station, Anand sponsored by various agencies, in which various new molecules/ products are being tested.

Screening of garlic cultivars for their resistance to thrips incidence is regularly carried out in various breeding trials at Dahod.

Medicinal and Aromatic Plants

Crop Improvement

Ocimum Spp.Z

• Under varietal trial, 17 genotypes were tested

and significant differences due to genotypes for green leaf and oil yield were observed in ocimum spp. Among all the genotypes, T-10 (Basil) was found superior and out yielded 89.59 % higher green leaf yield (579.27 Q/ ha) than T -17 (Basil check 1) and 95.22 % higher than T - 18 (Basil check 2). Similarly, T 10 exhibited outstanding performance and recorded 148.70 and 43.75 % higher oil yield than T-17 (C-1) and T-18 (C-2).

Asalio

Eight entries were evaluated for seed yield under IVT, where, maximum seed yield was recorded by the genotype ALS 6, followed by MLS- 1016 and ALS-1, whereas, for oil yield, T-1 was found superior with higher oil content (25.14 %).

Crop Production

During the report period, seven experiments were conducted successfully. The outcome of these experiments was:

- An application of 10 t FYM/ha produced higher dry biomass of Dodi (*Leptadenia reticulata*).
- Irrigation scheduling at 0.8 IW/CPE ratio achieved higher dry biomass of Dodi.
- The maximum dry biomass yield of bhumi amalaki (*Phylunthus ftraternus*) was obtained when sown in the 1st week of July.
- Sowing of vernonia in the 1st week of October with 45 cm spacing between row for securing higher seed yield.
- An applivation of RDF + FYM + bio-fertilizer
 + NOL drenching @ 500 l/ha. + NOL foliar
 @ 50 l/ha spraying at 30 and 45 DAS gave
 higher seed yield of *rabi* fennel.

Fruit Crops

Crop Improvement

Mango

During 2012-13, 1083 crosses were attempted at Horticultural Farm, Anand, using 7 parents (Amrutang, Vanraj, Amrapali, Mallika, Totapuri, Vaso and Cheratapuji Goa) for four traits (skin colour, short stature, Quality and Earliness) and of these, 325 crosses produced fruits successfully. 10 cross combinations attempted were Amrutang x Vanraj, Amrutang x Amrapali (Fruits set-2), Mallika x Amrutang, Amrapali x Amrutang (36), Totapuri x Amrutang (58), Totapuri x Vaso (17), Totapuri x Cheratapuji Goa (2), Amrapali x Cheratapuji Goa, Mallika x Cheratapuji Goa and Amrutang x Cheratapuji Goa, whereas fruits were set in only 5 cross combinations as above.

Guava

Crossing Programme

• The crosses between Seedless x Allahabad Safeda , Seedless x Lalit, Seedless x Sweta, Seedless x L-49 and L-49 x Lalit were attempted to combine important traits in a new variety.

Germplasm Collection programme

• A Field exploration tour was conducted on 14th December 2013 for collection of local germplasm of guava from Ahmedabad district. The details are as under.

Sr. No.	Accession	Co- lour of pulp	Characteristics
1	AGWS-13-1	White	Pear shape
2	AGWS-13-2	White	Small, roundish, sweet in taste, soft seeded
3	AGWS-13-3	White	Small, smooth skin, less seeded
4	AGWS-13-4	White	Pear shape, big size, rough skin, sweet in taste
5	AGWS-13-5	White	Roundish, less seeded, sweet in taste
6	AGWS-13-6	White	Pear shape, medium size
7	AGRS-13-1	Red	Roundish, big size and hard seeded
8	AGRS-13-2	Red	Roundish, red colour of flesh beginning from unripen stage, soft seeded
9	AGRS-13-3	Red	Roundish and big size
10	AGRS-13-4	Red	Pear shape

The seeds of the fruits were extracted and sown in the pots for further advancement and maintenance.

Custard Apple

- At Horticulture farm, six crosses were attempted including reciprocal *i.e.* Balanagar X Sindhan, Balanagar x Anand Selection-1, Anand Selection-1 x Balanagar, Anand Selection-1 x Sindhan x Balanagar, Sindhan x Anand Selection-1. Total 87 fruits were harvested from above crosses.
- The seeds of the fruits harvested from the crossing were sown in the nursery for seedling development and later on 521 plants of these crosses were transplanted in the field.



Crop Production

Experiments on different fruit crops carried out during the year and results of some are depicted below.

- Maximum number of fruits/plants and fruit yield per hectare was recorded in irrigation at 0.8 PE fraction and fertilized with 100% RD of NPK in sapota cv. Kalipatti.
- Maximum tree canopy (E-W) was recorded in the variety Anand Selection-2 compared to variety Anand Selection-1 and GJCA-1 in custard apple.
- The experiments on effect of chemical fertilizer and organic manures in high density planting system on growth, yield and quality of Banana cv. Grand Naine, Assessment of Natural Organic Liquid (NOL) and inorganic nutrient supply system on yield and quality of banana cv. 'Grand Naine' and Effect of plant growth regulators on rooting and survival of stem cutting of pomegranate (*Punica granatum* L.) cv. Bhagvo and G-137 are in progress.

Floriculture

Crop Production

- Higher vegetative growth and flower yield of jasmine (*Jasminum sambac* Ait) cv. 'Double' were obtained with application of Nitrogen @ 75g /plant and Phosphorus 40g /plant, while maximum shelf life of flower (43.24 hours) was observed with application of Nitrogen @ 25 g/plant.
- Effect of plant growth regulators on growth, flowering and flower yield of *Deshi* Red Rose (*Rosa damascena* L.) is in progress.

4.4 Pesticide Residues, Agril. Ornithology, Plant Protection and Micronutrients Pesticide Residue Laboratory

In order to study dissipation pattern of triazophos and profenophos in okra and brinjal, estimation of pesticide residue in agricultural commodities (vegetables, fruits, spices, pulses, milk and milk products), soil and water and determination of status of pesticide contamination in surface and ground water in Narmada command area, various field and laboratory experiments were carried out. Based on the experiments, it was found that the pre-harvest interval (PHI) of acephate 75 SP, profenophos 50 EC and triazophos 40 EC in/on okra could be suggested as 10, 5 and 5 days, respectively.

Agril Ornithology

Work on avian community structure in various crops, food habits of predatory birds, breeding performance of Indian Sarus crane and mapping of breeding sites of painted stocks, evaluation of nest box designs for various cavity nesters, screening of botanical products against depredatory birds, conservation and management of depredatory as well as predatory birds and mortality of key bird fauna due to pesticide poisoning is in progress. In addition to the above, awareness programme to farmers and extension workers about the importance of birds in agricultural landscape, documentation of wetland biodiversity, monitoring of breeding activity of Flamingos in Rann of Kachchh and evaluation of birdrepeller and acoustic devices to scare birds are also of prime importance in the field of Agril. Ornithology. Recently, a new technical programme on monitoring of wild boar population in agricultural landscape has been formulated as it is gaining importance day by day in middle



Gujarat region. Experimental data revealed that in middle Gujarat, 16 and 21 insectivorous bird species are occurring in cabbage and mustard crop, respectively which mainly feed on aphid, *Lipaphis erysimikalt* and hence these birds should be encouraged as bio control agents.

Biocontrol

Biodiversity of biocontrol agents in various agro-ecological zone, seasonal abundance of predatory spiders in rice ecosystem, evaluation of biocontrol agents against mango hoppers, large scale demonstration of bio-intensive pest management technology for tomato fruit borer and isolation, identification as well as characterization of indigenous stains of biocontrol agents for management of plant diseases, in addition to bioefficacy of Met-52 EC (*Metarhizium anisopliae*) as biocontrol agent and Jumpstart, Optimize 400 as well as Taegro (microbial product) have been evaluated on different crops under the sponsored projects.

Agril. Entomology, BACA, AAU, Anand and Vaso

Work on trapping of various lepidopteran pests in different types of traps, evaluation of insecticides against major pests of various field crops (blackgram, wheat, castor, mango, paddy, brinjal), screening guava varieties for their resistance to major insect pests, foraging activity of honey-bee on important crops of middle Gujarat and determination of number of pheromone traps for mass trapping of targeted insects in brinjal are in progress.

Studies of biodiversity of insect fauna through light traps and population dynamics of major insect pests through pheromone traps are operated at College of Agriculture, Vaso district-Kheda.

Plant Pathology, BACA, AAU, Anand

Identification of source of resistance in vegetable crops for certain diseases, monitoring of seedborne diseases, determination of host-range of bean common mosaic, standardization of biopriming for seed borne diseases and management of early blight of potato in addition to facilities for mushroom cultivation and studies on epidemiology and management of yellow mosaic virus of pulses and vegetable crops have been strengthened.

Micronutrients

The following research works/experiments were conducted during the year.

- Reassessment and delineation of micro- and secondary nutrients deficient or toxic areas
- Nutrient indexing of micro- and secondary nutrients deficiency in rice-wheat growing area of middle Gujarat
- Role of organic manures in maintenance of micronutrient status under continuous cropping in loamy sand soils of Anand
- Refinement of critical values of micro and secondary nutrients in soils and standardization of soil test methods
- Study on Evaluation / Standardization of AB-DTPA, a multi- nutrient extractant for analysis of major, secondary and micronutrients as well as heavy metals with established standard methods
- Effect of phasing of Zn application on fate of Zn pools in maize-wheat cropping system in loamy sand soils of middle Gujarat
- Effects of soil micronutrient content on animal-human health
- Biotitic effects of heavy metals on animal-



human health

- Survey of physiological disorder in Bt. cotton
- Understanding the mechanism of variation in status of a few nutritionally important micronutrients in some important food crops and the mechanism of micronutrient enrichment in plant parts
- National project on management on soil health & fertility-Preparation of GPS and GIS based soil fertility maps for selected districts of the country

4.5 Centre For Plant Biotechnology

Rice (Oryza sativa)

 Molecular characterization of aerobic rice through 23 RAPD, 9 ISSR and 14 SSR markers was carried out. In both SSR and ISSR, IET-19879 and IET-20966 showed highest molecular level similarity. Among three marker systems, SSR was found the most informative for characterization of aerobic rice and three markers RM201, RM213 and RM315 amplified genotype specific amplicons, which are useful for hybridization programme.

Castor (*Ricinus communis*)

- Molecular characterization of 17 important genotypes of castor using 13 SSR primers was carried out. Average PIC value of 0.76 was observed. Two genotypes ANDCI-10-1 and SKI-125 were found most diverse and can be exploited in castor breeding programme.
- Study was carried out to identify and characterize low ricin containing castor genotypes using genomics and proteomics tools. In order to determine ricin synthesis

stage during seed development, developing seeds were collected at 20 days after pollination (DAP) and 60 DAP. Ricin was absent in seeds until 25 DAP. Highest ricin was observed in ANDCI-1 (54.3 ng/mg of protein). Gene sequence analysis of ricin producing putative gene has shown that there is remarkable variation between sequence of high and low ricin containing genotypes. The results are presented as under.



SDS PAGE profile of ricin in different castor genotypes

Isabgol (Plantago ovata)

- With financial support from GSBTM, the department completed whole genome sequencing of isabgol (*Plantago ovata*L) through Roche-454 Next generation sequencing platform. The Incremental worth of data came in range of 850 to 1000 Mb which is almost 2x coverage of the genome. A total of 3447 contigs were assembled and were used to generate 249 SSRs.
 - First time, developed and validated 30 genomic SSR in isabgol and exploited for cross species amplification to examine relationship in *Plantago spp.*





• Phenotypic and molecular marker (10 SSR and 15 RAPD) based characterization of six selected species of Plantago with emphasis on *Plantago ovata*. The results of this study indicated that molecular markers are highly discriminatory, more precise, and more reproducible than morphological traits used to estimate genetic relatedness among Plantago accessions.

Pearl millet (Pennisetum glucum)

- Transcriptome sequencing of downy mildew resistant and susceptible genotypes through 454 pyrosequencing yielded 680 Mb data and identified several genes related to resistance including hypersensitive induced protein, MYB, WRKY transcription factors, signaling molecules like MAPKKK, 14-3-3 proteins, CDPK, pathogenesis related proteins and defence related genes. Results indicated that hypersensitive response and systemic acquired resistance were primarily involved in defence response in pearl millet against downy mildew.
- Developed and validated a set of 230 SSR

and 20 SNP markers using Next generation sequencing transcriptomics data. The primers can be used to enrich and saturate the present SSR based linkage maps for QTL mapping.

Cotton (Gossypium spp)

- Identified molecular markers linked with genes for fiber. Amplified, validated and sequenced SSR markers associated with fibre related genes from tetraploid into diploid cotton(*G. arboreum*). These markers can be used in cotton breeding for fibre quality improvement.
 - A set of 50 SSR were synthesized from expressed sequenced tags (EST) of different *Gossypium* species and validation of SSR is in progress.
- Development of EST-SSR markers for fibre quality in diploid cotton (*G. herbaceum*) is going on. For this, ovule samples [0, 7, 14 and 21 days after anthesis (DPA)] from variety G cot 13 were collected and RNA was extracted by CTAB method. Transcriptome sequencing was done by Roche-454 pyrosequencing method at ORF (Ome Research Facility), *De Novo* sequence assembly is in progress using various assemblers (Trinity, CLC, Nebuliser and Coupler).

Maize

For mapping of QTL associated with drought tolerant related traits during seedling stage in maize, parents CML 425 (drought tolerant) and V351 (drought susceptible)] and F_1 are at seedling stage in poly-house to get self seeds for development of F_2 mapping population.



SSRs have been procured to detect true F_1 heterozygote for mapping population development.

Cumin (Cuminum cyminum)

• First time, amplified and validated a set of 17 (34%) SSRs of carrot in cumin through cross transferability analysis, which is being used for variability analysis in cumin germplasm.



A gel image showing SSR markers amplification patterns in cumin (GC-4)

Tulsi (Ocimum spp):

- Detection of genetic variation in Ocimum 17 Ocimum genotypes belonging to five different species (*O. basilicum, O. amaricanum, O. sanctum, O. gratissimum and O. polystachyon*) through 20 RAPD and 12 ISSR markers.
- Many unique species-specific alleles were amplified by RAPD and ISSR markers. In both marker systems, maximum number of unique alleles were observed in *O. sanctum*. Species specific bands were also detected, which can be converted in SCAR markers.

Allele mining for colour & fragrance principle of Saffron and Sandalwood

• Department has been successful in inducing flowering in saffron under controlled environmental conditions in glass house.



• Identified and isolated genes involved in colour principles of saffron.





Molecular variability analysis in a set of 20 genotypes of sandalwood was carried out using RAPD. SSR primers developed in related santalum species was also amplified for cross species transferability and polymorphism study. However, no polymorphic SSR was detected in this study.

Centre for DNA Fingerprinting in Crops and other Bio-inputs in Agriculture

- Robust and polymorphic markers were selected for generating successful DNA fingerprints.
- A total of 42 SSR, 48 ISSR and 213 RAPD markers were used for generating 54 crop specific DNA fingerprints.
- DNA fingerprinting profiles of 54 crop varieties have been generated.



Summary DNA Fingerprints of various crops using different Marker system

Sr.	Crops	Number of varieties	Fingerprints		
No.			SSR	ISSR	RAPD
1	Green Gram	02	-	08	32
2	Dill Seed	01	-	08	60
3	Brinjal	02	10	08	60
4	Lucern	02	-	-	21
5	Rice	22	12	14	10
6	Chilli	08	10	-	10
7	Tobacco	08	10	-	-
8	Maize	04	10	-	10
9	Cotton	05	-	12	10
	Total	54	42	48	213

Research Centre for distant hybridization in Field and Fruit crops

	Number of germplasm lines collected under the project in different crops							
Sr. No.	Сгор	Wild	Cultivated	Sr. No.	Сгор	Wild	Cultivated	
1	Okra	116	24	09	Bottle gourd	-	03	
	Cotton	09	39	10	Smooth gourd	-	07	
3	Pumpkin	-	05	11	Bitter gourd	-	06	
4	Brinjal	02	-	12	Cow pea	-	04	
5	Mung bean	01	-	13	Chilli	-	03	
6	Citrulla	02	-	14	Sheriya	-	06	
7	Parvar	01	02	15	Bijoru (citrus)	-	01	
8	Tomato	25 (Cherry Type)	02	16	Custard apple / Reticulata/Cheri-moya/ Attimoya	-	12	

Number of useful germplasm lines identified for gene introgression

Sr. No.	Сгор	Species / line	Trait to be introgressed
1	Okra	<i>Abelmoschus moschatus subsps tuberosus</i> IC No. IC 470750, IC No. IC 413569	YVMV resistance
2	Desi cotton (<i>G. arborium</i>)	PA 255, AKA 8401	Fibre quality
3	Tomato	<i>S. esculentum var. cerasiforme</i> EC 589496	Lycopene content
		S. chilense(WIR- 5032)	Tolorongo for TLCV
		Cherry type (ATL-10-9)	

Number of interspecific crosses attempted

Sr. No.	Сгор	Cross attempted	Trait to be introgressed
1	Okra	18	YVMV resistance
2	Tomato	47	TLCV and Quality
3	Cotton	111	For fibre quality and yield
4	Custard Apple	04	For quality and shelflife improvement





A.tuberculatus





Germplasm lines of different crops

Plant Tissue Culture

a) Date palm:

- Tissue culture raised local elite date palm plantlets were supplied to CIAH, Bikaner, CAZRI, Jodhpur and SDAU, Mundra station for field demonstration and performance evaluation.
- Successful primary hardening of 500 Barhee plantlets has been done and is currently undergoing secondary hardening.
- Initiation of new cultures from offshoots of local elite trees from Kutchh has been done.
- Protocol refinement for early callus induction
 was carried out, among which offshoots
 collected during the month of November –
 December showed good response in terms



of proliferation and callus initiation as compared to offshoots collected during later season i.e. January to March. Effect of liquid culture media on callus induction was also attempted and is currently under progress.

• Different offshoots of known genotypes like yakubi, medjool etc. were procured from SDAU, Mundra station as well as farmers field and successfully established *in vitro*.

b) Bamboo:

• Axenic cultures of bamboo with long internodes distance have been successfully



Callus induction in date palm explant



Callus multiplication in date palm cultures

concern in sandalwood tissue culture, and therefore, experiments were carried out for the defoliation control in new and established axenic cultures. The cultures exposed to TIBA showed the least degree of defoliation rate as compared to other treatments.

Nanotechnology

Green synthesis of silver nanoparticles using plant leaf extracts has been carried out and sunlight mediated silver nanoparticles synthesis was found to be best among all the treatments.



Date palm plantlet growth and development



Mass multiplication of *in vitro* date palm plantlets



Date palm plantlet undergoing primary hardening



Secondary hardening of date palm plants



Sandalwood

• established *in vitro* and effects of different plant growth regulators for multiple shoot induction and rooting have been studied.

c) Sandalwood:

- i) Defoliation of leaves has been a major
- Comparison of different surface sterilization treatments including antimicrobial agents and silver nanoparticles was repeated (combinations of concentration and duration) for sandalwood and banana explants. The results revealed the superiority of the treatments of 50 mgl⁻¹ concentration



for 60 mins and 100 mgl⁻¹concentration for 100 mins. for sandalwood and banana, respectively.

- Effect of silver nanoparticles for controlling defoliation rate was studied. Among different treatment combinations tested, phytagel combined with silver nanoparticles (<150 nm) was found to be effective in reducing the defoliation of *in vitro*.
- Effect of nano-zinc application on seedling morphological parameters of rice variety Jaya was studied, as well as comparison of different combinations of bulk and nano zinc was carried out during seed germination test. Zinc in nano form at lower concentration was found to be growth stimulatory as compared to higher as well as bulk particles.



Sunlight mediated homogeneous silver nanoparticle (Size 65 nm)





Effect of silver nanoparticles in controlling (a) defoliation in sandalwood (b) contamination in banana cultures



4.6 Planning and Monitoring Agricultural Research and Education

Planning and development committee was constituted as per common statutes for Agricultural University of Gujarat, 2011 under section-III of statutes No. 48 to 51.

- The financial provisions made by project in-charge are scrutinized, compiled and prepared in plan budget and are put up in Finance committee and Board of Management. Thereafter, they are submitted to Government of Gujarat for provision in the Budget year 2013-14.
- An Annual plan of Rs.7786.59 Lakh was approved by Government of Gujarat for Agricultural Research and Education. The detail provisions of grant are as under.

Head	On going	New Item	Total
Education	3369.74	1110.45	4480.19
Extension Education	505.20	26.40	531.60
Research	2070.02	694.78	2764.80
IT	10.00	0.00	10.00
Total	5954.96	1831.63	7786.59

(₹ in Lakh)

- Three review meetings were conducted in August, 2013 January and March, 2014 to monitor the expenditure. After each review meetings, grants were realloted as per the demand and utility in the project.
- Quarterly and annual progress report of plan schemes were prepared and submitted to Government of Gujarat.
- Legislative Assembly Question (LAQ), Rajyasabha Starred Question (RSQ) and Legislative Starred Question (LSQ) raised during the year have been compiled and also

submitted to Government.

All plan and non-plan projects have been reviewed by the committeee chaired by Dr Satybrata Maiti during 21-22 November, 2013. The required modifications have been done by following University procedure.

Indian Council of Agricultural Research (ICAR) Development Grant

"Strengthening and Development of Agril. Education in SAUs"

The demand of ₹ 1245.93 lakhs for Strengthening and Development of Agricultural Education in SAUs was submitted to Indian Council Agricultural Research (ICAR) as per the demand received from the Principals/Deans of colleges.

The grant of \gtrless 579.00 lakhs was released by the ICAR in four installments for "Strengthening and Development of Agricultural Education in SAUs".

"Library strengthening of Agricultural Universities"

The demand of ₹ 104.00 Lakhs for "Library strengthening in Agricultural Universities" was submitted to Indian Council Agricultural Research (ICAR) as per the demand received from the University Librarian. The grant of ₹ 60.00 lakhs was released by the ICAR for "Library Strengthening in Agricultural Universities" Annual Utilization Certificate (AUC) of said grant was submitted to the ICAR, New Delhi for the financial year 2013-14.

Half Yearly and Annual Progress Report were submitted to ICAR as per the activities carried out during the year.

4.7 Water Technology

Considering the importance of irrigation in



Agriculture, Agricultural Research Station for irrigated crops, Thasra, conducted some experiments as under:

- Fertigation in sweet corn, wherein different combinations with different levels of fertilizers were used in drip irrigation to find suitable best combination of fertilizers for sweet corn variety.
- Cotton is main crop of this region and hence experiment has been initiated to ascertain best possible method of irrigation in Bt. cotton.
- An experiment on nitrogen management has been initiated in *rabi* drilled fennel under drip irrigation, with a view to finalize nitrogen for the crop under drip irrigation.
- Performance evaluation of guava under drip irrigation is also continued at Thasra.

Apart from these, some experiments on nutrient management through fertigation in fruit crops have been initiated by Department of Horticulture, BACA, Anand. Results are awaited and will be presented after completion of experiments.

Extension and demonstration schemes for irrigation funded by Sardar Sarovar Narmada Nigam Limited at sub centers of Anand Agricultural University viz. Thasra, Dhandhuka, Dabhoi, Khandha, organized 68 training programmes on campus and off campus on the subject of irrigation scheduling, method of irrigation and related aspects. In all, 2170 farmers attended the training programme.

4.8 Agricultural Rural Development Studies

Rural development programme revolves around raising economic and social level of the rural people as the main objective. Research in context with above said objectives can throw some light in the direction of bringing rural development. Keeping this in view, research in extension education is conducted in the broad areas of adoption and diffusion of innovations, transfer of technology, role of mass media in dissemination of technology, impact of different programmes and centres on rural development, communication behavior of rural people/farmers, bench mark surveys etc.

During the year, bench mark surveys (especially in terms of socio economic status) were carried out by Training Center, Jabugam, Dairy Vigyan Kendra, Vejalpur Pashu Vigyan Kendra, Limkheda (D'baria) and Farm Technology Training Centre, Sansoli. Effort was also made to assess the training needs of the farmers so that pertinent training modules for the respective can be developed.

4.9 Agri-Business Development

BPD Unit was established,

- To accelerate agri-business technologies development and canvassing to private organizations under PPP and by that creating agribusiness environment.
- To provide services for R & D to potential and existing entrepreneurs for setting up own units with services like consulting, training and advice for contract farming etc.
- To promote new technologies on verge of completion, new varieties and hybrids of crops developed at AAU for commercialization.

Work carried out

- Area Specific Mineral Mixtures Technology commercialized to Prakriti Biocare, Thiruvananthapuram on 7th May, 2013.
- Biodiesel technology commercialized to United



Phosphorus Limited (UPL), Mumbai during Vibrant Gujarat Summit on 10th September, 2013.

• Technology for production of Ready-to-Puff Rice commercialized to Pushaki Impex Private Limited, Ahmedabad on 8th January, 2014.

Other Indicators:

- a. MoU with CIIE (IIM), Ahmedabad during Vibrant Gujarat 2013: Anand Agricultural University (AAU), Anand and Centre for Innovation, Incubation and Entrepreneurship (CIIE) Initiatives IIM Ahmedabad have signed an MoU to promote business incubation in their respective areas through mutual collaboration.
- MoU with EDI, Gandhinagar during
 Vibrant Gujarat 2013: Anand
 Agricultural University (AAU), Anand and
 Entrepreneurship Development Institute
 (EDI), Gandhinagar have signed an MoU to
 promote Entrepreneurship through mutual
 collaboration.
- c. Anand Agricultural University signed MoU with Central Potato Research Institute (CPRI), Shimla for "Heap Storage Technology with the use of CIPC (EC)".
- d. International MoU: Anand Agricultural University signed MoU with Food Development Centre (FDC), Gov. of Manitoba, Canada in the area of "Development of Food Processing Technologies and Products" during Vibrant Gujarat Global Agriculture Summit-2013 on 10th Sep, at Mahatma Mandir, Gandhinagar.
- e. Anand Agricultural University signed an MoU with Rural Development Foundation (RDF), Anand through BPD Unit for "Training

& Capacity Building" on 7th May, 2013. As per MoU, AAU scientists will train the trainers of NGO RDF in small holder's agriculture, dairy farming and organic farming etc. Other offerings included inviting RDF beneficiaries to technology shows of BPD Unit, business incubation support, Entrepreneurship Development Programs (EDPs), Consultancy, Supporting and Promoting entrepreneurship.

Other Institutes' Technologies Commercialized

AAU BPD Unit being Western India's lead project has supported other institutes (4), state Agricultural Universities and ICAR Institutes in commercializing their technologies.

- "Organic liquid fertilizer from banana pseudo stem sap" technology of Navsari Agricultural University was licensed to Green Globe Biotechnologies, Chopda (MH) and Blossom (Surat).
- "Browning free custard apple pulp storage" technology of Maharana Pratap University of Agriculture and Technology (MPUAT) was licensed to Santram Ice Cream and Snacks, Anand and Deep Fresh Frozen Products, Navsari.
- "Omega-3 oil and soft gel technology" of Bharati Vidyapeeth University, Pune was licensed to Tasty Food Products, Pune and Nutrizen International, Pune.
- "Virgin Coconut oil technology" of Central Plantation Crops Research Institute (CPCRI), Kasargod, Kerala was licensed to individual entrepreneur, Mr. A. B. Rajshekhar.

Innovators Supported

• AAU BPD Unit has been recognized by Ministry of Micro, Small and Medium

Enterprises (MSME) for implementing its scheme "Entrepreneurial and Managerial Development of SMEs through Incubators". Two incubatees of AAU BPD Unit have been sanctioned ₹ 11.75 lakhs (cumulative) for commercializing their innovations under the scheme. The details of the innovations and split of amount are as follows:

Sr. No.	Name of Innovator	Innovation	Sanctioned amount (₹ in lakhs)
1	Mohan Muktaji	Bullock drawn	5.50
	Lamb	Sprayer	
2	Maulik Patel	Spore forming	6.25
		animal probiotics	

4.10 Veterinary Science And Animal Husbandry

Research work carried out under different projects of Veterinary Science and Animal Husbandry has been grouped into two subgroups; 1: Animal Production Group and 2: Animal Health Group.

Animal Production Group:

After long exhaustive work for poultry strain development under AICRP on poultry, three strains crosses namely "Anand Commercial Layer", "Anand Bentamised White Leghorn" and "Anand Synthetic White Leghorn" have been released for important characters like commercial egg type, commercial feed efficiency and egg weight line respectively.

Animal Nutrition Research Station has number of projects financed by GOG, GOI, ICAR and other agency. Under these projects, the research work carried out includes, Animal Nutrition survey of Anand District, on farm trial on supplementation of bypass fat to Lactating buffaloes in Gopalpura village of Anand district resulted in improved fat percent of milk, yield of whole milk and feed conversion efficiency in treated buffaloes.

Further, study on effect of dietary incorporation of appropriate mineral mixture to anestrous and repeat breeder buffalo of tribal villages Jinjari and Kharod of Panchmahal district revealed that such supplements improve the reproductive efficiency of these buffaloes. In goats, supplementation of Solid State Fermentation (SSF) biomass improved digestibility and nutrient utilization.

Under schemes operated at Reproductive Biology Research Unit, work on hormonal profile of super ovulated buffaloes, study of ultra sonography for pregnancy diagnosis in goat and estimation of hormones from samples of PG students' work as well as other departments research projects have been carried out during the reporting period.

Research projects of Animal Biotechnology and Animal Genetics and Breeding are mainly on molecular study of genomes. During the year, molecular characterization of indigenous livestock breeds, development of molecular markers for percentage verification of cattle, buffalo and camel isolation and characterization of Canine Mesenchymal Stem Cells; metagenomic analysis of human microbes; whole genome sequencing in two commercially important fish Labeorohita and Clarias batrachus etc. have been carried out. Most of the projects of these departments are long term projects.

Research work carried out under Livestock Production and Management, was on effect of water restriction and rehydration on sheep and goat. Results are encouraging and will be useful to manage these animals under water restriction during summer draught condition without major losses.

Animal Health Group:

AAU

Department of Pharmacology and Toxicology conducted research work on use and impact of indigenous medicinal plants, toxicology and xenobiotics and pharmaco-kinetics of drugs. These all are long term projects and every year one or two plants are being taken to evaluate its impact in animals. Department of Veterinary Medicine, under the scheme of Diagnosis and Epodemiology of important disease, conducted studies on goat diseases and bovine mastitis. performed Α study was to know the effect of 1% of 10 ml alkaloids of P. Juliflora for 5 consecutive days on subclinical mastitis in cattle.

Department of Veterinary Surgery and Radiology screened 123 opthelmic cases for progressive Retinal Atrophy and 26 cases were screened for Progressive Rod Cone Degeneration (PRCD), out of which 3 cases were found positive to PRCD.

Department of Veterinary Parasitology examined 15361 samples including blood, faecal, skin etc for parasite infection from university farms, hospitals, gaushalas, fields etc. The result revealed a number of parasites viz. *Ascaridia galli, Heterekis gallinaram, Parascaris equorum, Trichuris spp.* etc. Apart form this, the department had taken up study on parasitic infection of goat in Anand district and Abattoir studies on Amphistomosis of Buffaloes.

Under scheme of Disease Management in Livestock at Anand, dairy animals in Simarda, Manjipura and Mogar villages were screened for brucellosis. Camels' skin, faecal and blood samples were examined for endo and ecto parasite infestation. Under the scheme of Etiopathological studies on mortality in broilers, Department of Veterinary Pathology studied 8320 carcasses of broiler birds. The result revealed that the major diseases were Low Pathogenic Avian Influenza, Colisepticemia, CCRD, Visceral gout, Heat stroke, Yolk sac infection and salmonellosis.

Department of Gynaecology and Obstetrics processed 423 ejaculates from cattle and surti bulls at Central Sperm Station for freezing. This is for research as well as training purpose to UG & PG students. Under scheme of Augmenting Reproductive efficiency in Dairy animals of Tribal areas, number of cases of infertility were treated in clinical camps organized in Tribal area.

4.11 Dairy Science

Dairy Technology Department of Dairy Science college conducted research work on optimizing different variables for development of mango based fermented milk drink. The results on levels of ingredients have been recommended. Further, same department has also worked on standard preparation of dairy and non dairy processed cheese and mozzarella cheese analogues.

Department of Dairy Processing Operation has one project of standardization of recipe for preparation of ready mix carrot halwa using dried carrot sheds. Under this project different system of drying carrot sheds and different ingredients of milk solids, have been used to standardize the process. The work is in progress.

Under the project of evaluation of energy conservation potential of soft starter in dairy industry, the work carried out during 2013-14 by the Department of Dairy Engineering could find that operation of motor on soft starter showed different levels of energy saving which was



between the range of 6.12 to 12.53 percent under various load condition. The work is in progress.

Department of Dairy Microbiology has projects on storage study of formulated and control probiotic dry mix and on development of probiotic/dahi culture tablets. Both the projects are in progress and will be continued for next year. Different parameters have been studied and final phase of self life study of probiotic culture and tablet preparation with less disintegration time, good viability and activity is left out. Apart form this work, there are other on going projects viz. Iron fertification of buttermilk, whole genome sequence of *Streptococcus thermophilus* bacteria, designing and validation of real time PCR primers for *Lactobacillus belveticus*, isolation and characterization of lactic acid bacteria etc.

Projects on Development of technology for utilization of soybean and groundnuts as protein rich material for fabrication of human food; study on distribution of pattern of nitrogenous components in milk, study of composition and properties of camel milk etc. are going on in the Department of Dairy Chemistry. All the projects are on going projects and phase wise research work is being carried out. During 2013-14, work of first phase has been completed in almost all the projects.

4.12 Agricultural Engineering And Technology

Agricultural engineering interventions of micro irrigation, farm mechanization, value addition and energy management in production and post harvest operations are required to make Indian agriculture sustainable, profitable and a competitive enterprise.

The CAET, Godhra has mainly four departments viz; Soil & Water Engineering, Farm Machinery & Power Engineering, Agricultural Process Engineering and Renewable Energy.

During the year, all the four departments had carried out research work on spatial and temporal variability of infiltration under real field conditions, Assessing and Simulating Seepage from Irrigation Canals in Panchmahal & Vadodara Area, Prevailing Quantitative and Qualitative Status of Ground Water in Selected Locations of Panchmahals District, roof top rain water harvesting (RTRWH) for conservation and management of water resources, Impact assessment of climate change on hydrology in the semi-arid region of middle Gujarat, Development and evaluation of mini tractor operated strip till multi crop planter cum fertilizer applicator, Development and evaluation of a multipurpose tool bar for mini tractor suitable for the cropping pattern of middle Gujarat region, Assessment of prevailing post harvesting practices of Custard Apple and developing set of complete post harvest practices for this crop in Panchmahal district, Process Development of juice preparation from Ivy Gourd (Coccinia grandis). Production Technology for Preparation of Wood Apple (Limonia acidissima) Jam, Development of a biomass gasifier combustor of 200 Nm³/hr capacity hot air production suitable for drying and thermal applications, Software implementation of effective Space Vector PWM scheme for a Multilevel Inverter for Stand-alone/off grid PV applications, Modifications in hand operated disc type Maize Sheller and Modifications in existing hand operated paddy thresher.

4.13 Agricultural Information Technology

This institute prepares human resources in the field of Agriculture Information Technology (AIT) as a tool to sharpen the edges of the agriculture structure in the country. It takes the onus to develop and hone the sector and its changing environment.

AIT has emphasized and encouraged research right from its foundation. At present, active research is being carried out within the institute on various aspects of Agricultural Information Technology and also into many ways in which ICT impacts society and culture. During the year, ICT based research works were undertaken on different aspects viz., Critical Evaluation of Gujarat State Agricultural Universities Websites: A case study, Calculation of leaf area index through image processing (LAM Software), Web based Experiment Data Management Tool for Plant Breeders and Web based Inward-Outward Management System.

4.14 Fisheries Science

In order to create awareness among the farmers for adopting fish farming and to utilize available resources in a fruitful manner for generating employment opportunities in rural youths, a systematic full-fledged training cum demonstration centre has been started at KVK, AAU, Devataj.

 In the year of 2013-14, total 2 On campus and 3 Off campus trainings have been organized in different subjects viz., Carp breeding and hatchery management, Composite fish culture through village pond, Value addition in fish and Fresh water prawn culture management. Total 76 farmers, 32 farm women and 15 rural youth were trained.

- Three FLDs on IMC fry seed rearing were also organized. IMC fry (25-30 mm) to fingerling were produced (70-100 mm) within 2 to 3 months under scientific culture practices and survival rate also was found 70%- 82% as compared to local or farmers methods (60% -70%) i.e. increased survival rate up to 10% to 22 % over local check, Further, these fingerlings were stocked in to village ponds for rearing to table size fish.
- Four Demonstrations on Freshwater Prawn culture were carried out in which Nagli (*Bavto*) as feed was given to fish farmers.
- In addition to this, 12 demonstrations on Composite fish culture management were distributed in which oxygen tablets for increasing O₂ level in pond and Mineral Mixture as feed supplement were included.
- Under extension activities, two film shows, 22 scientist visits to farmers' fields, 30 farmers' visits to center and 10 diagnostic visits were organized.

4.15 Home Science

Polytechnic in Food Science and Home Economics is actively involved in research work apart from teaching and extension. During last year, various research projects were carried out by the polytechnic. Among those, one is on "Development of Health Bar". Various functional ingredients are used to develop health bar, their sensory and nutritional evaluation were carried out together with their physical characteristics. The product aims to supply various nutrients including good quality fat, multivitamins and minerals so as to replace the health bar to commercial, particularly bakery foods among children of rich population.

Another project is on "Formulation, Nutritional Evaluation and Storage study of Low cost Supplementary Food". Supplementary food is prepared by using minor millets such as pearl millets and finger millets together with soybean. Sensory, Nutritional and storage study were carried out in this project. That will be low cost weaning food and useful to replace too costly readymade weaning food particularly among rural people including farm-labours, tribals and the like. Third project is on "Knowledge and attitude of Anganwadi workers and mothers towards nutrition and supplementary foods". Under this project, a survey is going on to evaluate the knowledge and attitude towards supplementary nutrition by using questionnaire methods to enable the need-based population to use supplementary foods developed at the polytechnic.

4.16 Agricultural Meteorology

The following research work was carried out during the reporting period.

Development of weather based models for predicting outbreak of insect-pest and diseases of mustard

- The highest significant negative correlation (-0.838**) was observed with Tmean for mustard aphid index under D3 (30th Oct.) sowing.
- As Tmean drops below 20 °C, aphid population out break starts and when it goes above 20 °C, aphid intensity decreased.
- AGDD up to pod development phase of

mustard and aphid index showed inverse relationship.

Crop growth simulation modeling and crop weather relationship of wheat

- The highest grain yield was recorded with the crop sown on 15 November. The highest grain yield was obtained with variety GW-366.
- Nearly 84 % yield variation can be explained
 by minimum temperature during booting
 phase of wheat.
- Periodic biomass and accumulated GDD showed linear and positive relationship.

Crop weather relationship of *kharif* groundnut

- The highest pod yield was recorded when crop was sown at the onset of monsoon i.e.
 6th July.
- Cultivar GG-20 was found most suitable for sowing at the onset of monsoon for getting optimum pod yield of groundnut.
- Late sown groundnut experienced severe moisture stress during reproductive phase of the crop and caused poor pod yield.

National Initiative on Climate Resilient Agriculture

- Farmers are using the weather forecast for planting or sowing of various crops and other plant protection measures.
- Farmers are giving more weightage to rainfall and temperature.
- Agro-Advisory bulletin is more useful for vegetables due to short duration and is more



sensitive to seasonal weather.

- Farmers want more emphasis on plant protection measures in bi-weekly advisory.
- Low yield of various crops was due to high fluctuation in temperature, low market price and price fluctuation.
- Erratic rainfall fluctuation during crop season adversely affected *Kharif* yield of various crops.
- Some Progressive farmers have regularly taken care about weather conditions mainly for adjusting the sowing date according to weather forecast through AAS.
- Some farmers have adopted advisory for irrigation application and spraying of insecticides, Pesticides or Fungicides and other plant protection measures.

Analysis and thematic mapping of extreme weather events of Gujarat

- The climatic analysis was performed to analyze the observed temperature and rainfall extremes in Gujarat during recent past.
- Observed daily data of maximum and minimum temperature and rainfall of 32 geographically well distributed stations in Gujarat for the available time series during 1958 to 2011 has been used to calculate various extreme climate indices and their trends.
- Results showed warming signatures in some temperature extremes in most parts of Gujarat. Most of the temperature and

precipitation indices revealed geographically mixed pattern, indicating uncertainty in the climate change pattern. A recommendation has been formulated and proposed for scientific community/planners.

Analysis of climatological trend line analysis of different districts of Gujarat states

- The climatological data results revealed that the oscillating trend was determined over Gujarat state with respective weather variables like Minimum Temperature (Tmin), Maximum Temperature (Tmax) and Rainfall since 1901 to 2002 years data.
- The annual Tmin changes in 0.04°C, annual Tmax changes in 0.05°C and rainfall decade wise changes was observed from-0.34 to -0.86 mm.

Study of spectral characteristics of potato as influenced by nitrogen levels

- The spectral reflectance recorded at different phenological stages using narrow band spectroradiometer were used to compute Normalized Difference of Vegetation Index (NDVI), Normalized Difference of Red Edge (NDRE), Modified Simple Ratio (mSR) and Ratio of Vegetation Index (RVI).
- The indices were found to be useful to discriminate among the treatments of different nitrogen doses. Yet, the crop spectral responses were not found significant with the levels of nitrogen application. Besides, it was observed that the observations were affected by the uneven growth of the plant strength in experimental plots.



Development of yield forecasting models based on weather parameters (FASAL)

- The weather data of agro-meteorological observatory situated at Anand district were used to derive various weather indices. To minimize the technological factors, the yearnumber was used to study the overall effect of technology on yield.
- Among the districts for which crop weather models have been prepared showed a large variation in the Coefficient of determination (R²). In the developed groundnut model, R² ranged between 0.29 (Kheda) and 0.94 for Baroda. For rice model, the minimum R² found for Bhavnagar (0.43), while maximum was for Baroda district (0.96). For maize, R² ranged between 0.57 for Dahod to 0.84 for Baroda.

Gramin Krishi Mausam Sewa (GKMS) at AAU, Anand

Total 98 weather based agro-advisory bulletins were issued in local newspapers viz.; Sardar Gurjari, Naya Padakar, Divya Bhashkar (Anand and Kheda editions) and Gujarat Samachar-Kheda Edition. Agroadvisory bulleins have also been uploaded on the IMD website as well as Departmental and University's webpage www. aau.in. In addition to this, bulletins are regularly sent by Email to State Department of Agriculture through Gujarat Agricultural Universities Council, Director of Agriculture, Joint Director of Agriculture (State), Associate Director of Agriculture (State), Gandhinagar, different Agencies involved in agriculture viz. N-Logue communication, Project Co-ordinator, AICRP on Agro-Meteorology CRIDA, Hyderabad and AIR Vadodara, DD Ahmedabad, ETV Hyderabad, SMS service provider Routers, Handigo, Nokia and IFFCO. Daily weather data are being sent regularly to press media of local newspapers. TV talks on importance of weather based agro-advisory services have also been delivered by Bisag studio. All possible measures were taken to improve awareness among the farming community regarding the activity of the project and utility of weather forecast in crop production to minimize input cost and maximize crop production. Field surveys have been done for flooded areas of different districts like Vadodara, Anand, Kheda and farmers were advised to take necessary measures to protect crops from damage.

4.17 Seed Production

Ensuring quality of seeds to farmers, Anand Agricultural University has registered its trademark and logo of "ANUBHAV SEEDS" with the Trademark Registration Authority of India. All the seed producing centres/units of Anand Agricultural University, Anand are well equipped with seed production machinaries required for all operations starting from land preparation to harvesting. The total seed production of the year 2013-14 reached all time high 7539.82 quintals showing more than three times increase over the year 2004-05 (2247.83 quintal). The seed processes and seed testing facilities also boosted the efforts of seed quality assurance. Moreover, the university has started seed production through **Participatory Seed Production** in farmers' fields and produced 20232 quintals of Paddy seed, 18702 quintals of Wheat seed certified and 300 quintals of Greengram seeds.

Seed and Seedling production, 2013-14

AAI

Sr. No.	Crop	Bree- der	Other stage	Total Seed
A	Cereals	uor	stage	5000
1	Paddy	176.16	2575.46	2751.62
2	Maize	336.64	646.4	983.04
3	Wheat	540	1719.8	2259.8
В	Pulses			
4	Green gram	2.5	85.52	88.02
5	Gram	71	346.25	417.25
6	Pigeonpea	6	11.1	17.1
С	Oilseeds	,		
7	Castor (Hyb.)	5.5	133.82	139.32
8	Groundnut	21	0	21
9	Soybean	8	176.2	184.2
10	Sesamum	0	10	10
D	Cash/ Other crop	S		
11	Cotton	81.7	55.2	136.9
12	Tobacco	0	36.24	36.24
10	Clusterbean	4 -	101 10	100 (0
13	(Seed)	1.5	181.19	182.69
<u>14</u>	Sunhemp	0	7.5	7.5
上 1 m	Forage crops	10 5	(20	1(00
15	Lucerne		6.38	10.88
10	Uat Dailea Dairea	106.85	28	134.85
1/	Kajka-Dajra		101.62	0.74
10	Courses	1	101.05	101.05
19 E	Vogotablos	1	0	1
ľ	Clusterbean			
20	(Veg)	0	7 76	7 76
21	Pigeonnea(Veg)	0	0	0
22	Chilli (Veg.)	0	1.83	1.83
23	Brinial	0	1.6	1.6
24	Cucumber	0	0.001	0.001
25	Okra	0	0.28	0.28
26	Tomato	0	0.03	0.03
27	Bottle gourd	0	0.68	0.68
28	Cowpea (Veg.)	1.7	0.25	1.95
	Indian bean			
29	Papdi	0	1.65	1.65
30	Pumpkin	0	0.005	0.005
31	Garlic	0	1.0	1.0
F	Spices (Seed)			
32	Cumin	4.5	27.7	32.2
<i></i>	M & A plants			_
33	seed	0	1.05	1.05
	Total	1374.55	6165.27	7539.82

(In quintal)

Planting material production of AAU, 2013-14

Seedlings and Planting materials (lakhs)			
1	Tobacco	15.00	
2	Napier/ Gajraj rooted slips	2.38	
	Total	17.38	
Tissu	e cultured plants (Nos.)		
1	Date palm	2000	
2	Parval	0	
3	Stevia	0	
	Total	2000	
Veg. S	eedlings/ planting material (lak	hs)	
1	Brinjal	1.11850	
2	Chilli	3.56174	
3	Tomato	0.26600	
	Total	4.94624	
Horti.	Seedlings/ planting material		
Fruit	Planting materials (Nos.)		
1	Mango grafts	1192	
2	Aonla graft	109	
3	Sapota grafts	458	
4	Fig grafts	479	
5	Custard apple grafts	5092	
6	Jamun grafts	217	
7	Guava grafts	383	
8	Mulberry graft	204	
9	Guava plants	1723	
10	Custard apple plants	4474	
11	Kagzilime plants	12452	
12	Jamun plants	3133	
13	Drumstick plants	4235	
14	Almond plants	218	
15	Cashew nut plants	981	
16	Jack fruit plants	1252	
17	Phalsa plants	1872	
18	Karonda	1885	
19	Sandalwood	1748	
20	Papaya seedlings	18468	
	Total	60575	

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Flowers And Ornamental Plants (Nos.)			
1	Red Rose (Deshi)	15847	
2	Mogra (Jasmine)	4469	
3	Chrysanthemum	3005	
4	Tuberose(bulbs)	477	
5	Chrysanthemum(seedlings)	29300	
6	Seasonal flowers-seedlings	68140	
7	Seasonal flowers seed packets	228	
8	Ixora	519	
9	Tulsi	857	
10	Tagar	1535	
11	Chandan	106	
12	Kamini	220	
13	Tecoma	410	
14	Draceana	1328	
15	Gerbera	187	
16	Jatropha	497	
17	Bouganivellia	493	
18	Hibiscus	1552	
19	Barmasi - Vinca	1013	
20	Cycas palm	114	
21	Night Queen	1757	
22	Duranta	6751	
23	Colius	215	
24	Canna bulb	299	

25	Aralia	892
26	Pot plant (big size)	544
27	Pot plant (mid size)	452
28	Other flowering / ormental	36016
	plants (Marigold, Gallardia, etc.)	
29	Kalgies (Nos)	394
	Total	177617
	Medicinal & Aromatic Plants (N	os.)
1	Brahmi	334
2	Madhunashini	119
3	Dodi	14391
4	Ardushi	314
5	Jammu Lemon Grass	383
6	Tulsi	582
7	Rice Plant	476
8	Kunvarpathu	382
9	Beejoru	215
10	Chives	406
11	Mithi Limdi	215
12	Chanothee	463
13	Shatavari	238
14	Karamda	144
15	Kachaka	313
16	Other medicinal plants/ cuttings	1599
17	Kariyatu Dharu	71100
	Total	91674





AAU