

Chapter - IV



RESEARCH



4.1 Agricultural Research Council

The Agricultural Research Council was constituted according to the provision of the Gujarat Agricultural Universities Act 2004 in exercise of the power vested under section 62(1) in pursuance of section

17(5). Dr. V. P. Chovatia monitored and guided the research activities during the reporting period. 16th Research Council meeting was organized on January 21, 2019 for approval of new research programs and review of research activities during the year.

Table 4.1 Members of 16th Agricultural Research Council

No.	Name	Designation
1	Dr. A. R. Pathak	Vice Chancellor (Chairman)
2	Dr. V. P. Chovatia	Director of Research & Dean PG Studies (Member Secretary)
3	Dr. B. M. Modi	Director of Agriculture, Government of Gujarat, Gandhinagar
4	Dr. P. M. Vaghasiya	Director of Horticulture, Government of Gujarat, Gandhinagar
5	Dr. A. J. Kachhia Patel	Director of Animal Husbandry, Govt. of Gujarat, Gandhinagar
6	Dr. P. V. Patel	Director of Extension Education
7	Dr. V. V. Rajani	Associate Director of Research
8	Dr. Promod Mohnot	Associate Director of Research
9	Dr. D. S. Hirpara	Associate Director of Research, JAU, Targhadia
10	Dr. M. A. Vaddoria	Dean, Faculty of Agriculture
11	Dr. N. K. Gontia	Dean, Faculty of Agricultural Engineering
12	Dr. A. Y. Desai	Dean, Faculty of Fisheries Science
13	Dr. P. H. Tank	Dean, Faculty of Veterinary Science & Animal Husbandry
14	Dr. K. A. Khunt	Dean, Post Graduate Institute of Agribusiness Management
15	Dr. K. L. Dobarra	Research Scientist and Convener, Crop Improvement AGRESKO Subcommittee
16	Dr. S. G. Savalia	Professor & Head and Convener, Crop Production AGRESKO Subcommittee
17	Dr. L. F. Akbari	Professor & Head and Convener, Plant Protection AGRESKO Subcommittee
18	Dr. D. K. Varu	Professor and Convener, Horticulture & Agro Forestry AGRESKO Subcommittee
19	Dr. P. M. Chauhan	Professor & Head and Convener, Agricultural Engineering AGRESKO Subcommittee
20	Dr. B. A. Golakia	Professor & Head and Convener, Basic Science AGRESKO Subcommittee
21	Dr. P. R. Kanani	Professor & Head and Convener, Social Science AGRESKO Subcommittee
22	Dr. U. D. Patel	Associate Professor and Convener, Animal Science & Fisheries AGRESKO Subcommittee
23	Dr. K. L. Dobarra	Research Scientist (Groundnut)
24	Dr. B. A. Golakia	Professor & Head (Biotechnology)
25	Dr. B. K. Sagarka	Professor & Head (Agronomy)
26	Dr. P. M. Chauhan	Professor & Head (RERE)
27	Dr. M. R. Gadaria	Research Scientist, Bull Mother Farm, JAU, Amreli
28	Dr. S. I. Yusufzai	Associate Research Scientist, Fisheries College, JAU, Veraval
29	Dr. V. K. Poshia	Retired Research Scientist (Plant Breeding)
30	Dr. H.J. Vyas	Retired Professor (Entomology)
31	Shri Sanjaybhai Ratibhai Vagadia	Progressive Farmer, Dhava(Gir), Ta: Talala, Dist. Gir Somnath





4.2 Planning and Monitoring

Monitoring

The monthly and quarterly progress reports were collected from the concerned heads of the schemes which were compiled and submitted to the Government quarterly. The problems of the scheme were solved satisfactorily by discussion between scientists and the Director of Research in two meetings held during the month of December-2018 and February-2019 for evaluation of expenditure of planned schemes and reallocation of the funds, *etc.*

State Programs

Monitoring of research works is done through a set system in the University. The University jurisdiction is comprises of four agro-climatic zones *viz.* North Saurashtra, South Saurashtra, partially North West and Bhal & Coastal agro-climatic zones. The authorities of Directorate of Research at Junagadh and Dry Farming Research Station, Targhadia coordinate, monitor and supervise the

implementation of research programs of various schemes in the respective zones. The monitoring is carried out directly on field as well as through presentation of findings in various committees *viz.* 1) Zonal Research and Extension Advisory Committee (two zones) 2) Agricultural Research Subcommittee (eight discipline wise) 3) Joint Agricultural Research Subcommittee (one for all disciplines) and 4) Combined Joint Agricultural Research Subcommittee (one for all four State Agricultural Universities). All the committee meetings are held regularly in every year to evaluate the progress of research works, research findings of each experiment, examination and scrutiny of new research programs, examination and refining of findings to be delivered in the form of recommendations. The presentation of research results as well as reports for all research stations is mandatory. The reports are prepared separately for various committees.

**Table 4.2.1 List of plan and non-plan research projects functioning in the university
(A) Plan Scheme (Sponsored by Government of Gujarat)**

Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
1	12002-00	Strengthening of research in millet	1986	Main Pearl millet Research Station, Jamnagar
2	12006-00	Strengthening of research in sorghum	1981	Cotton Res. Station, Kukada
3	12007-00	Strengthening of research in pulses	1989	Pulses Res. Station, Junagadh
4	12008-00	Strengthening of research in oilseed (Groundnut)	1986	Oilseed Research Station, Junagadh & Manavadar
5	12009-00	To establish a centre of excellence for cotton research	1986	Cotton Res. Stat., Junagadh and ARS, Amreli & Ratia
6	12013-00	Strengthening of scheme of vegetable research at Junagadh	1995	Vegetable Research Station, Junagadh
7	12027-00	Scheme for management of salt affected soil & poor quality of under-ground water	1988	Dept. of Agriculture Chemistry & Soil Science, Junagadh
8	12044-01	Research in bio-technology	1995	Dept. of Biochem., Junagadh
9	12078-00	Strengthening of research in dry-farming	1979	DFRS, Targhadia & Ratia
10	12092-00	Strengthening of tissue culture research & development at all campuses	1990	Dept. of Plant Breeding & Genetics, Junagadh





Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
11	12094-00	Research for integrated pest mgmt. in fruit crops	1997	Dept. of Entomology, Junagadh
12	12095-00	Strengthening of horti. res. & devp. activities	1997	Dept. of Horticulture, Junagadh
13	12096-00	Res. on micro irri. system in Saurashtra region	1997	Dept. of Agronomy, Junagadh
14	12131-00	Research on eco-friendly biological fertilizer	1997	Dept. of Pl. Patho., Junagadh
15	12712-06	Creation of additional posts as per Supreme court orders	1991	CBF, CoA, CAET, Junagadh & College of Fish. Sci., Veraval
16	12712-5B	Campus development program (on campus)	2004	Directorate of Research, Junagadh
17	12903-00	Establishing of organic farming cell at Junagadh	2000	Dept. of Agronomy, Junagadh
18	12905-00	Proposal for research on watershed management	2000	MDFRS, Targhadia; GRS, Dhari & Dept. of SWCE, CAET, Junagadh
19	12907-00	Strengthening of agro-meteorology at JAU	2000	Dept. of Agronomy, Junagadh
20	12930-00	Establishment of new sub-center for research on cumin	1998	Agriculture School, Halvad
21	12931-00	Establishment of new research centre on onion crop	2003	Vegetable Research Station, Junagadh & FRS, Mahuva
22	12573-00	Research on tillage technology	2006	Dept. of Agronomy, Junagadh
23	12574-00	Research on rejuvenation of degraded coastal agro-eco systems of Saurashtra	2006	Research Training & Testing Centre, Junagadh
24	12575-00	Strengthening research in sesamum	2006	Agril. Research Station, Amreli
25	12101-00	Centre of excellence on soil and water management	2006	RTTC, Junagadh; MDFRS, Targhadia; ARS (FC), Mahuva & FRS, Mangrol
26	12576-00	Research on post-harvest technology of important crops of Saurashtra	2006	Dept. of Processing & Food Engg., CAET, Junagadh
27	12582-00	Strengthening of research on genetically modified cotton	2009	Cotton Research Station, Junagadh
28	12583-00	Strengthening of wheat research	2009	Wheat Res. Station, Junagadh
29	12584-00	Strengthening research on castor	2009	Main Oilseed Research Station, Junagadh
30	12585-00	Strengthening research in sugarcane	2009	Sugarcane Res. Stat., Kodinar
31	12586-00	Strengthening of research in plantation and fruit crops at A.R.S.(Fruit crops)	2009	Agricultural Research Station (FC), Mahuva
32	12587-00	Conservation of plant biodiversity	2009	Dept. of Genetics & Plant Breeding, Junagadh





Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
33	12588-00	Development of arid and semi-arid fruit crops	2009	Dept. of Horticulture, Junagadh
34	12590-00	Establishment of Bt cotton research centre at Surendranagar district	2011	Cotton Research Station, Kukada
35	12014-00	Establishment of spices res. centre at Junagadh	2011	Vegetable Res. Stat., Junagadh
36	12015-00	Establishment of bio-fertilizer unit at Junagadh	2011	Dept. of Plant Patho., Junagadh
37	12018-00	Establishment of research centre on onion at Talaja, Dist.: Bhavnagar	2011	Agriculture Research Station, Talaja
38	12019-00	Strengthening of dry farming research at Jam Khambhaliya	2012	Dry Farming Research Station, Jam Khambhaliya
39	12020-00	Strengthening of dry farming research at Vallbhipur	2012	DFRS, Jam Khambhaliya and Vallbhipur
40	12021-00	Establishment of mango res. project at Talala	2012	Dept. of Horticulture, Junagadh
41	12022-00	Project on mega seed for quality seed production & distribution	2012	Dept. of Seed Science & Tech., Junagadh
42	12023-00	Micronutrients and sulphur research in soils and plants in Saurashtra region	2012	Dept. of Ag. Chemistry & Soil Science Junagadh
43	12024-00	Centre of remote sensing and geoinformatics in agriculture	2012	Dept. of Soil & Water Consr. Engg., CAET, Junagadh
44	12025-00	Recycling of organic waste for sustainable soil productivity under dry land agri. at Targhadia	2012	Main Dry Farming Research Station, Targhadia
45	12026-00	Project for res. on forage crop prod. at Dhari	2012	Grassland Res. Station, Dhari
46	12028-00	Aflatoxin and its management in groundnut in Saurashtra region of Gujarat	2013	Main Oilseed Research Station, Junagadh
47	12029-00	Molecular mapping of important traits and their transfer through marker assisted selection (MAS) in groundnut and cotton	2013	Dept. of Biochemistry, Junagadh
48	12030-00	Studies on effect of climate change on fruit crops of Saurashtra region	2013	Dept. of Horticulture, Junagadh
49	12303-05	Establishment of Gir cattle & Jaffrabadi buffaloes	1996	Cattle Breeding Farm, Junagadh
50	12953-00	Strengthening of livestock & veterinary component	2002	Cattle Breeding Farm, Junagadh





Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
51	12303-14	Integrated farming system (Integrated farming combining crop livestock bio resources)	2009	Cattle Breeding Farm, Junagadh
52	12303-15	Establishment of bull mother farm of Gir cattle & Jaffrabadi buffaloes	2011	Cattle Breeding Farm, Junagadh
53	12950-00	Establishment and devp. of res. in fisheries	2000	Fisheries Res. Station, Okha
54	12577-00	Value added products from fish / shellfish	2006	College of Fish. Sci., Veraval
55	12578-00	Establishment of inland fishery research centre	2006	Inland Fisheries Research Station, Junagadh
56	12579-00	Establishment of pearl oyster hatchery	2009	Fisheries Res. Station, Sikka
57	12581-00	Feasibility of mass culture of marine red algae <i>Kappaphycus alvarezii</i> (Schimitz) on the Saurashtra region at west coast of India	2009	Fisheries Research Station, Okha
58	12016-00	Establishment of aqua-based research and training centre in coastal Saurashtra at Mahuva	2011	Agricultural Research Station (FC), Mahuva
59	12031-00	Crop improvement in papaya at Junagadh	2014	Dept. of Horti., Junagadh
60	12032-00	Integrated pest management in seed spices at Junagadh	2014	Dept. of Entomology, Junagadh
61	12033-00	Evaluation of pharmacological activity of indigenous medicinal plants of Saurashtra region	2014	College of Veterinary Science & Animal Husbandry, Junagadh
62	12034-00	Identification & documentation of marine fish biodiversity using mitochondrial DNA bar coding at Veraval	2014	College of Fisheries Science, Veraval

(B) Non Plan Scheme (Sponsored by Government of Gujarat)

Sr. No.	Budget Head	Name of Program	Sanction Year	Location
1	3226	Scheme of design experiment	1980	Dept. of Agril. Statistics, Junagadh
2	5002	Scheme for research in bajra	1985	Main Pearl millet Research Station, Jamnagar Agricultural Res. Station, Talaja
3	5004	Scheme for research in wheat	1995	Wheat Research Station, Junagadh Fruit Research Station, Mangrol
4	5006	Scheme for research in sorghum	2011	Cotton Research Station, Kukada





Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
5	5007	Project for the research in pulses	1975	Pulses Research Station Junagadh
6	5008	Scheme for oilseed research	1962	Main Oilseed Res. Stat., Junagadh
			1973	Agril. Research Station, Amreli
			1985	Main Pearl millet Research Station, Jamnagar
	5008	Scheme for oilseed research	1979	Sugarcane Res. Station, Kodinar
			1979	Oilseed Res. Station, Manavdar
7	5009	Scheme for strengthening of research in cotton investigation of fiber crops other than cotton, development of remie fiber.	1985	Agril. Research Station, Amreli
			1985	Cotton Research Station, Khapat
			2002	Cotton Research Station, Junagadh
8	5011	Scheme for research in sugarcane	1971	Sugarcane Res. Station, Kodinar
9	5012	Scheme for research in grasses forage	1985	Grassland Research Station, Dhari
10	5013	Strengthening of research in vegetable (Tomato)	1962	Vegetable Research Station, Junagadh
11	5014	Scheme for research and improvement in fruit crops	1961-62	Fruit Research Station, Mangrol
				Agril. Res. Station (FC), Mahuva
				Dept. of Horticulture, Junagadh
12	5018	Scheme for res. studies in agri. economics	1972	Dep. of Agril. Eco., Junagadh
13	5020	Scheme for research in agriculture chemistry & soil science	1972	Dept. of Agril. Chemistry & Soil Science, JAU, Junagadh
14	5025	Project for the research in agronomy and crop husbandry	2005	Dept. of Agronomy, Junagadh
15	5026	Project for the research in pest control and other entomological aspect	1960	Dept. of Entomology, Junagadh
16	5042	Strengthening of dry farming research station	1965	Dry Farming Res. Station, Ratia
			1979	Main Dry Farming Research Station, Targhadia
			1967	DFRS, Jam-Khambhalia
			1964	Dry Farming Res. Stat., Vallbhipur
			2011	Cotton Res. Stat., JAU, Kukada
			1975	Grassland & Agril. Research Station, Dhari
			1947-48	Dept. of Seed Science & Tech., Junagadh
			1995	Cotton Res. Stat., JAU, Khapat
1967	Dept. of Agronomy, Junagadh			
17	5044	Project for the research in plant diseases and other pathological aspect	1985-86	Department of Plant Pathology, Junagadh





Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
18	5046-A	Study of biology investigation & control of weed control, botanical garden and cytogenesis	1969	Dept. of Genetics & Plant Breeding, Junagadh
	B			
	C			
19	5073	Research in agricultural engineering	1962-63	RTTC, Junagadh
20	5075	Establishment of seed technology cell	1981	Directorate of Research, Junagadh
21	7082-A	National agriculture research project	1987	Main Oilseed Res. Stat., Junagadh
	7082-B	National agriculture research project	1995	DFRS, Jam- Khambhaliya
	7082-B	National agriculture research project	1988	Main Pearl millet Research Station, Jamnagar
	7082-C	National agriculture research project	1982	Grassland Research Station, Dhari
22	9091	NARP Scheme phase-II	1989	Cattle Breeding Farm, Junagadh
23	9091-9	NARP Scheme phase-II	1989	Cattle Breeding Farm, Zonpur
24	5353	Livestock research station	1978	Cattle Breeding Farm, Junagadh
25	7253	Strengthening research in veterinary science & animal husbandry	1986	
26	5302	State farm for Gir and Kankarej cattle	1949	

Zonal Research Extension Advisory Committee (ZREAC)

This committee is functioning at Zonal level of South Saurashtra & North Saurashtra agro-climatic zones and two meetings are organized in the year viz., *kharif* and *rabi* summer. The research programs/works carried out in different schemes/projects are presented by scientists in the meeting. The power point presentations are made in the house for thorough discussion and refinement of each on going

project. In this meeting scientists from different disciplines as well as officers from state government departments are participating and debating on the results of the projects as well as suggest improvement in new technical programs for future research work. The officers from the line departments are also presenting feedback as well as overall agriculture situations in their regions. They also suggest the inputs for new area of research. It is the multidisciplinary task to evaluate the research results of different disciplines.





During the year 2018-19, four meetings of ZREAC were organized; two each at Junagadh and Targhadia. In both the ZREAC meetings, eight varieties, 50 farmers' recommendations, 32 scientific

recommendations and 136 new technical programs were approved (Table 4.2.2). The feedbacks as well as suggestions were also received from the officers of line departments.

Table 4.2.2 Zonal Research Extension Advisory Committee (ZREAC) meeting

Meeting	Place	Date	No. of Recommendations approved		New Technical Programs
			Farmers'	Scientific	
29 th ZREAC (Rabi-summer)	Targhadia	September 27, 2018	02*	01	06
30 th ZREAC (kharif)	Targhadia	January 28, 2019	02*+07	03	20
29 th ZREAC (Rabi-summer)	Junagadh	October 5-6, 2017	18	13	56
30 th ZREAC (kharif)	Junagadh	January 17-18, 2019	04*+25	15	54
Total			08*+50	32	136

*Indicate no. of varieties released

Agricultural Research Sub Committee (AGRESCO - Discipline wise)

There are eight sub-committees of research functioning in the university to manage the research activities mentioned herein:

Table 4.2.3 Agricultural Research Sub Committees

Sub Committee	Subject areas of Research
Crop Improvement	Development of variety and maintenance of germplasm of mandate crops
Crop Production	Agronomy, Agricultural Chemistry & Soil Science, Weed Control
Plant Protection	Entomology & Plant Pathology
Horticulture & Agro Forestry	Fruits, Vegetables, Flowers and Spices
Agricultural Engineering	Soil & Water Conservation Engineering, Farm Machinery & Power Engg., Renewable Energy Engineering, Processing & Food Engineering
Fisheries Science	Fisheries Resource Management, Post-harvest Technology, Aquatic Environment, Aquaculture, Fishery Hydrology and Fishery Engineering
Animal Science	Animal Breeding, Animal Nutrition, Livestock Production & Management, Anatomy, Medicine & Surgery, Animal Genetics, Vet. Microbiology, Vet. Pharmacology and Toxicology, Vet. Surgery and Radiology, Vet. Pathology.
Basic Science	Biochemistry, Biotechnology, Plant Physiology, Plant molecular Biology
Social Science	Agricultural Economics, Agricultural Extension Education, Agricultural Engineering Extension Education, animal Husbandry Extension Education, Agricultural Statistics and Agribusiness Management





The members of the committees are senior scientists of the university working in various departments/ projects, subjects matter specialists and representatives of state line departments. The conveners of all the committees are nominated by the Director of Research for two years to organize the meeting and also issuing the proceedings. The meeting of all committees is held annually to discuss and to evaluate the research results. The members are also discuss the new technical programs as well as the recommendations for farmers and scientific

community. The scientists presenting the results of various schemes will refine the reports, recommendations and new programs for ensuring season. The suggestions made in the meetings are incorporated in the reports. The committee is consisting of senior scientists as a member. Hence, the proposals and programs pertaining to the various disciplines are discussed critically. The conveners of various sub committees present the proceedings in the Joint AGRESKO meeting.



Animal Science & Fisheries Science AGRESKO Sub-committee Meeting



Social Science AGRESKO Sub-committee Meeting

The Agricultural Research Sub Committees were held during February to March 2019 at Junagadh. Seven new crop varieties, 52 farmers' recommendations, 31 scientific recommendations

and 135 new technical programs were approved. The reports of the work carried out at various research schemes of the university were also presented and approved.

Table 4.2.4 Various AGRESKO (Discipline wise) subcommittee meetings organized

Sub Committee	Date	No. of Recommendations		New Technical Programs	On-going Research Projects
		Farmers	Scientific		
Social Science	February 6, 2019	-	03	21	21
Basic Science	February 7-8, 2019	02	01	03	41
Animal Science & Fisheries Science	February 12-13, 2019	05	09	17	33
Agricultural Engineering	February 15-16, 2019	05	02	18	27
Plant Protection	February 19-20, 2019	17	07	31	321
Horticulture & Agro Forestry	February 21-22, 2018	08	-	07	20
Crop Production	March 5-6, 2019	14	09	32	137
Crop Improvement	March 7-8, 2019	07*+01	-	06	251
Total		07*+52	31	135	851

*Variety released





Joint Agricultural Research Sub Committee (Joint AGRESKO)

Joint Agricultural Research Sub Committee meeting is held annually to discuss research proposals and results. The committee finalizes the recommendations and new technical programs to be undertaken in various disciplines. This committee comprises of the Director of Research, Associate Director of Research, the senior scientists of various disciplines, representatives of line departments *etc.* finalize the programs. The conveners of various AGRESKO present the findings of their respective committees for approval. This committee meeting is presided over by the Hon'ble Vice Chancellor. Joint AGRESKO will finalize the recommendations and new technical programs for research, which is to be presented in the ensuing 15th Combined Joint AGRESKO of State Agricultural Universities.



The 15th Joint AGRESKO meeting was held at College of Agricultural Engineering & Technology, JAU, Junagadh on March 20, 2019 under the chairmanship of Dr. A. R. Pathak, Hon'ble Vice

Chancellor, JAU, Junagadh. All AGRESKO conveners of various committees presented their reports and approved. Seven new crop varieties, 52 farmers' recommendations, 31 scientific recommendations and 135 new technical programs were approved in the meeting.

Combined Joint Agricultural Research Sub Committee (One for four State Agricultural Universities)

This is the apex body to finalize the research recommendations at state level as well as the new technical programs. The meeting is held at the venues in the rotational mode. The members of this committee include Hon'ble Vice Chancellor, Director of Research, Director of Extension Education, Associate Director of Research, Conveners of various AGRESKO subcommittees and senior scientists of various disciplines of all State Agricultural Universities. Director of Agriculture, Director of Horticulture and Director of Animal Husbandry are the members of the committee. Hon'ble Minister of Agriculture & Cooperation, Govt. of Gujarat also attends the meeting. Separate sessions are organized discipline-wise, in which conveners of various AGRESKO subcommittee present the reports of their respective universities. In the concluding session, the conveners from each subcommittee present the final report of research in the meeting. The output of research in the form of recommendations/ technologies is published in the form of proceedings and supplied to the all concerned for implementation.

The 15th Combined Meeting of Agricultural Research Council (AGRESKO-2019) of SAUs and Kamdhenu University was held at Anand Agricultural University, Anand during April 29 to May 1, 2019, presided by Dr. N. C. Patel, Hon. Vice Chancellor of AAU, Anand. Shri Sanjay Prasad (IAS), Additional Chief Secretary, Department of Agriculture, Co-operation and Farmers Welfare, Govt. of Gujarat was the Chief Guest. Hon'ble Vice Chancellors of JAU, NAU, SDAU and KU namely respected Dr. A. R. Pathak, Dr. C. J. Dangaria, Prof. (Dr.) Ashok A. Patel





and Dr. N. H. Kelawala respectively were present as Guests of Honour. Director of Agriculture, Horticulture and Animal Husbandry, Govt. of Gujarat, Shri B. M. Modi, Dr. P. M. Vaghasiya and Dr. A. J. Kachhiapatel also graced the occasion respectively.



Dr. A. R. Pathak, Hon. Vice Chancellor, JAU, Junagadh informed the house that JAU has released bio-fortified variety of pearl millet. He urged the house for focusing on five letters in a sequence PQRST - i.e. research outcome should have Profitability, Quality, Remunerative and Sustainable with good Trading. Agricultural research sustainability is important as green revolution was found to be effective with good results upto 1990, but then after problems of soil degradation *etc.* have been observed. He noted that Intergovernmental Panel on Climate Change (IPCC) declared that during 2040, the temperature will increase up to 2 °C. In this context, we have to start work on effect of temperature on plant/animal, reduction in Fertilizer Use Efficiency (FUE) *etc.* Site specific recommendations and Site Specific Nutrient Management (SSNM), Nano fertilizers will help to increase the FUE. He also opined that speed breeding is the demand of the day.

In the 15th Combined Joint AGRESKO meeting, six varieties *viz.* Groundnut (GG 41), Pearl millet (GHB 1129 and GHB 1225) Cotton (G. Cot 38), Uradbean (GU 2) and Ridge Gourd 2 (GRG 2) were recommended for release in the state. Besides, 46 technologies / recommendations were made for farmers and 29 recommendations were made for scientific community. In addition, as many as 131 new technical programs were formulated to initiate the new research programs for the solutions of the applied and basic problems of agriculture and allied fields.

Table 4.2.5 15th Combined Joint AGRESKO meeting of SAUs

Sub Committee	No. of Recommendations		New Technical Programs
	Farmers	Scientific	
Crop Improvement	06*+01	-	06
Crop Production	13	10	31
Plant Protection	18	05	29
Horticulture & Agro Forestry	05	-	06
Agricultural Engineering	06	01	18
Animal Science	03	06	13
Fisheries Science	01	03	03
Basic Science	02	01	03
Social Science	-	03	22
Total	06*+49	29	131

*Variety released





All India Coordinated Research Projects (AICRP)

Apart from the mechanism of evaluating and monitoring the research programs / schemes at university level; the projects sanctioned by ICAR, the annual workshop and review meetings in different universities in India are organized. A total presently 20 AICRP projects are operating in the university. The monitoring of the projects is also carried out by respective Project Coordinator/Director every year at

field level. After five years, the evaluation of performance of each research project is also carried out by QRT committee comprising of leading senior scientists nominated by the ICAR. The research scientist of the project will present results to the quinquennial review team (QRT). All AICRP projects operating in the university are regularly reviewed and monitored as per the ICAR norms.



Monitoring of AICRP of Groundnut and Cotton at JAU, Junagadh



Monitoring of AICRP of Pulses and AICRP of PET at JAU, Junagadh





Table 4.2.6 Monitoring of AICRP trial at Junagadh Agricultural University

Name of Project	Department/ Research Station	Date of Monitoring	Name and designation of member of monitoring
AICRP on Soybean	Agricultural Res. Station, Amreli	September 26, 2018	Dr. Sanjay Gupta, Principal Sci. and Dr. Lokesh Mina, Sci. (Ento.), IISR, Indore
AICRP- National Seed Project (Crops) Seed Technology Research	Main Pearl Millet Research Station, JAU, Jamnagar	September 28, 2018	1. Dr. Govind Pal, Principal Scientist and Convener, ICAR-IISS, Mau (U.P.) 2. Dr. Sharmila D. Deka, Principal Scientist, AAU, Jorhat 3. Dr. B. Pushpavathi, Principal Scientist, PJTSAU, Hyderabad
AICRP on Pearl millet	Agricultural Res. Station, Talaja	September 29, 2018	1. Dr. P. S. Shekhawat, Prof. and Dr. P. C. Gupta, Prof., AICRP-PM, ARS, Bikaner 2. Dr. C. S. Thakre, Asstt. Prof. (Patho.), AICRP-PM, CoA, Dhule
AICRP on Groundnut	Main Oilseeds Research Station, JAU, Junagadh	October 11, 2018	1. Dr. H. F. Nadaf, Principal Groundnut Breeder, UAS, Dharwad 2. Dr. B. S. Yenagi, Agronomist; Dr. P. S. Tippanawar, Entomologist and Dr. P. Nagaraju, Pl. Pathologist, UAS, Dharwad 3. Dr. Gangadhar, Scientist (Pl. Breeding), DGR, Junagadh
AICCP	Cotton Research Station, JAU, Junagadh	October 26- 27, 2018	1. Dr. S. Manickam, PI (Pl. Br.) and Dr. M. Sabesh (Social Sci.), ICAR-CICR, Coimbatore 2. Dr. Rathod (Crop Prod.) and Dr. Nemade, (Ento.) PDKV, Akola 3. Dr. S. K. Sain, (Path.), ICAR-CICR, Sirsa
AICRP on Castor	Main Oilseeds Research Station, JAU, Junagadh	November 18-19, 2018	1. Dr. P. Duraimurugan, Sr. Scientist (Ag. Entomology), ICAR-IIOR, Hyderabad 2. Dr. S. R. Venkatachalam, Breeder and Dr. M. Deivamani, Pathologist, Yethapur 3. Dr. P. Srivalli, Jr. Breeder, Ananthpur
AICRP on PET	Dept. of REE, CAET, Junagadh	November 19, 2018	Dr. P. R. Bhatnagar, Head, Central Soil & Water Conservation Research & Training Institute, Research Centre, Vasad
AICRP on Vegetable crops	Vegetable Research Station, JAU, Junagadh	January 01-04, 2019	Dr. Sudhakar Pandey, FNAAS, Principal Scientist (Cucumber Breeder), ICAR-IIVR, Varanasi (UP)
AICRP on Chickpea	Pulses Research Station, JAU, Junagadh	January 30, 2019	Dr. Sarvjeet Singh, Pr. Sci. (Pl. Br.); Dr. Poonam Sharma, Pr. Sci. (Micro.); Dr. Ravinder Singh, Pr. Sci. (Ento.) and Dr. Upasana Rani, Sci. (Patho.) PAU, Ludhiana





Name of Project	Department/ Research Station	Date of Monitoring	Name and designation of member of monitoring
AICRP on Wheat and Barley	Agricultural Research station, JAU, Amreli	February 20, 2019	1. Dr. Hanifkhan, Senior Scientist, Karnal 2. Dr. Shashikant Patel, Asstt. Res. Sci., Wheat Research Station, Vijapur,
AICRP on Wheat	Wheat Research Station, JAU, Junagadh	February 21, 2019	3. Dr. K. K. Mishra, Sr. Sci., Pawarkheda 4. Dr. Jagadish Chaudhari, Asstt. Professor, MPUAT, Udaypur (Rajasthan) 5. Dr. J. B. Singh, Senior Scientist (Pl. Br.), Regional Research Station, Indore

**Table 4.2.7 List of AICRPs functioning in the university
(ICAR Shared the grant 75% & State Govt. 25%)**

Sr. No.	Budget Head	Scheme	Sanction Year	Location
1	2002-00	AICRP on Pearl millet	1969	Main Pearl millet Research Station, Jamnagar
2	2004-00	AICRP on Wheat	1987	Wheat Res. Station, Junagadh
3	2008-01G	AICRP on Groundnut	1987	Main Oilseed Res. Station, Junagadh
4	2008-1C	AICRP on Castor	1968	Main Oilseed Res. Station, Junagadh
5	20-1SM	AICRP on Sesame	1986	Agricultural Research Station, Amreli
6	2009-00	AICRP on Cotton	1967	Cotton Research Station, Junagadh
7	2013-01	AICRP on Vegetable	1988	Vegetable Res. Station, Junagadh
8	2258-D	AICRP on Farm implements & machinery	2015	Dept. of Farm Machinery & Power, CAET, Junagadh
9	2030-01	AICRP on Long term fertilizer experiments	1999	Dept. of Agri. Chemistry & Soil Science, CoA, Junagadh
10	2040-00	AICRP on Cropping system research (CSR sub centre)	1989	Department of Agronomy, CoA, Junagadh
11	2042-01	AICRP on Dry land agriculture	1971	Main Dry Farming Research Station, Targhadia
12	2076-02	AICRP on BSP-NSP seed technology research	1984	Main Pearl millet Research Station, Jamnagar
13	2258-00	AICRP on Post-harvest Technology	1980	Dept. of Processing & Food Engg., CAET, Junagadh
14	2374-00	AICRP on Chickpea	1993	Pulses Research Station, Junagadh
15	2374-05	AICRP on Pigeon pea	2000	Pulses Research Station, Junagadh
16	2258-B	AICRP on Plasticsulture Engineering & Technologies	2005	Dept. of Renewable Energy Engg., CAET, Junagadh
17	2258-A	AICRP on Ground water utilization	2004	Dept. of Soil & Water Conservation Engg., CAET, Junagadh
18	2305-03	Network project on buffalo	2001	Cattle Breeding Farm, Junagadh
19	2303-08	Gir germ plasm unit	2009	Cattle Breeding Farm, Junagadh
20	2303-09	Gir data recording unit	2009	Cattle Breeding Farm, Junagadh





External Funded Research Projects

The university is also undertaking various external funded research projects of ICAR, Govt. of India, Govt. of Gujarat and Private Agencies.

According to their terms and conditions, research work is carried out and research report is submitted to concern funding agency.

Table 4.2.8 List of External Funded Research Projects functioning in the university

Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
1	18008-43	Devp. and promotion of promising varieties/ lines with high yield and high oil content with enhanced O/L ratio for enhancing production and quality of groundnut oil in drought-prone environments to boost the income of small and marginal groundnut farmers in India.	2011	ICRISAT, Hyderabad	Main Oilseed Research Station, Junagadh
2	18005-10	Genetically enhanced micronutrient- dense pearl millet grains for improved human nutrition in the India	2010	ICRISAT, Hyderabad	Main Pearl millet Research Station, Jamnagar
3	18053	Scheme for creating permanent machinery for studying the cost of cultivation/ production of principal crops grown in Gujarat state (Non plan under DAG)	1984	DAG, Govt. of Gujarat	Dept. of Agril. Economics, Junagadh
4	18005-04, 05 & 15	Agricultural demonstration activities in SSP command area Phase-II	2010	Sardar Sarovar Narmada Nigam Ltd. Govt. of Gujarat	DFRS, Vallbhipur, Agri. School, Halvad and Cotton Research Station, Kukada
5	18311-12	Mapping and marine fish biodiversity along the Veraval coast using mtDNA barcoding.	2012	GSBTM, Govt. of Gujarat	College of Fisheries Science, Veraval
6	18005-18	Establishment of model organic farm	2015	GoG	Dept. of Agronomy, Junagadh
7	18005-01	Experimental agro-met advisory services	1996	GOI	Dept. of Agronomy, Junagadh/ MDFRS, Targhadia
8	18126-02	Centrally sponsored scheme (Spices)	2006	GOI	Vegetable Research Station, Junagadh
9	18127-00	Seed production in agricultural crops and fisheries	2006	GOI	(Oilseed-Megaseed) Junagadh
10	18127-00	Seed production in agril. crops and fisheries (Oilseeds-Megaseeds)	2006	GOI	Main Oilseed Research Station and Dept. of Seed Sci. & Tech., Junagadh
11	18803-01 to 12	Megaseed revolving fund	2006		
12	18804-01 to 04	Seed production in agricultural crops	2006		





Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
13	18005-06	Forecasting agricultural output using space, agro meteorology and land based observations (FASAL)	2011	GOI	Dept. of Agronomy, Junagadh
14	18025-05	Ocean state forecast validation and research (Okha and Veraval coasts of Gujarat)	2013	GOI	Fisheries Research Station, Okha
15	18003-10	Utilization of chickpea genome sequence for crop improvement	2014	GOI	Pulses Research Station, Junagadh
16	2012	All India network research project on onion and garlic	2009	ICAR-Network	Vegetable Research Station, Junagadh
17	2030-2	Soil test based fertilizers application for targeted yield of Bt cotton in Saurashtra region of Gujarat	2010	ICAR-Network	Dept. of Agri. Chem. & Soil Science, Junagadh
18	2042-02	National initiative on climate resilient agriculture - dry land	2011	ICAR-Network	Main Dry Farming Res. Station, Targhadia
19	2002-03	National surveillance program for aquatic animal diseases	2013	ICAR-Network	College of Fisheries Science, Veraval
20	2002-5	Implementation of protection of plant varieties and farmer's rights legislation	2002	ICAR-Network	Main Pearl millet Res. Station, Jamnagar
21	2027-04	Network project on market intelligence	2013	ICAR-Network	Dept. of Agril. Economics, Junagadh
22	2004-1	Project for frontline demonstration in wheat		ICAR-Network	Wheat Research Station, Junagadh
23	2008-3	Project for frontline demonstration in sesame	2007	ICAR-Network	Agriculture Research Station, Amreli
24	2008-11	Need based research on AICRP on castor	-	ICAR-Network	Main Oilseed Research Station, Junagadh
25	2008-12	Scheme for breeder seed production of oilseeds crops (ICAR revolving fund)	2007	ICAR-Network	Main Oilseed Research Station, Junagadh
26	2009-6	Front line demonstration on cotton	2001	ICAR-Network	Cotton Research Station, Junagadh
27	2076-3	Central sector special food grain production of breeder seed (Revolving fund)	-	ICAR-Network	Pulses Research Station, Junagadh
28	2254	Study storage losses of food grains	2013	ICAR-Network	Dept. of PFE, CAET, Junagadh
29	2259	Testing fees for conduct of AICMIP	2002	ICAR-Network	Main Pearl Millet Res. Stat., Jamnagar/ Agril. Res. Station, Talaja
30	2374-1	FLD on Chickpea	-	ICAR-Network	Pulses Research Station, Junagadh
31	2374-6	FLD on Pigeon pea		ICAR-Network	Pulses Research Station, Junagadh
32	2504-00	Revolving fund horticulture (Nursery)	-	ICAR-Network	Dept. of Horticulture, Junagadh





Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
33	2704-40	Project for frontline demonstration on groundnut	1999	ICAR-Network	Main Oilseed Res. Station, Junagadh/ Agril. Res. Stat., Amreli
34	2704-43	Project for frontline demonstration in pearl millet	1989	ICAR-Network	Main Pearl millet Research Station, Jamnagar
35	2002-07	Consortia research platform (CRP) on bio fortification	2014		
36	18132	Creation of seed-hubs for increasing indigenous production of pulses in India	2016	ICAR-Network	Dept. of Seed Science & Tech., Junagadh
37	18024-13	Genome and transcriptome sequencing of coriander (<i>Coriandrum sativum</i>) to reveal insight of its genomic architecture and breeding targets	2016	GOG	Dept. of Biotechnology, Junagadh
38	18311-17	Evaluation of fish meal substitution with plant proteins in formulated feed in rohu (<i>Lebeo rohita</i>) through nutrigenomics approach	2016	GOG	Dept. of Biotechnology, Junagadh
39	18055-02	Estimation of coconut yield and production in the state of Gujarat	2017	GOI	Dept. of Economics, Junagadh
40	18303-14	Technical assistance for wild life health care, diseases diagnosis and therapeutic management	2017	GOG	College of Veterinary Science & Animal Husbandry, Junagadh
41	18802-03	Use of molecular markers in testing genetic purity of dwarf and tall coconut population at Mangrol (Agri. Res. Station) and Mahuva (Fruit Res. Station) sub-center of JAU, Junagadh	2017	GOG	Wheat Research Station/ Dept. of Genetics & Plant Breeding, Junagadh
42	18803-12	Centre for entrepreneurship development on agri. and allied sci.	2016	GOG	Dept. of Seed Sci. & Technology, Junagadh
43	18009-33	Proliferation of Bt-gene in native cotton varieties of Gujarat	2017	GOG	Cotton Research Station, Junagadh
44	2009-09	Testing of Bt. Cotton	2017	ICAR	Cotton Research Station, Junagadh
45	18246-91	River flow simulations integrating satellite data in forested catchment	2017	GOG	CAET, JAU, Junagadh
46	18009-34	Seed infrastructure under NMOOP	2017	GOG	Agril. Research Station, JAU, Amreli





Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
47	1855-03	Mapping and valuation of economics, social and environmental benefits of conserving Gir Forest area	2018	GOG	Dept. of Economics, JAU, Junagadh
48	18024-14	To identify the candidate biocontrol agent putatively involved in biological control of plant disease	2018	GOI	Dept. of Biotechnology, JAU, Junagadh
49	2009-07	Insecticide Resistance Management: Dissemination of pink bollworm management strategies	2018	ICAR	Cotton Research Station, JAU, Junagadh
50	18132-02	Creation of Seed-Hubs for Enhancing Quality Seeds Availability of Major Oilseeds Crops - Groundnut under NFSM - Oilseed mission	2018	GOI	Department of Seed Science & Technology, JAU, Junagadh

4.3 Crop Improvement

New crop varieties

Six varieties viz. Groundnut (GG 41), Pearl millet (GHB 1129 and GHB 1225) Cotton (G. Cot 38), Uradbean (GU 2) and Ridge Gourd 2 (GRG 2) were recommended for farmers of the state during the year 2018-19.

Groundnut: Gujarat Groundnut 41 (GG 41)

The farmers of Gujarat state growing groundnut during *kharif* season are advised to grow virginia runner groundnut variety Gujarat Groundnut 41 (GG 41). This variety has recorded mean pod yield of 2722 kg/ha, which was 15.74 and 16.10 per cent higher over the check varieties, GG 11 (2352 kg/ha) and



GJG 17 (2344 kg/ha), respectively. This variety has also recorded high shelling and oil per cent over the check varieties. The GG 41 was found comparable to the checked varieties against tikka and rust diseases.

The incidence of stem rot and collar rot diseases was very low in GG 41. The damage due to thrips and leaf defoliators was also lower in GG 41 than the check varieties.

Pearl Millet Hybrid: Gujarat Hybrid Bajara 1129 (GHB 1129)

The pearl millet growing farmers of Gujarat state are recommended to grow the biofortified pearl millet hybrid GHB 1129 during *kharif* season as medium maturing hybrid. This hybrid has given 2957 kg/ha grain and 6210 kg/ha dry fodder yield which is 8.0 and 12.9 per cent, respectively higher over presently recommended medium maturing check hybrid GHB 744 and 3012 kg/ha grain and 6350 kg/ha dry fodder



yield which is 6.9 and 11.7 per cent, respectively higher over latest medium maturing check hybrid GHB 905. This proposed biofortified hybrid is also recommended to grow during summer season, in





which it has given 5303 kg/ha grain 9179 kg/ha dry fodder yield which is 15.7 and 7.3 per cent higher over check hybrid GHB 558, respectively and at par yield and 6.2 per cent higher dry fodder yield than check hybrid GHB 732. The proposed hybrid has also given higher grain and dry fodder yield over private sector check hybrid. Further, this hybrid is tolerant to major pearl millet diseases, pest and lodging. Moreover, this hybrid is having higher micro nutrient minerals Fe (more than 70 ppm) and Zn (more than 40 ppm) in its grain over it's all the yield checks which is additional benefit to the farming and consumer community of pearl millet for their nutritional security.

Pearl Millet Hybrid: Gujarat Hybrid Bajara 1225 (GHB 1225)

The *kharif* pearl millet growing farmers of Gujarat state are recommended to grow the GHB 1225 as late group dual purpose biofortified hybrid. It has given 3023 kg/ha grain and 7306 kg/ha dry fodder yield which is 22.98 and 10.74 per cent higher grain and 21.1 and 17.4 per cent higher dry fodder yield over presently recommended medium late group hybrids GHB 558 and GHB 732, respectively. The proposed hybrid has also given higher grain and dry fodder yield over private sector check hybrid. Further, the proposed hybrid is resistant to major pearl millet diseases and pest and this hybrid is having higher micronutrients minerals Fe (more than 70 ppm) and Zn (more than 40 ppm) content in its grain which is additional benefit to the farming and consumer community of pearl millet for their nutritional security.



Cotton: Gujarat Cotton 38 (G. Cot 38)

The farmers of Gujarat state growing Non Bt cotton (*Gossypium hirsutum* L.) under irrigated conditions are advised to grow variety Gujarat Cotton-

38 (G.Cot-38). This variety has recorded a seed cotton yield of 2315 kg/ha, which is 28.1, 19.7, 9.0 and 18.9 per cent higher than the check varieties, G.Cot-18,



G.Cot-20, GN.Cot-22 and CNHO-12 as a zonal check, respectively. The lint yield in G.Cot-38 was 767 kg/ha, which is 27.5, 18.1, 6.0 and 11.4 per cent higher than check varieties G.Cot-18, G.Cot-20, GN.Cot-22 and CNHO-12, respectively. It has 33.1 per cent ginning outturn and 19.2 per cent oil. This variety is medium late in maturity.

Urdbean: Gujarat Urd 2 (GU 2)

The Farmers of Gujarat growing urd in *kharif* season are advised to cultivate Gujarat Urd-2 (GU 2) variety. This variety has produced (1079 kg/ha) 14.9 per cent higher seed yield over both the check



varieties T-9 (939 kg/ha) and Gujarat Urd-1 (939 kg/ha). Seeds of this variety are of large size and greenish brown in colour. This variety is resistant to MYMV, leaf curl and powdery mildew diseases.

Ridge Gourd:Gujarat Ridge Gourd 2 (GRG 2)

The farmers of Saurashtra and Middle Gujarat regions, growing ridge gourd during *kharif* season are advised to grow Gujarat Ridge Gourd-2 (GRG-2). This variety has recorded average fruit yield of 105.70 q/ha,





which was 22.06 and 29.76 per cent higher over check varieties; Gujarat Anand Ridge Gourd-1 (86.60 q/ha) and Pusa Nasdar (81.46 q/ha), respectively. The fruits of this variety are long in size, green in colour with better in quality characters *viz.*, protein, sugars, TSS and chlorophyll-B contents as compared to check varieties.

Recommendation for Farmers' Community

Effect of pre-treatment on seed emergence and seedling vigour of coriander

The farmers of South Saurashtra region growing coriander are advised that the bitted seeds of coriander with pre-treatment of GA₃ @ 50 mg/ litre for 12 hrs or NaCl 2g/ litre for 12 hrs or the bitted seeds tied in wet coarse cloth (*Pacchedi*) for 12 hrs gives early emergence with good germination percentage and seedling vigour.

4.4 Crop Production

Recommendation for Farmers' Community

Nutrient Management

Herbicidal control of purple nutsedge

The farmers of South Saurashtra Agro-climatic Zone are recommended to spray either tank-mix glyphosate 1230 g/ha (41% SL 60 ml/10 L water) + halosulfuron-methyl 33.75 g/ha (75% WG 0.9 g/10 L water) or halosulfuron-methyl 67.5 g/ha (75% WG



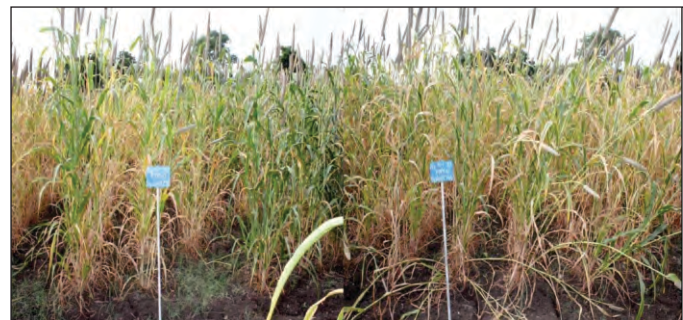
1.8 g/10 L water) at 30 days after emergence for effective control of purple nutsedge under non-cropped condition during summer season. These herbicides have no residual effect on the succeeding *kharif* crops (groundnut, pearl millet, cotton and sesame) grown 90 days after spray.

Fertilizer management in groundnut + castor (3:1) intercropping system under rainfed condition

The farmers of North Saurashtra Agro-climatic Zone growing groundnut + castor (3:1) intercropping system are recommended to apply 75 % of recommended fertilizer dose to groundnut and 100 % recommended fertilizer dose to castor on area basis of both the crops for obtaining higher yield and net return.

Performance of pearl millet hybrid and popular cultivars under organic condition

The farmers of North Saurashtra Agro-climatic Zone adopting organic farming of pearl millet are recommended to apply FYM 10 t/ha and sow



pearl millet hybrid GHB 732 or GHB 744 or GHB 538 for achieving higher yield and net realization, maintaining soil fertility and improving quality of produce.

Effect of N, P and K fertilizers on growth, yield and nutrients uptake by brinjal

The farmers of South Saurashtra Agro-climatic Zone growing brinjal under medium black calcareous soil in late *kharif* season are recommended to apply nitrogen @ 125 kg/ha in four equal splits (Basal, 25, 50 and 75 days after transplanting), P₂O₅ @ 50 kg/ha and K₂O @ 50 kg/ha as basal for achieving higher yield and net return.





Cultural Practices

Evaluation of groundnut + sweet corn mix/intercropping systems

The farmers of South Saurashtra Agro-climatic Zone growing *kharif* groundnut are



recommended to adopt paired row (45-75-45 cm) groundnut + sweet corn (2:1) or groundnut + sweet corn (3:1) additive intercropping system for achieving higher net returns as compared to sole groundnut.

Optimization of seed rate and spacing in semi-spreading groundnut cultivars having differential seed sizes

The farmers of South Saurashtra Agro-climatic Zone growing *kharif* semi-spreading groundnut



varieties having seed index of 42-45 and 50-52 g/100-seed are recommended to sow at spacing of 45 cm x 10 cm with seed rate of 110 and 125 kg/ha, respectively for obtaining higher yield and net returns.

Production potential and economics of *Bt* cotton based intercropping system under rainfed condition

The farmers of North Saurashtra Agro-climatic Zone adopting *Bt* cotton-based intercropping system under rainfed condition are recommended to



intercrop one row of cowpea or sesame or groundnut or green gram in between two rows of cotton (Spacing: 120 cm x 30 cm) for obtaining higher yield and net return.

Effect of spacing on castor under conserved moisture condition at Ratia

The farmers of North Saurashtra Agro-climatic Zone growing castor in *Ghed* area under conserved soil moisture are recommended to sow the castor at 120 cm x 60 cm for obtaining higher yield and net return.

Irrigation Management

Response of *Bt* cotton to high density planting and nitrogen levels through fertigation

The farmers of South Saurashtra Agro-climatic Zone growing *Bt* cotton (Cv. G.Cot.Hy.-8 BG-II) under high density planting are recommended to sow the crop at 30-60-30 cm x 30 cm or 30-90-30 cm x 30 cm in paired row and fertilized with 125%





RDN (300 kg N/ha) in eight equal splits at 15 days interval through drip fertigation along with 50 kg P₂O₅

and 150 kg K₂O/ha for obtaining higher yield and net return.

Details of drip system

Details of drip system particular	Detail	Duration of irrigation
Lateral spacing	90 cm	Oct.: 1 hour 30 minutes
Dripper distance	40 cm	Nov.: 1 hour 20 minutes
Dripper discharge rate	4 L/h	Dec.: 1 hour 15 minutes
Operation pressure	1.2 kg/cm ²	
Irrigation interval	Alternate day	

Weed Management

Integrated weed management in Indian bean

The farmers of South Saurashtra Agro-climatic Zone growing Indianbean in *rabi* season are recommended to carryout hand weeding at 15, 30 and 45 DAS for effective weed management and achieving higher seed yield and net realization.



Post-emergence weed management in wheat

The farmers of South Saurashtra Agro-climatic Zone growing wheat are recommended to carry out hand weeding at 15 DAS *fb* either ready-mix sulfosulfuron + metsulfuron 32 g/ha (75 + 5% WDG



0.8 g/10 L water) or ready-mix clodinafop + metsulfuron 64 g/ha (15 + 1% WP 8 g/10 L water) at 30 DAS or hand weeding at 15 and 30 DAS as per availability of labourers for effective weed management along with higher yield and net returns.

Weed control in *kharif* groundnut

The farmers of North Saurashtra Agro-climatic Zone growing groundnut during *kharif* season are recommended to keep their crop weed free through hand weeding and interculturing at 15, 30, 45 and 60 DAS or apply Quizalofop - ethyl 40 g/ha at 20 DAS *fb* IC & HW at 40 DAS for effective weed management as well as to obtain higher yield and net return.

Weed management in autumn planted sugarcane-chickpea intercropping system

The farmers of South Saurashtra Agro-climatic Zone growing autumn-planted sugarcane are recommended to grow one row of chickpea as an intercrop in sugarcane planted at 90 cm row spacing for securing higher yield and net return. Weed control should be done with two hand weeding at 30 and 60 days after sowing of the intercrop.





Recommendation for Scientific Community

Integrated weed management in castor

Under South Saurashtra Agro-climatic Zone, effective weed management as well as higher seed yield and net returns from irrigated castor during *kharif* season can be achieved by keeping the crop weed free through interculturing and hand weeding at 20, 40, 60, 80, 120 and 150 DAS or pendimethalin as pre-emergence 1 kg/ha *fb* Quizalofop ethyl 0.05 kg/ha as post-emergence at 25 DAS *fb* IC & HW at 60 DAS.

Weed control in *kharif* groundnut

Under North Saurashtra Agro-climatic Zone, effective weed management as well as higher yield and net returns from *kharif* groundnut can be achieved by application of Oxyfluorfen 0.24 kg/ha as pre-emergence *fb* IC & HW at 40 DAS.

Integrated weed management in Indian bean

Under South Saurashtra Agro-climatic Zone, effective weed management along with higher yield and net returns from *rabi* Indian bean can be achieved



by pre-emergence application of either pendimethalin 30% EC 900 g a.i./ha as pre-emergence or pendimethalin 37.8% CS 900 g a.i./ha as pre-plant incorporation followed by interculturing and hand weeding at 45 DAS.

Weed management in autumn planted sugarcane + chickpea intercropping system

The scientific community is informed that application of pendimethalin 1.0 kg/ha as pre-emergence followed by hand weeding at 45 days after sowing of chickpea as intercrop in sugarcane planted



at 90 cm row spacing gave higher yield and net return as well as effective weed management.

Performance of sesame genotypes differing in maturity and plant types and their response to spacing in *kharif* season.

In North Saurashtra Agro-climatic Zone, sesame varieties/genotypes differing in maturity and plant type gave higher seed yield with different spacing in *kharif* season as below.



- Variety with profuse branches and late maturity (G.Til 10) at 45 cm x 10 cm or 60 cm x 10 cm spacing.
- Variety with few branches and mid late (G.Til 3 and GJT 5) as well as late maturity (AT 308) at 45 cm x 10 cm or 30 cm x 10 cm spacing.
- Variety with few branches and early maturity (AT 375 and AT 377) at 30 cm x 10 cm spacing.
- Uniculm variety with late maturity (AT 363 and AT 374) at 30 cm x 10 cm spacing.

Establishment of critical limit of sulphur for green gram crop in medium black calcareous soils.

For recommending sulphur application to green gram crop grown in calcareous soils of Saurashtra, STLs of Gujarat should consider the critical limit of





13.8 ppm in soil and 0.395 per cent in green gram plant at 45 DAS.

Soil test based fertilizers application for targeted yield of soybean in Saurashtra region of Gujarat

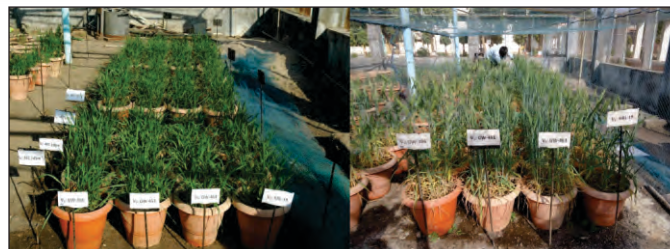
The soil testing laboratories are informed that the nutrients requirement for production of one quintal soybean seed was assessed as 5.65, 0.91 and 2.53 kg; N, P₂O₅ and K₂O, respectively. The fertilizer prescription equations are: for N: $[FN = (7.87 \times T) - (0.50 \times SN) - (0.39 \times FYM)]$, P: $[FP_2O_5 = (3.10 \times T) - (1.87 \times SP) - (0.17 \times FYM)]$ and K: $[FK_2O = (4.70 \times T) - (0.20 \times SK) - (0.19 \times FYM)]$ with FYM. Targeted



yield concept could effectively be adopted up to 20 q/ha for site specific fertilizer recommendation to achieve high yields of soybean in the medium black calcareous soils of Saurashtra region of Gujarat.

Effect of saline irrigation water on wheat crop

It is information for scientific community especially plant breeders that wheat varieties GW 366 and KRL 19 recorded higher mean salinity index (86.7 and 79.8 %), comparable mean seed yield (18.4 and 14.4 g/pot), minimum yield decline (29.38 and



34.89 %) at EC 8.0 dS/m and for 50% yield reduction at EC 12.24 and 10.54 dS/m, respectively as well as lower Na/K ratio in grain (GW 366) and straw (KRL19), hence found more tolerant as compared to GW 451 and GW 463.

Effect of saline irrigation water on tomato crop

It is information for scientific community especially plant breeders that tomato varieties Anand Tomato 3 and Gujarat Tomato 1 recorded higher mean fruit yield (219.3 and 213.1 g/pot), higher mean salinity index (80.8 and 76.9 %), minimum yield decline (29.84 and 37.84 %) at 8.0 dS/m and for 50% yield reduction at EC 11.92 and 10.21 dS/m, respectively, hence found more salt tolerant compared to Gujarat Tomato 2 and Junagadh Tomato-3.

Effect of saline irrigation water on brinjal crop

It is information for scientific community especially plant breeders that brinjal variety GJB 2 recorded higher mean fruit yield (1490.2 g/plot) with mean salinity index (78.7 %), yield decline (31.16 %)



at 8.0 dS/m and for 50% yield reduction at EC 11.28 dS/m, as well as lower Na/K ratio in fruit (0.124) and stalk (0.10) comparable with other varieties.





4.5 Plant Protection

The research work carried out by plant protection group is to develop the economically viable technology for increasing production of agricultural commodities without any adverse effect on the environment and livelihood of the people.

Recommendation for Farmers' Community

Entomology

Effectiveness of *Beauveria bassiana* in combination with different insecticides against onion thrips

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply three sprays of dimethoate 30 EC 0.03% (10 ml/10 l of water)

OR *Beauveria bassiana* 1.15 WP 0.0035% (Min. 2 x 10⁶cfu/g) + dimethoate 30 EC 0.015% (30 g + 5.0 ml/10 l of water) OR *Beauveria bassiana* 1.15 WP 0.007% (60 g/10 l of water) first at initiation of pest infestation and subsequent two sprays at ten days interval for effective and economical management of thrips, *Thrips tabaci* in onion.



Summary of recommendation for farming community										
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2018-19	Onion	Thrips	Dimethoate 30 EC	150	0.500 l	0.03	10 ml	500 l	First spray at pest initiation and subsequent two sprays at ten days interval after first spray	-
			<i>Beauveria bassiana</i> 1.15 WP + dimethoate 30 EC	17 + 75	1.5 kg + 0.250 l	0.0035 (Min 2 x 10 ⁶ cfu/g) + 0.015	30 g + 5 ml	500 l	-	
			<i>Beauveria bassiana</i> 1.15 WP	35	3.0 kg	0.007 (Min 2 x 10 ⁶ cfu/g)	60 g	500 l	-	

Effect of different schedule base insecticidal spray against garlic thrips

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply schedule spraying of *Beauveria bassiana*1.15 WP (Min. 2x10⁶ cfu/g), first

spray at initiation of pest infestation 0.0035% (30 g/10 l of water). Subsequent second 0.007% (60 g/10 l of water) and third 0.009% (80 g/10 l of water) spray at ten days interval for effective and economical management of thrips, *Thrips tabaci* in garlic.





Summary of recommendation for farming community										
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2018-19	Garlic	Thrips	<i>Beauveria bassiana</i> 1.15 WP	17	1.50 kg	0.0035% (Min.2x10 ⁶ cfu/g)	30 g	500 l	First spray at initiation of pest infestation and subsequent two sprays at ten days interval after first spray	-
			<i>Beauveria bassiana</i> 1.15 WP	35	3.00 kg	0.007% (Min.2x10 ⁶ cfu/g)	60 g			-
			<i>Beauveri bassiana</i> 1.15 WP	46	4.00 kg	0.009% (Min.2x10 ⁶ cfu/g)	80 g			-

Management of sucking pests in cumin

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply two sprays of *Beauveria bassiana* 1.15 WP (Min. 2x10⁶ cfu/g) 0.007% (60 g/10 l of water), first at initiation of pest infestation and second at ten days interval for effective, economical and eco-friendly management of thrips, *Thrips tabaci* in cumin.



Summary of recommendation for farming community										
Year	Crop	Pest	Pesticides / Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2018-19	Cumin	Thrips	<i>Beauveria bassiana</i> 1.15 WP	35	3.0 kg	0.007 (Min. 2x10 ⁶ cfu/g)	60 g	500 l	First spray at initiation of pest infestation and second spray at 10 days interval after first spray	-

Evaluation of new pheromone based mating disruption technology for fruit fly in mango

The farmers of South Saurashtra Agro-climatic Zone (VII) growing mango are advised to give Sawaj MDP technology 400 g paste/ha uniformly distributed in 1000 dots on main and subsidiary branches of each tree against fruit fly, first application in the month of March, when fruit fly catches in the trap and successive two applications at 30 days interval for effective, economical and eco-friendly management.





Summary of recommendation for farming community										
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2018-19	Mango	Fruit fly	Sawaj MDP technology	-	400 g Paste per application per ha	-	-	-	First application in the month of march, while second and third at 30 days interval after first application.	-

Effectiveness of different bio-pesticides against mealybug in custard apple

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply two sprays of *Lecanicillium lecanii* 1.15 WP (Min. 2×10^6 cfu/g) 0.007% (60 g/10 l of water) OR *Beauveria bassiana* 1.15 WP (Min. 2×10^6 cfu/g) 0.007% (60 g/10 l of water) along with sticker (3 ml/10 l of water), first at initiation of pest infestation and second at 20 days interval for effective, economical and eco-friendly management of mealybug in custard apple.



Summary of recommendation for farming community										
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2018-19	Custard apple	Mealy bug	<i>Lecanicillium lecanii</i> 1.15 WP	83	7.2 kg	0.007 (Min. 2×10^6 cfu/g)	60 g	1200 l	First spray at initiation of pest infestation and second spray at 20 days interval after first spray	-
			<i>Beauveria bassiana</i> 1.15 WP	83	7.2 kg	0.007 (Min. 2×10^6 cfu/g)	60 g			-

Testing the bio-efficacy of newer insecticides against castor defoliators

The farmers of South Saurashtra Agro-climatic Zone (VII) growing castor are advised to apply two sprays of chlorantraniliprole 18.5 SC 0.006% (3.0 ml/10 l of water) OR indoxacarb 14.5 SC 0.0073% (5.0 ml/10 l of water) OR spinosad 45 SC 0.009% (2.0 ml/10 l of water) OR emamectin benzoate 5%

WG 0.002% (4.0 g/10 l of water) at 15 days interval starting from pest infestation for effective and economical management of defoliators (*Spodoptera* and Semilooper).

Note:

Castor being a non edible crop CIB recommendation for insecticides are not considered.





Summary of recommendation for farming community											
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remarks
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2018	Castor	Defoliators	Chlorantraniliprole 18.5 SC	27.8	0.150 l	0.006	03 ml	500 l	First spray at initiation of defoliators and second at 15 days after first spray	112	Result of residual analysis was found below detection limit.
			Indoxacarb 14.5 SC	36.3	0.250 l	0.0073	05 ml	500 l			
			Spinosad 45 SC	45	0.100 l	0.009	02 ml	500 l			
			Emamectin benzoate 5 WG	10	0.200 l	0.002	04 g	500 l			



Management of lepidopteron pests using botanicals in groundnut

The farmers of South Saurashtra Agro-climatic Zone (VII) growing groundnut in *kharif* season are advised to apply two sprays of pongamia oil (30 ml/10 l of water) OR ponneem (30 ml/10 l of water) at 15 days interval starting from pest infestation for effective and economical management of defoliators (*Helicoverpa* and *Spodoptera*). To prepare ponneem, mix 450 ml of neem oil + 450 ml of pongemia oil (karanj oil) + 100 ml of soap solution (wetting agent).



Evaluation of egg parasitoid *Trichogramma bactrae* through inundative release for the management of cotton pink bollworm

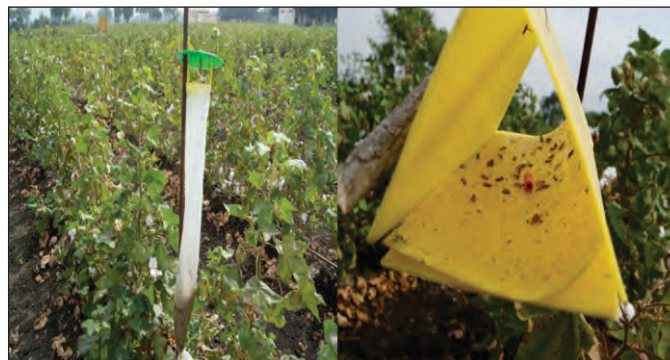
The farmer of the South Saurashtra Agro-climatic Zone (VII) growing cotton are advised to apply *Trichogramma bactrae* 1.5 lakh parasitoid eggs per hectare, two release at flowering stage (40-50 days) at weekly interval and three release at boll formation stage (60-75 days) at weekly interval for biological management of pink bollworm.





Evaluation of pheromone traps and lures against cotton pink bollworm through mass trapping

The farmers of the South Saurashtra Agro-climatic Zone (VII) growing cotton are advised to install the phero-sensor TM-BP-sleeve trap OR phero-sensor TM-SP-sleeve trap, 20 traps/ha after 30 days of germination. Change the sex pheromone trap lure thrice in a season at 45 days interval for effective management of pink bollworm.



Summary of recommendation for farming community									
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)			
2018	Cotton	Pink bollworm	Phero-sensor TM-BP-sleeve trap	-	20 traps/ha	-	-	Installation of traps at 30-35 days after germination and each trap lure changed after 45 days interval.	-
			Phero-sensor TM-SP-sleeve trap	-	20 traps/ha	-	-		-

Bio-efficacy of insecticides against major sucking pests in *Bt* cotton

The farmers of South Saurashtra Agro-climatic Zone (VII) growing *Bt* cotton are advised to apply three sprays of flonicamid 50 WG 0.02% (4.0 g/10 l of water) OR diafenthiuron 50 WP 0.06% (12.0 g/10 l of

water) OR dinotefuran 20 SG 0.008 % (4.0 g/10 l of water), first at pest initiation and subsequent two sprays at 15 days interval for effective and economical management of aphid, jassid, whitefly and thrips.

Summary of recommendation for farming community										
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2017-18	Cotton	Aphid, Jassid, Thrips and Whitefly	Flonicamid 50 WG	100	0.200 kg	0.02	4 g	500 l	First spray at pest appearance and subsequent two sprays at 15 days interval after first spray	25
			Diafenthiuron 50 WP	300	0.600 kg	0.06	12 g			21
			Dinotefuran 20 SG	40	0.200 kg	0.008	4 g			15





Management of major insect pests infesting pearl millet under organic cultivation

The farmers of North Saurashtra Agro-climatic Zone (VI) growing organic pearl millet are advised to apply two sprays of *Beauveria bassiana* 1.15 WP

(2×10^6 cfu/g) 50 g/10 l of water at 30 and 60 days after sowing for the effective and economical management of shoot fly and stem borer, whereas for ear head worm, *Helicoverpa armigera* one spray of *Ha* NP V 250 LE / ha at anthesis stage to be carried out.

Summary of recommendation for farming community											
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remarks
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Pearl millet (bajra)	Shoot fly and stem borer	<i>Beauveria bassiana</i> 1.15 WP ₆ (2×10^6 cfu/g)	28.75	2.500 kg	5g/l	50 g	500 l	Two spray at 30 and 60 DAS	-	-
		<i>Helicoverpa a armigera</i>	<i>Ha</i> NPV @ 250 LE/ha	--	0.250 l	250 LE/ha	5 ml	500 l	Single spray at anthesis stage	-	--

Plant Pathology

Efficacy of bio-agents against *Aspergillus flavus* and aflatoxin production in groundnut

Farmers of South Saurashtra Agro-climatic Zone (VII) growing groundnut are advised furrow application of *Trichoderma harzianum* 1% WP (2×10^6 cfu/g) 0.625 kg + *Pseudomonas fluorescens* 1% WP (1×10^8 cfu/g) 0.625 kg in 125 kg of castor cake/ha at the time of sowing and soil application (broadcasting at plant base) of same quantity at one month after sowing found effective for management of aflarot (*Aspergillus flavus*).



Summary of recommendation for farming community											
Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remarks
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Groundnut	Aflarot disease	<i>Trichoderma harzianum</i>	-	0.625 kg	2×10^6 cfu/g	--	125 kg	At sowing and 30 DAS	Nil	These bio pesticides are not registered with CIB & RC for use in groundnut crop for management of this disease.
			<i>Pseudomonas fluorescens</i>	-	0.625 kg	1×10^8 cfu/g	--	125 kg	At sowing and 30 DAS	Nil	





Management of groundnut diseases through organic amendments, bio products and biocontrol agents

Farmers interested in organic cultivation of groundnut are advised to apply *Trichoderma harzianum* 1% WP (2x 10⁶cfu/g) as a seed treatment 10 g/kg seed along with its furrow application 4.0kg/ha

enriched in 300 kg FYM at the time of sowing for management of collar rot and stem rot diseases. Whereas, for leaf spot spray neem seed kernel extract 5% (500 g/10 l of water) at 30, 45 and 60 DASOR to spray cow urine 10% (1000 ml/10 l of water) at 20, 40, 60 and 80 days after sowing.

Summary of recommendation for farming community											
Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remark
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Groundnut	Collar rot, Stem rot & leaf spot disease	<i>Trichoderma harzianum</i>	--	10 g/ kg seed	2 x 10 ⁶ cfu/g	--	--	As a seed treatment	Nil	-
			<i>Trichoderma harzianum</i>	--	4.0 kg	2 x 10 ⁶ cfu/g	--	300 kg FYM	Furrow application at the time of sowing	Nil	
			Neem seed kernel extract	-	25 l	5 %	0.500 l	500 l	Three sprays at 30, 45 and 60 DAS	Nil	
			Cow urine	--	50 l	10 %	1.000 l	500 l	Four sprays at 20, 40, 60 and 80 DAS	Nil	



Efficacy of *Trichoderma harzianum* on growth and stem rot disease management in groundnut

The farmers of South Saurashtra Agro-climatic Zone (VII) growing *kharif* groundnut are advised to apply *Trichoderma harzianum* 1% WP (2x 10⁶cfu/g) as furrow application 4 kg/ha in 250 kg of castor cake at the time of sowing and soil drenching 4 kg/ha in soil at 30 days after sowing for effective and economical management of stem rot disease and obtaining higher pod yield. The application of *Trichoderma harzianum* also resulted in growth promoting ability by



increasing leaf dry weight, leaf area, plant height, number of branches, pods per plant and root length in groundnut.





Summary of recommendation for farming community											
Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remark
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Groundnut	Stem rot & Growth promoting Ability	<i>Trichoderma harzianum</i>	--	4.00 kg	2 x 10 ⁶ cfu/g	--	250 kg castor cake	Furrow application at the time of sowing	NIL	-
			<i>Trichoderma harzianum</i>	--	4.0 kg	2 x 10 ⁶ cfu/g	--	1000 l	As a soil drenching at 30 DAS	NIL	

Integrated management practices to minimize *Aspergillus flavus* infection and other diseases in groundnut

The farmers of South Saurashtra Agro climatic Zone (VII) growing *kharif* groundnut are advised seed treatment with mancozeb (75% WP) 3g/kg of seed + furrow application of *Trichoderma harzianum* 1% WP (2x 10⁶cfu/g) 2.5 kg in 250 kg of castor cake/ha at the time of sowing for effective and economical management of aflarot and obtaining higher pod yield. It is also effective for management of stem rot and collar rot.

Farmers interested in nonchemical cultivation of groundnut are advised seed treatment with *Trichoderma harzianum* 1% WP (2x 10⁶cfu/g) 10g/kg

of seed + furrow application of *Trichoderma harzianum* 2.5 kg enriched before one week in 250 kg of FYM/ha at the time of sowing for effective and economical management of aflarot and obtaining higher pod yield. It is also effective for management of stem rot and collar rot.



Summary of recommendation for farming community											
Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remark
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Groundnut	Aflarot disease and collar and stem rots	Mancozeb 75 % WP	0.36	3 g/kg seed	0.2 %	---	--	As a seed treatment	---	Registered product with CIB
			<i>Trichoderma harzianum</i>	---	2.5 kg	2 x 10 ⁶ cfu/g	--	250 kg castor cake	Furrow application at the time of sowing	Nil	-
OR											
2019	Groundnut	Aflarot disease and collar and stem rots	<i>Trichoderma harzianum</i>	---	10 g/kg seed	2 x 10 ⁶ cfu/g	--	--	As a seed treatment	Nil	-
			<i>Trichoderma harzianum</i>	--	2.5 kg	--	250 kg FYM	Furrow application at the time of sowing	Nil		





Biological control of root rot of castor

The farmers of South Saurashtra Agro climatic Zone (VII) growing castor during *kharif* season are advised to apply *Trichoderma harzianum* 1% WP (2×10^6 cfu/g) as seed treatment 4 g/kg seed along with its soil application 2.5 kg enriched in 100 kg FYM/ha for a week and applied at the time of sowing for effective and economical management of root rot disease.



Summary of recommendation for farming community											
Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remark	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)					Qty. of formulation in 10 l of water (g or ml)
2019	Castor	Root rot of castor	<i>Trichoderma harzianum</i>	---	4 g/kg seed	2×10^6 cfu/g	--	--	As a seed treatment	---	--
			<i>Trichoderma harzianum</i>	---	2.5 kg	2×10^6 cfu/g	--	100 kg FYM	Furrow application at the time of sowing	---	

Standardization of numbers of pheromone traps for fall army worm in maize

For effective management of fall army worm in maize, the farmers are advised to install 50 sex pheromone traps per hectare. The lure to be changed after 40 days

Evaluation of bio-agents and chemical insecticides against fall army worm in maize

For effective management of fall army worm in maize, the farmers are advised to apply three sprays of *Beauveria bassiana* 1.15 WP (2×10^6 cfu/g) 0.009 % (80 g/10 l of water) OR *Nomuria rileyi* 1.15 WP (2×10^6 cfu/g) 0.007 % (60 g/10 l of water) + S/NPV 450 LE (10 ml/10 l of water) OR two sprays of emamectin benzoate 5 SG 0.0025 % (5 g/10 l of water) OR thiodicarb 75 WP 0.075 % (10 g/10 l of water) OR spinetoram 11.7 EC 0.012 % (10 ml/10 l of water), first at initiation of pest infestation and second at 15-day interval.

Recommendation for Scientific Community

Entomology

Effectiveness of *Beauveria bassiana* combination of different insecticides against onion thrips

For effective and economical management of thrips, *Thrips tabaci* in onion, three sprays of spinosad 45 SC 0.0135 % (3 ml/10 l of water) OR *Beauveria bassiana* 1.15 WP 0.0035% (Min. 2×10^6 cfu/g) + spinosad 45 SC 0.0068% (30 g + 1.5 ml/10 l of water), first at initiation of pest infestation and subsequent two sprays at ten days interval found effective in onion.

Effect of different schedule base insecticidal spray against garlic thrips

For effective and economical management of thrips, *Thrips tabaci* in garlic, schedule spraying of dimethoate 30 EC 0.003% (10 ml/10 l of water), fipronil 5 SC 0.01% (5 ml/10 l of water) and acetamiprid 20 SP 0.006% (4 g/10 l of water) OR profenophos 50 EC 0.075% (20 ml/10 l of water), spiromesifen 240 SC 0.011% (10 ml/10 l of water) and thiamethoxam 25 WG 0.01% (4 g/10 l of water), first at initiation of pest infestation and subsequent two sprays at ten days interval after first spray.





Management of sucking pests in cumin

For effective and economical management of thrips, *Thrips tabaci* in cumin, two sprays of *Beauveria bassiana* 1.15% WP + dinotefuran 20% SG 0.005% (60 g + 2.5 g/10 l of water) OR *B. bassiana* + flonicamide 50% SG 0.0125% (60 g + 2.5 g/10 l of water), first at pest infestation and second at ten days interval.

Screening of sesame genotypes against insect pests and diseases under unprotected as well as protected condition

Sesame genotype AT 382 and variety G.Til 10 found resistant to mite pest whereas G.Til 10 also found resistant to powdery mildew and phytophthora diseases. These cultures can be utilized as multiple resistant source for further breeding programme.



Plant Pathology

Management of leaf spot of custard apple

For the effective and economical management of leaf spot of custard apple, apply three spray of tebuconazole 50% + trifloxystrobin 25% WG 0.045% (6 g/10 l of water) OR carbendazim 12% + mancozeb 63% WP, 0.15 % (20 g/10 l of water) OR azoxystrobin 23% SC, 0.023% (10 ml/10 l of water) OR mancozeb 75% WP 0.2% (27 g/10 l of water), first at initiation of disease and subsequent sprays at 20 days interval.



4.6 Horticulture and Agro Forestry

Recommendation for Farmers' Community

Effects of different doses of N and K with split application through fertigation system on yield and quality of banana (*Musa paradisiaca* L.) cv. Grand Naine.

Banana growers of South Saurashtra are cultivating in paired row system (1.2 x 1.2 x 2.4 m) are advised to apply 150 g each at N & K₂O per plant (325 g urea + 250 g muriate of potash) through fertigation with 30 splits at 7 days interval along with 5 kg FYM as a basal and 90g/plant phosphorus (560 g single super phosphate) in three equal splits at 3rd, 4th and 5th months after planting for getting higher yield and net return.



Effect of polyamines on quality and shelf life of mango (*Mangifera indica* L.) cv. Kesar.

Kesar mango traders are advised to dip freshly harvested mango fruit in Putrescine Dihydrochloride 175 mg/l for 5 minute for increasing shelf life and quality up to 12 days storage at room temperature.





Effect of boron and NAA on flowering, fruit set and yield of coconut cv. D x T.

Farmers of South Saurashtra having mature coconut (cv. D x T) plantation are advised to spray on palm inflorescence with sodium borate (20.50 B) 0.4 % (4g/ litre) at monthly intervals from January to June for getting higher nut yield and net return.



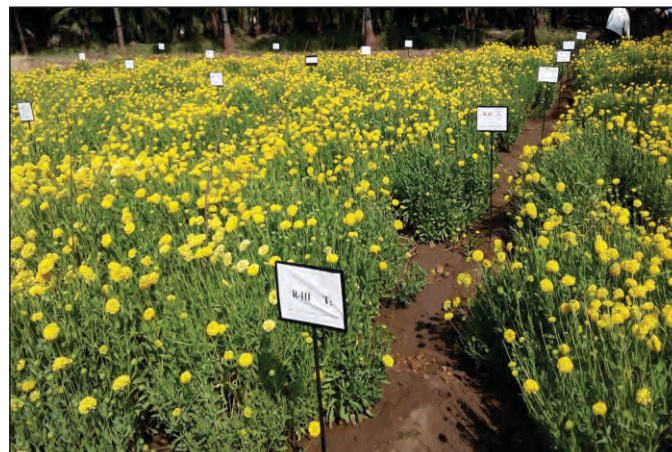
Standardization of severity of pruning and crop load on yield and quality in pomegranate (*Punica granatum* L.) var. Bhagwa.

Farmers of south Saurashtra preferring *hast bahar* in pomegranate are advised to prune branches at 30 cm from top after 45 days of resting from withdrawal of monsoon and retain 50 fruits load per plant for getting higher yield and net return.



Integrated nutrient management in gaillardia (*Gaillardia pulchella* Var. *Lorengiana*) cv. Yellow Double under saline water

The farmers of south Saurashtra growing gaillardia flower crop under saline irrigation condition up to 14 dSm⁻¹ EC are advised to apply 50 % RDF of N: P₂O₅: K₂O as a 25:25:25 kg/ha + 50 % N from castor cake or neem cake (500 kg/ha) for obtaining higher yield and net realization.



4.7 Agricultural Engineering

The Agricultural Engineering group accomplished the studies on design, development & fabrication of agricultural machinery, equipment, tools, sources of renewable energy, processing of agricultural goods, and conservation of water.

The “Testing and Training Center of Farm Machinery” under the Department of Farm Machinery and Power, CAET, JAU, Junagadh was established in August, 2008 by the State Govt. with the financial support from the Central Govt. under Rashtriya Krishi Vikas Yojna (RKVY). It is on the line of testing of agricultural machines carried out by Farm Machinery Testing and Training Institutes (FMTTIs), established by the Govt. of India. This Center is one of the twenty five institutions approved by the Department of Agriculture & Co-operations, Ministry of Agriculture, GoI in the direction of ensuring supply of quality agricultural machinery and equipment under Government programs. Various types of equipments produced by the manufacturer of the state and national level have been received for evaluation of their work performance and feasibility.





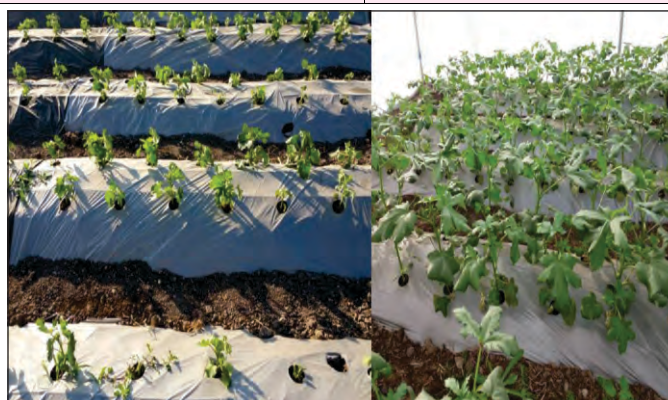
Table 4.7.1: No. of Farm Machineries/ Implements/ equipments (category wise) tested at testing centre of FMPE, CAET

Farm Machineries/ Implements tested (Category wise) during the year 2018-19		
Category	Name of Equipment / Machine	No. of Equipment / Machine Tested
A	Land development, tillage & seedbed preparation equipment	44
B	Sowing and planting equipment	25
C	Inter-cultivation equipment	-
D	Plant protection equipment	25
E	Harvesting and threshing equipment	20
F	Equipment for residue management	08
G	Post-harvest and agro processing equipment	01
H	Hand tools	02
Total		125

Recommendation for Farmers' Community

Optimum water management for off-season okra cultivation under protected environment

The farmers of South Saurashtra Agro climatic Zone are recommended to use net-cum-polyhouse without ridge vent with silver black plastic mulch (20 μ m) for cultivation of okra during winter season (off season). This net-cum-polyhouse without ridge vent increase water productivity and water saving as well as controls weeds.



Details of mulching technology :

1.	Mulch film: 20 μ m silver black plastic
2.	Bed size: (a) Top width : 60 cm, (b) Bottom width : 75 cm, (c) Height : 20 cm
3.	Spacing: (a) Bed spacing : 100 cm, (b) Plant spacing on bed : 35 cm x 35 cm
4.	No. of row per bed: 2

Coriander crop response to deficit soil moisture in various growth stages under drip irrigation system

The farmers of South Saurashtra Agro-climatic zone growing coriander crop (variety: GC-2) are advised to irrigate the crop using drip irrigation having following system details and time of operation to get maximum net return and water saving upto 17.6 %. They are also advised to consider flowering stage as most sensitive to deficit irrigation followed by vegetative stage and seed development/setting.





Drip system details	Stage (Duration, DAS)	Irrigation time	Irrigation interval
Lateral size: 16mm Lateral spacing :0.9 m Dripper spacing : 0.5 m Dripper discharge: 4lph	Vegetative stage (0 to 55)	55 min	Alternate day
	Flowering stage (56 to 80)	63 min	
	Seed development / setting stage (81 to 100)	77 min	

Evaluation of well recharge techniques for Junagadh region

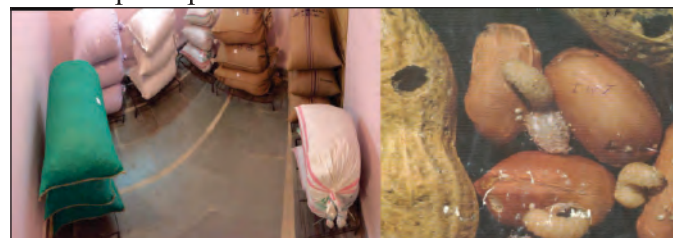
It is recommended to the farmers, Govt. departments and NGOs that the open well technique is effective for recharging shallow aquifer in Junagadh region which may recharge 103 cu.m groundwater per sq.m of bottom area of open well with recharge cost of Rs 1.94 per cum.

The tube well is effective for deep aquifer recharge, which may recharge 44473 cu.m groundwater per year with recharge cost of Rs. 0.45 & 0.28 per cum including and excluding tube well cost respectively.

To study the effect of different packing materials against Groundnut Bruchid (*Caryedon serratus* Olivier.) during storage

Farmers storing groundnut are advised to store the well dried (8.0% MC) groundnut pods in Purdue

Improved Crop Storage (PICS) bag or Closely woven net bag for effective and economical management of *bruchid* pest up to six months.



Enzymatic Pre-treatment in the Processing of Pigeonpea

The pulse processing entrepreneurs are recommended to give enzymatic pretreatment at specific enzyme concentration, incubation time, incubation temperature and tempering water pH as given below in Table 1 for different varieties of pigeon pea to get higher recovery, to reduce the dhal making time and to get more protein content as compared to traditional method as Table 2.

Table 1 Optimization of enzymatic pretreatment parameters for seven varieties.

Variety	Optimized value			
	Enzyme concentration (mg/100 g dry matter)	Incubation time (hr)	Incubation temperature (°C)	pH
BDN-2	31.34	8.72	43.47	5.99
GJP1	28.79	7.46	44.97	4.96
Vaishali	27.64	8.05	45.04	5.31
ICP2043	32.36	8.19	40.00	5.50
BSMR736	31.62	7.34	44.70	5.34
ICPL87119	28.64	7.62	43.00	5.50
Pinku	30.86	7.84	43.58	5.62



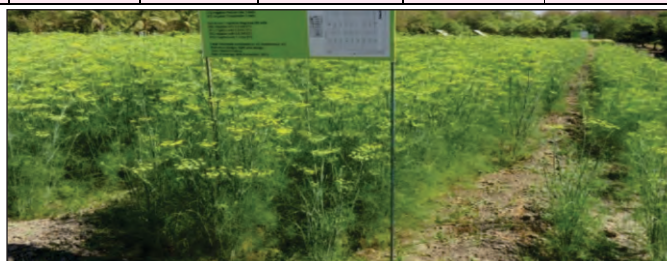


Table 2 Results of different treatment for seven varieties of pigeon pea.

Variety	Traditional method			Optimized value			Actual value		
	Hulling efficiency (%)	Cooking time (min)	Protein (%)	Hulling efficiency (%)	Cooking time (min)	Protein (%)	Hulling efficiency (%)	Cooking time (min)	Protein (%)
BDN2	78.30	14.50	19.80	84.35	13.06	22.60	80.74	12.80	25.30
GJP1	76.63	16.92	19.80	84.24	15.51	24.64	82.80	15.10	23.43
Vaishali	75.66	13.23	20.89	83.71	13.51	23.16	78.30	13.14	23.28
ICP2043	72.16	14.97	21.81	80.47	13.63	23.26	77.60	13.01	20.70
BSMR736	66.00	18.00	18.74	80.95	14.64	21.42	76.90	13.50	21.53
ICPL87119	69.12	16.24	18.89	84.44	13.59	22.68	82.52	13.12	22.15
Pinku	72.62	13.45	19.63	75.27	12.35	20.96	76.54	12.42	22.16

Impact of irrigation frequency and regimes on the economic productivity of drip irrigated fennel.

Farmers' of South Saurashtra Agro-climatic Zone growing fennel are advised to adopt drip irrigation for acquiring higher yield (59%), water saving (69%) and higher net return over control.



Details of drip system	Irrigation scheduling
Lateral spacing : 75 cm Dripper spacing: 40 cm Dripper discharge: 2 lph	At 3 days interval with 0.8 IW/ETc or a) November-December: 1h and 15min to 1h and 30 min b) January: 2h and 20 min c) February-March: 3h to 3h and 20 min d) April: 2h and 20 min

Recommendation for Scientific Community

Assessment of potential water resources of Aji river basin using SWAT Model

The scientific Community/ Policy makers working for Aji River Basin are informed as below.

1. Warming trend

- The day maximum temperature may increase by 3.31°C, 1.46°C and 2.52°C up to end of 2070 over the present 34.51°C, 38.65°C, 36.01°C and minimum temperature by 3.35°C, 5.80°C and

3.07°C up to end of 2070 over the present 14.83°C, 26.38°C and 22.37°C in winter, summer and monsoon season respectively.

- The adoptions of heat resistant crop varieties with frequent irrigations of smaller depth through MIS particularly during summer season should be promoted to lessen the adverse effects of higher temperature.
- The following mathematical models may be used to predict the day maximum and day minimum temperature for the period up to 2070.

Period/ Season	Day maximum temperature (°C)		Day minimum temperature (°C)	
	Model	R ²	Model	R ²
Annual	$T_{max} = 0.0462 \times \text{Year} - 56.927$	0.90	$T_{min} = 0.081 \times \text{Year} - 141.62$	0.98
Winter	$T_{max} = 0.0625 \times \text{Year} - 91.552$	0.86	$T_{min} = 0.0632 \times \text{Year} - 112.64$	0.98
Summer	$T_{max} = 0.0276 \times \text{Year} - 17.023$	0.90	$T_{min} = 0.1094 \times \text{Year} - 194.28$	0.98
Monsoon	$T_{max} = 0.0476 \times \text{Year} - 59.997$	0.87	$T_{min} = 0.0579 \times \text{Year} - 94.417$	0.88





2. Surface water

- The crop water requirements during winter, summer and monsoon season may change by the tune of 6.4%, - 0.3% and 1.5% respectively in future up to 2070 as compared to the past, due to global warming. On an average, the water balance components like rain fall and runoff may be decreased by 26%, and 29% in future up to 2070

Hydrological Parameter	Probability distribution	Empirical cumulative probability function
Monsoon Rainfall(mm)	Frechet type (Fisher-Tippett 2)	$P(x \geq X) = 1 - e^{-\left[\frac{x - (-53)}{-10.5627}\right]^{-1.88227}}$
Monsoon runoff(mm)	Log-logistic	$P(x \geq X) = 1 - \frac{1}{1 + e^{(-1.20153 \ln(x) + 5.00776)}}$

2. Surface water

- The crop water requirements during winter, summer and monsoon season may change by the tune of 6.4%, - 0.3% and 1.5% respectively in future up to 2070 as compared to the past, due to global warming. On an average, the water balance components like rain fall and runoff may be decreased by 26%, and 29% in future up to 2070

3. Ground water

- The groundwater recharge may be decreased by 51% up to 2070 as compared to past due to the climate change impacts. Therefore, the water harvesting-cum-groundwater recharge structures as well as artificial groundwater recharge through open/tube well should be planned for the ground water sustainability.

4.8 Basic Science

Recommendation for Farmers' Community

Influence of weather parameters on cotton (*Gossypium hirsutum*L.) phenology and seed cotton yield

The farmers of South Saurashtra Agro Climatic Zone sowing early (31st May) and late (10th July) Bt cotton hybrids under irrigated condition are advised to sow cotton crop timely (20th June) for increasing chlorophyll content, leaf area, specific leaf weight, higher heat use efficiency, reduce pink bollworm damage, higher seed cotton yield and net return.

as compared to past. The monsoon seasonal rainfall and runoff will be decreased up to 2070 but the extreme event (100 years return period) will be increased by tune of 39% and 87.5% respectively due to climate change impacts. Therefore, the following empirical probability distributions should be used for the rainwater management planning.

Farmers preferring early sowing (31st May) are also advised to sow G.Cot. Hy-8 for higher seed cotton yield and net return.

Manipulation of source-sink relationship in pearl millet through growth retardants

The farmers of North Saurashtra Agro Climatic Zone growing *kharif* pearl millet are advised to apply foliar spray of CCC (chloromequet chloride, 99%) @ 250 ppm (2.5 ml/ 10 liter water) attillering and post-anthesis stage to get higher grain yield and net return.

Recommendation for Scientific Community

Draft genome sequencing and analysis of fungal phytopathogen *Sclerotium rolfsii* to reveal insight into its genetic structure.

- It is recommended to the scientific community involved in Groundnut improvement that the sequencing of plant pathogenic fungi *Sclerotium (Athelia) rolfsii* showed the size of genome is 73 Mb. The draft genome having 8919 contings, 16830 genes and 11171 SSR present in the genome. In genome 3507 and 261 genes involve in Transporter and catalytic function respectively, 1531 genes involve in cellular component and 709 of genes involve in biological process. Pathogenicity related genes identified in this study have high relevance in future fungicide designing and following primers can be used for the specific identification of pathogenic fungi *Sclerotium (Athelia) rolfsii*.





Name	Primer 3'-5'	Product length	GC%	Tm
JAUSRF1	GAAGAGTTTTCGTCGAGTCC	250	55	59.85
JAUSRR1	GCTGTCAGAGAAACCGAAGA		50	59.84
JAUSRF2	ACGAACTCGATCCCAGCATC	170	50	60.47
JAUSRR2	TCGATTATGAGGGTTTCCTC		50	60.05
JAUSRF3	CGGACTAATAATCGACCCTA	230	50	60.07
JAUSRR3	ATAAAGGTGCGTTGACGTTT		45	60.17

4.9 Veterinary Science & Animal Husbandry

Cattle Breeding Farm, Junagadh Agricultural University is the largest and oldest farm and is the only organized research station where purebred *Gir* Cattle and *Jaffrabadi* Buffaloes are maintained in the country. This research station is involved since its inception in conservation, improvement and advancement of *Gir* Cattle & *Jaffrabadi* Buffaloes through selective breeding. The herd of *Gir* Cattle was established as early as in 1920 by the erstwhile Nawab of Junagadh State, while *Jaffrabadi* herd was established in the year 1978. Since that this research station always maintains *Gir* Cattle and Buffaloes. Besides maintaining pure breed herds of *Gir* Cattle

and *Jaffrabadi* buffaloes at the station, the center is involved in conservation and improvement of field animals of these breeds through Field Progeny Testing programs and supply of high quality males to different Gram Panchayats.

Presently this station has a 184 hectare of land out of which 106.5 hectare is cultivated, 42 hectare uncultivated/ Grassland-vidi is being utilized for grazing and 22 hectare under road and buildings.. The subsidiary farm known as Narsimehta Talav has 16 hectare and Jonpur farm Grass land of 130 hectare from where annually 4 to 5 lakh kg of dry grass is made available for feeding the animals.

Table 4.9.2 Distribution of Semen doses from CBF

Sr. No.	Particular	Gir Bulls	Jaffrabadi Bulls
1.	Frozen Semen doses available from last year (Nos.)	170531	99868
2.	Frozen Semen doses Produced (Nos.)	23090	29630
3.	Frozen Semen doses used for AI in Field (Nos.)	1816	1953
4.	Frozen Semen doses used for AI on Farm (Nos.)	517	135
5.	Frozen Semen doses sold to AI Workers (Nos.)	2925	3235
6.	Frozen Semen doses in Stock (Nos.)	188363	124175
7.	<i>Gir/ Jaffrabadi</i> bulls distributed to Grampanchayat Gaushala, other Institute etc. (Nos.)	82	12

Table 4.9.3 (a) Total number of cases treated at TVCC

Types of cases	Cattle	Buffalo	Equine	Canine	Others	Total
Medicine	1201	1335	206	2367	742	5851
Gynecology	436	408	88	80	52	1064
Surgery	804	523	322	745	382	2776
Total	2441	2266	616	3192	1176	9691





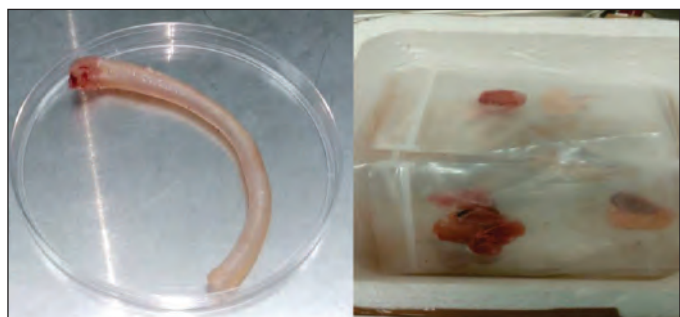
Table 4.9.3 (b) Total number of cases treated through Ambulatory Clinics and Clinical Camps

Type of case	Ambulatory Clinic	Clinical Camps
Medicine	439	1026
Gynecology	81	51
Surgery	148	104
Deworming	-	103745
Vaccination	-	1650
Total	668	106576

Recommendation for Farmers' Community

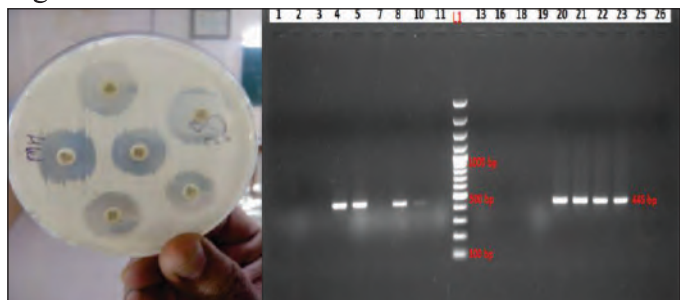
Ecological studies of *Staphylococcus aureus* isolates from poultry meat and associated environment in and around Junagadh district

Poultry meat handlers need awareness for hygienic production of poultry meat to reduce possible food infection caused by *Staphylococcus aureus* in Junagadh District.



Phenotypic and Molecular characterization of extended-spectrum β -lactamase (ESBL) producing *Escherichia coli* from poultry in Junagadh, Gujarat

The presence of *E. coli* is confirmed in poultry in and around Junagadh, hence poultry farmers are advised to use antibiotics in the treatment of poultry diseases under the guidance of registered veterinary practitioners and strictly follow prescribed antibiotic regimens to avoid anti-microbial resistance.



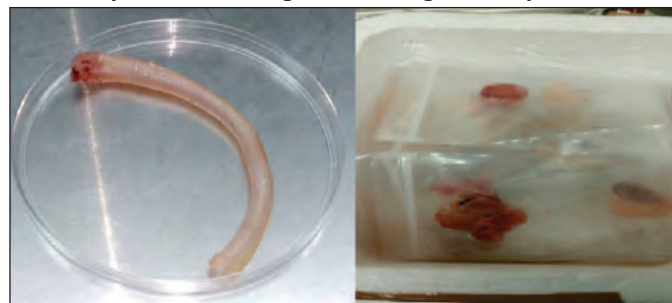
Studies on nutritive value and feeding varying levels of Marvel (*Dicanthium annulatum*) grass on milk production and milk composition in lactating Gir cows

Dairy farmers are recommended to feed 18 kg/day green Marvel/Jinjavo grass equivalent to 50 % Crude protein replacement to Gir cows (470 kg body weight and 7.6 litres milk/day) to enhance milk production by 6.81 % and profit (return over feed cost) by 41.08 %. Marvel/Jinjavo grass should be harvested at 40-45 days interval.

Recommendation for Scientific Community

Ecological studies of *Staphylococcus aureus* isolates from poultry meat and associated environment in and around Junagadh district

A total of 27 (13.5 %) isolates of *Staphylococcus aureus* were recovered from samples collected from poultry raw meat, knife and hands of poultry meat handlers in and around Junagadh district. Among isolates, 19 (70.37 %) and 17 (62.96 %) were resistant to tetracycline and ampicillin, respectively.



Etiological and Therapeutic studies on Canine Dermatoses in and around Junagadh

Higher prevalence of dermatoses are seen in Pug, Labrador and Doberman in the age group of 4 -5 years during summer and monsoon seasons with



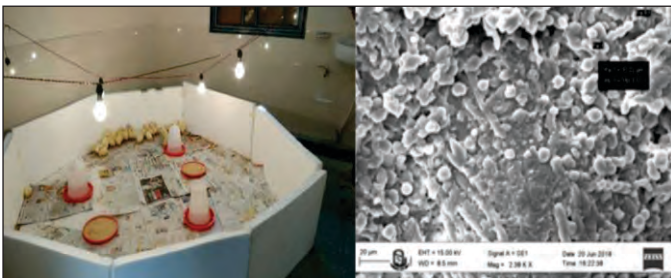


higher Staphylococcal infection (80.33 %) followed by *Streptococcus* Spp. (11.48 %) and *Micrococcus* Spp. (8.2 %) which favourably responded to Amoxicillin - Sulbactam or Cefaperazone - Sulbactam antibiotics.



Evaluation of an antioxidant effect of poly-herbal mixture against cadmium induced oxidative stress in chickens

Addition of poly-herbal mixture (2 %) comprising of powders of fruits of *Opuntia elatior* Mill. (Hathlo thor) and *Sphaeranthus indicus* (L.) (Gorakh Mundi); leaves of *Peltophorum pterocarpum* (DC) Baker ex DC, (Pilo Gulmohar), *Syzygium cuminii* (L.) Skeels (Kala Jambu) and *Cressa cretica* (L.) (Rudravanti); aerial part of *Withania somnifera* (L.) Dunal (Ashwagandha) and *Solanum xanthocarpum* Schrad. & Wendl (Bhoi ringani) at equal proportions in feed ameliorates the cadmium chloride induced oxidative damage in chickens.

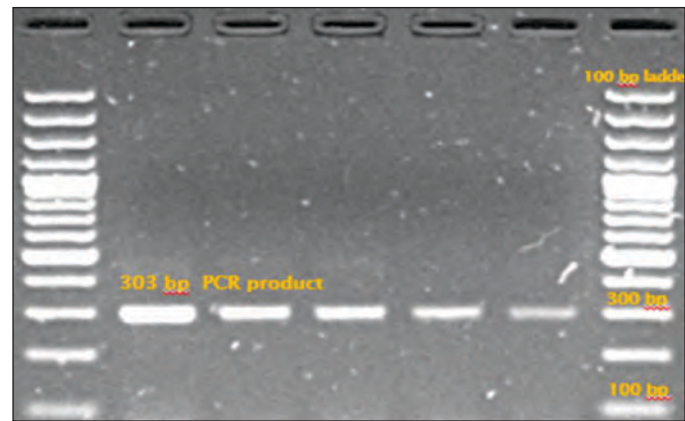


Principal component analysis to predict the herd life using first lactation traits in Gir cattle.

The first lactation records *viz.*, AFC, FLL and DP can be used to predict herd life up to five lactations using MLR equation $HLFL = 608.64 + (1.18 \times AFC) + (2.08 \times LL) + (1.33 \times DP)$ explaining 70 % of underlying variance (Adjusted $R^2 = 0.694$). The explained variance ($R^2 = 0.687$) for estimating herd life up to five lactations using PCA can be invariably be used using regression equation $HLFL = 3422.69 + (468.15 \times FAC1) + (127.63 \times FAC2)$ with added advantage of nullifying collinearity among independent variables.

Molecular characterization of BoLA-DRB3 gene in Gir cattle

Partial exon II of DRB 3 gene amplified with reported HL 030 (5'-ATCCTCTCTCTGCAG CACATTTCC-3') and HL 031 (5'-TTTAATT CGCGCTCAC CTCGCCGCT-3') primers showed high variation (~22%) and polymorphism in sampled Gir cattle population. *Pst* I, *Eco*R V and *Sal* I restriction enzymes showed their restriction sites in analyzed sequences which can be further used for genotyping and association studies.



Studies on nutritive value and feeding varying levels of Marvel (*Dicanthium annulatum*) grass on milk production and milk composition in lactating Gir cows

Marvel/Jinjavo (*Dicanthium annulatum*) grass has 8.65 % Digestible Crude Protein (DCP) and 61.83 % Total Digestible Nutrients (TDN). Chemical composition of Marvel/Jinjavo grass: Crude protein-13.4 %, Crude fibre-32.8 %, Crude fat-2.1 %, DCP-8.65 % and TDN-61.83 %.

4.10 Fisheries Science

Fisheries science includes research in the areas of Fisheries Resource Management, Harvest and Post-Harvest Technology of fishes, Aquaculture, Fishery Hydrography and Fishery Engineering. Fisheries Research Station, Sikka has produced 171.36 lakh pearl oyster larvae and among them 2.4 lakh were supplied to Marine National park for improving pearl oyster population in gulf of Kachchh. During the year total 100.2 lakh larvae of pearl oyster





were sea ranching to the Gulf of Kachchh to increase the pearl oyster population in Gulf of Kachchh, Gujarat. Fisheries Research Station, Okha has produced 287 liters seaweed liquid fertilizer and 432 seaweed greeting cards.

Recommendation for Fish Farmers

Utilization of duckweed (*Lemna minor*) meal as partial supplementation in the diet of *Catla catla* fry

Fish Farmers are recommended to incorporate 15 % of duckweed (*Lemna minor*) leaf meal in the feed of *Catla catla* to obtain better growth rate, survival rate and economic return in freshwater rearing pond.

Recommendation for Scientific Community

Study of copepod diversity in coastal region of Okhamandal and its culture potential as live feed

Nineteen copepod species were recorded from coastal areas of Okhamandal, i.e. eight species of calanoid copepods mainly *Eucalanus elongatus*, *Calanus minor* and *Paracalanus parvus*; five species of harpacticoid copepods mainly *Longipedia weberi*, *Microsetella norvegica* and six species of cyclopoid copepods mainly *Oncea venusta* and *Oithona similis* were recorded. Higher copepod diversity was found in Okha area followed by Mithapur and Dwarka, higher diversity during monsoon season followed by winter and least in summer. *Macrosetella gracilis* and *Oithona brevicornis* have culture potential.



Estimation of agar and alginic acid from the seaweeds available at coast of Okha

The highest % agar yield 17.98 ± 1.87 was observed in *Gracilaria corticata* among the Rhodophyceae species available at Okha coast. The highest gel strength (63.46 ± 2.66 g/cm²) of agar was observed in *Gracilaria corticata* among Rhodophyceae species available at Okha coast. At Okha coast, higher % of agar yield 17.98 ± 1.87 was observed in *Gracilaria corticata* among the Rhodophyceae species. The higher gel strength (63.46 ± 2.66 g/cm²) of agar was observed in *Gracilaria verucosa* among Rhodophyceae species. Among the phaeophycean species available, higher percent (40.21 ± 1.95) alginic acid content was observed in *Sargassum wightii*.

Estimation of *in vitro* antioxidant potential of the seaweeds available at coast of Okha

Amongst the seaweeds available at Okha coast, the highest *in vitro* antioxidant potential was observed in *Sargassum johnstonii* with the value of 1.72 ± 0.22 DPPH (2, 2, Diphenyl-1-Picrylhydrazyl) activity Eq. mM Ascorbic acid/g FW.

4.11 Social Science

Agricultural economists worked on different research projects *viz.* Farm cost studies of important crops in Gujarat state; An economic analysis of herbicide used on groundnut crops in Saurashtra region of Gujarat state; Development of Optimal Crop Plans (OCPs) for Sustainable groundwater management practices in Saurashtra Region, Gujarat; Export performance of marine products from India; An economic analysis of coconut in Saurashtra region of Gujarat state; Mapping and valuation of economic, societal and environmental benefits of conserving Gir forest ecosystem and scheme for creating a permanent machinery for studying the cost of cultivation/production of principal crops in Gujarat state. Yield, production and price forecast different crops *viz.* groundnut, cotton, castor, cumin, coconut *etc.* were analyzed and for suggestions to farmers.





Recommendation for Scientific Community

Title: Performance and price discovery of Cotton in spot and futures markets in India

The efficiency of futures markets of cotton and cotton oilseed cake can be improved by increasing the participation of various stakeholders including farmers. This can be tackled with the help of a three pronged strategy: (i) Creating large scale awareness among various stakeholders, including farmers by focusing on market oriented extension services. (ii) Mobilizing farmers under groups to pool their resources. (iii) Decreasing the current lot size of cotton based future contract which is a prime reason behind nonparticipation of farmers.

Comparison of various methods of stability analysis to identify stable genotypes in Sesame

The Desirability Index (D_i) of parametric method and Mean of absolute Rank Difference of genotype over environments (Si⁽³⁾), Variance among the ranks over environments (Si⁽⁶⁾) of non-parametric methods found useful for stability analysis of genotypes in sesame. These non-parametric methods need not require to fulfill strong assumptions as in case of Eberhurt & Russel.

Scope and opportunities of Agro-tourism in Saurashtra region

There is an ample potential for development of agro-tourism in four identified routes; route-I

(Junagadh-Amreli-Sasan Gir-Junagadh), II (Junagadh - Jamnagar–Porbandar– Junagadh), III (Junagadh - Rajkot-Surendranagar-Junagadh) and route-IV (Junagadh - Veravel – Junagadh) of Saurashtra region.

4.12 Human Resource Development

During the year 2018-19, under HRD component of the University, as a part of capacity building for JAU scientists, 137 scientists/teachers were deputed to attend winter/ summer school Short/Refresher Course, Orientation Programme, Short Training, training; 331 attended seminar, symposium, conference, convention; 197 attended the workshops, group/annual/QRT meeting of their respective projects and 156 scientists/ teachers were deputed to attend AICRP monitoring, visit of other stations etc. at national as well as state level. The University has also organized seven national level programs like winter/ summer school, seminar, symposium. Training etc. as well as state level workshops.

4.13 Mega Seed Unit

At Mega Seed processing plant, the crop seeds produced in the farms were processed. The processed good quality seeds were sold to farmers under the trade name of "Gir Sawaj". Very good response was observed among the farmers to avail this facility.

Table 4.13.1 Production of truthful, foundation and certified seeds of field crops under mega- seed project and Seed Hub Project (Pulses & Groundnut)

Sr. No.	Crops	Production (q)		
		Truthful	Foundation	Certified
1	Groundnut	626.50	147.35	1130.15
2	Chickpea	216.89	58.00	751.75
3	Sesame	59.20	-	-
4	Wheat	420.00	385.50	38.50
5	Cotton	51.50	-	-
6	Castor	10.00	-	-
7	Cumin	15.00	-	-
8	Coriander	22.50	-	-





Sr. No.	Crops	Production (q)		
		Truthful	Foundation	Certified
9	Soybean	177.36	-	-
10	Mungbean	58.00	-	-
11	Urdbean	55.48	8.50	19.00
12	Pigeon pea	10.00	20.00	240.60
13	Sugarcane Setts	700.00	-	-
14	Sorghum	50.99	-	-
15	Garlic	30.00	-	-
16	Onion	37.00	-	-
17	Papaya Seeds	0.50	-	-
18	Vegetable seeds	11.00	-	-
	Total	2551.92	619.35	2180.00
	Grand Total	5351.27		

The breeder seeds of different crops also produced to fulfill the demand of private and public sectors as per the national and state indents under coordination of Mega Seed unit and concern crop

scientist are given in following table. The required nucleus seeds of different crops were also produced for the breeder seed production in the ensuring season.

Table 4.13.2 Production of Nucleus / Breeder Seeds

Sr. No.	Crop	Variety	Nucleus Seed (q)	Breeder Seed (q)		Total (q)
				National	State	
1	Groundnut	GG-2	0.50	5.00	59.20	64.70
		GG-4	0.30	-	0.90	1.20
		GG-5	0.90	-	59.40	60.30
		GG-6	0.60	-	4.20	4.80
		GG-7	0.60	-	21.60	22.20
		GG-11	0.90	-	107.40	108.30
		GG-13	0.85	-	3.90	4.75
		GG-20	2.10	70.00	1450.95	1523.05
		GG-21	-	4.20	6.00	10.20
		GJG-9	0.50	40.00	60.20	100.70
		GJG-17	0.90	10.00	125.60	136.50
		GJG-18	0.75	-	-	0.75
		GJG-19	4.75	-	-	4.75
		GJG-22	1.50	-	513.99	515.49
		GJG-31	0.40	30.00	9.00	39.40
		GJG-32	11.25	-	-	11.25
		GAUG-10	0.50	5.00	89.00	94.50
		GJG HPS-1	1.00	-	13.20	14.20
	Sub Total	28.30	164.20	2524.54	2717.04	





Sr. No.	Crop	Variety	Nucleus Seed (q)	Breeder Seed (q)		Total (q)
				National	State	
2	Pearl millet	GHB 558	0.008	-	0.680	0.688
		GHB 744	0.006	-	0.79	0.796
		GHB 905	0.007	-	0.83	0.837
		Sub Total	0.021	-	2.300	2.321
3	Sesame	G. Til-1	0.03	3.00	4.20	7.23
		G. Til-2	0.20	10.00	15.60	25.80
		G. Til-3	0.10	2.00	4.30	6.40
		G. Til-4	0.15	2.50	6.40	9.05
		GJT-5	0.10	0.05	1.95	2.10
		G. Til-6	0.10	-	-	0.10
		G. Til-10	0.05	8.00	0.90	8.95
		Sub Total	0.73	25.55	33.35	59.63
4	Chickpea	GG 1	2.77	-	12.00	14.77
		GG 2	3.02	-	21.25	24.27
		GJG 3	2.23	-	107.73	109.96
		GG 4	0.38	3.75	-	4.13
		GG 5	9.58	72.50	153.50	235.58
		GJG 6	0.68	-	5.53	6.21
		Sub Total	18.66	76.25	300.01	394.92
5	Pigeon pea	GJP 1	0.11	-	17.50	17.61
		Sub Total	0.11	-	17.50	17.61
6	Wheat	GW 366	10.50	308.40	22.80	341.70
		GJW 463	2.50	-	47.00	49.50
		GW 496	-	-	55.20	55.20
		LOK 1	-	-	71.60	71.60
		Sub Total	13.00	308.40	196.60	518.00
		Grand total	60.821	574.4	3074.3	3709.52

4.14 Production of Sawaj brand bio-agents and microbial products

During the year 2018-19, Department of Plant Pathology has produced and distributed bio-agents under the trade name "Gir Sawaj". *Trichoderma harzianum* used for the management of various soil

borne disease especially stem and pod rot of groundnut in the Saurashtra region. Department also produced and distributed products like *Rhizobium*, *Azotobacter* and PSB liquid bio-fertilizer to farmers, State Departments, other Govt. bodies etc. at reasonable price.

Table 4.14.1 Production of Sawaj brand bio-agent and liquid bio-fertilizer

Sr. No	Name of Product	Quantity
1	<i>Trichoderma</i> (tonne)	186.981
2	<i>Rhizobium</i> (litre)	2067
3	<i>Azotobacter</i> (litre)	1556
4	PSB (litre)	3050





Department of Entomology has produced various microbial agents under the trade name "Gir Sawaj" e.g. viruses, bacteria, fungi, protozoans and nematodes are being used in IPM program. Among viral pathogens, nuclear polyhedrosis viruses of *Helicoverpa* (HNPV),

Spodoptera (SNPV), entomopathogenic fungi *Beauveria bassiana*, fruit fly trap, fruit fly lure, pheromone trap, pheromone lure are widely used for insect control. These pathogens are highly specific to their host and being considered environmentally safe.

Table 4.14.2 Production of microbial agents, traps, lure etc.

Sr. No.	Name of product	Quantity
1	<i>Beauveria</i> (tonne)	115
2	<i>Metarhizium</i> (tonne)	52.41
3	HNPV (liter)	253.5
4	SNPV (liter)	161.75
5	Fruit fly traps (Nos.)	4864
6	Fruit fly lure for fruit crops (Nos.)	5212
7	Fruit fly lure for vegetable crops (Nos.)	607
8	Pheromone Trap (Nos.)	46,365
9	Pheromone Lure (Pink bollworm) (Nos.)	1,03,998
10	Pheromone Lure (<i>Heliothis</i>) (Nos.)	4378
11	Pheromone Lure (<i>Prodenia</i>) (Nos.)	816
12	Pheromone Lure (Brinjal shoot and fruit borer) (Nos.)	1322
13	MDP Technology for Pink bollworm (100 gm Tube)	1528
14	Honey (500 ml Bottle)	340.50

4.15 Others

Table 4.15.1 Production of planting material of horticultural and other crops

Sr. No.	Planting Material	Production (Nos.)
1	Fruit crop graft	28678
2	Fruit crops saplings	74556
3	Seedlings	45788
4	Ornamentals & Medicinal plants	53086
	Total	202108



**Table 4.15.2 Analysis of Soil & Irrigation Water Sample**

Sr. No.	Name of Research Station/ Department	Number of Sample
1	Soil sample analysis	2834
2	Irrigation water analysis	1625
3	Plant sample analysis	78198
Total		82657

Front Line Demonstration (FLD) conducted on farmers' field

Crop scientists have successfully organized front line demonstration on farmers' fields organized by research stations of JAU.

Table 4.15.3 Summary of information of improved varieties

Sr. No.	Crop	Improved variety	No. of FLDs	Total area under FLD (ha)	Yield in IP (q/ha)	Yield in FP (q/ha)	Increase in yield (%)
1	Pearl millet	GHB 732	50	20	45.77	43.03	6.36
		GHB 744	25	10	31.54	29.66	6.34
2	Wheat	GJW 463	25	10	53.25	48.85	9.08
3	Coriander	G.Co.-2	9	0.4	13.00	10.00	30.00
4	Cumin	Guj. Cumin-4	4	0.4	8.70	7.50	16.00
5	Garlic	GJG-5	4	0.4	70.45	66.15	06.50
6	Fenugreek	Guj. Fenugreek-2	5	0.4	21.00	18.50	13.51

Table 4.15.4 Summary of information of improved technology

Sr. No.	Crop / other	Improved technology	No. of FLDs	Total area under FLD (ha)	Yield in IP (q/ha)	Yield in FP (q/ha)	Increase in yield (%)
1	Groundnut (Summer)	Whole package	10	4	20.93	18.62	12.43
2	Groundnut (Kharif)	Whole package	50	20	19.08	16.89	13.03
3	Wheat	Integrated Nutrient Management	5	0.1	62.21	43.43	43.24
4	Castor (Kharif)	Whole package	31	12.40	35.99	31.08	15.78
		Inter cropping	21	8.40	50.12	21.25	135.80
5	Cotton	Integrated Cotton Crop Management	47	20	25.74	22.49	13.50
		Inter cropping	20	20	24.99	19.17	24.00
		IRM, PBW	50	20	23.11	19.12	21.52
6	Pigeon pea	Seed treatment + Biofertilizer pesticides+	10	10	17.94	14.72	18.3
7	Chickpea	Seed treatment and drenching + pest control	10	10	21.29	18.80	11.6
8	Sesame	Whole package	25	8.00	7.32	5.71	28.20

Note: Improved technology includes crop production, plant protection, horticulture, fisheries, animal science, basic science, social science and agricultural engineering.





Table 4.15.5 New research programs sanctioned

Sr. No.	Agency	No. of Research Programs	Amount (Rs. in Lakh)
1	ICAR	1	8.75
2	Govt. of India	2	158.00
3	Govt. of Gujarat	1	16.00
4	RKVY	1	830.00
5	Other Agencies	40	282.073
	Total	45	1294.823

