RESEARCH

Chapter - IV

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. 18th Research Council meeting was organized on January 25, 2021 for approval of new research programs and research activities during the year.

Table 4.1: Members of 18th Agricultural Research Council meeting

No.	Name	Designation
1	Dr. V. P. Chovatia	Vice-Chancellor (I/c) (Chairman)
2	Dr. V. P. Chovatia	Director of Research & Dean PG Studies (Member Secretary)
3	Dr. H. M. Gajipara	Director of Extension Education
4	Shri B. M. Modi	Director of Agriculture, GoG, Gandhinagar
5	Dr. P. M. Vaghasiya	Director of Horticulture, GoG, Gandhinagar
6	Dr. F. S. Thakar	Director of Animal Husbandry, GoG, Gandhinagar
7	Vacant	Associate Director of Research
8	Dr. P. Mohnot	Associate Director of Research
9	Dr. D. S. Hirapara	Associate Director of Research, JAU, Targhadia
10	Dr. S. G. Savalia	Dean, Faculty of Agriculture
11	Dr. N. K. Gontia	Dean, Faculty of Agricultural Engineering & Technology
12	Dr. P. H. Tank	Dean, Faculty of Fisheries Science
13	Dr. P. H. Tank	Dean Faculty of Veterinary Science & Animal Husbandry
14	Dr. K. A. Khunt	Dean, Faculty of Agribusiness Management
15	Dr. R. B. Madariya	Convener, Crop Improvement AGRESCO Subcommittee
16	Dr. R. K. Mathukia	Convener, Crop Production AGRESCO Subcommittee
17	Dr. M. F. Acharya	Convener, Plant Protection AGRESCO Subcommittee
18	Dr. D. K. Varu	Convener, Horticulture AGRESCO Subcommittee
19	Dr. V. K. Tiwari	Convener, Agricultural Engg. AGRESCO Subcommittee
20	Dr. G. P. Sabapara	Convener, Animal Production & Fisheries Science AGRESCO Subcommittee
21	Dr. G. K. Kataria	Convener, Basic Science AGRESCO Subcommittee
22	Dr. N. B. Jadav	Convener, Social Science AGRESCO Subcommittee
23	Dr. K. L. Dobariya	Rtd. Research Scientist
24	Dr. B. M. Dabhi	Rtd. Research Scientist
25	Dr. P. D. Kumavat	Research Scientist (Sugarcane), Kodinar
26	Dr. D. R. Mehta	Professor & Head, Genetics & Plant Breeding
27	Dr. H. D. Rank	Professor & Head, Soil & Water Conservation Engineering
28	Dr. B. D. Savaliya	Research Scientist (AGB), Cattle Breeding Farm
29	Dr. K. H. Vadher	Associate Professor, College of Fisheries Sceince, Veraval
30	Shri Arjanbhai Naranbhai Chariya	Progressive Farmer, At Gadu Ta-Maliya Hatina Dist-Junagadh

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 schemes were solved satisfactorily by discussion between scientists and the Director of Research in two meetings held during the month of December-2020 and February-2021 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), twice in a year, 2) Agricultural Research Subcommittee (nine 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 State 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 Horti., 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 & Coll. of Fish. Sci., Veraval
16	12712-5B	Campus development program (on campus)	2004	Directorate of Res., 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. Res. 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

Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
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
33	12588-00	Development of arid and semi-arid fruit crops	2009	Dept. of Horti., 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 Pathology, 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 Horti., 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, Targahdia
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

Sr. No.	Budget Head	Scheme Name	Sanction Year	Location
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
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 / shelifish	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 *Kappaphycus alvarezii*(*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 State Government of Gujarat)

Sr. No.	Budget Head	Name of Program	Sanction Year	Location
1	3226	Scheme of design experiment	1980	Dept. of Agril. Stat., 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
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 Res. Station, Dhari
10	5013	Strengthening of res. in vegetable (Tomato)	1962	Vegetable Res. 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

Sr. No.	Budget Head	Name of Program	Sanction Year	Location
16	5042	Strengthening of dry farming research station	1965	Dry Farming Res. Station, Ratia
			1979	Main Dry Farming Research Station, Targhadia
			1967	Dry Farming Research Station, Jam-Khambhalia
			1964	Dry Farming Research Station, 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
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	Research, Testing & Training Centre, 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	Dry Farming Research Station, 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 and 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 ongoing project. In this meeting scientists form different disciplines as well as officers from line 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 2020-21, four meeting of ZREAC were organized; two each at Junagadh and Targhadia. In the ZREAC meetings, six crop varieties, 73 farmers' recommendations, 40 scientific recommendations and 96 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	
33rd ZREAC *(Rabi-summer)* of South Saurashtra Agro-climatic Zone	Junagadh	October 20-21, 2020	3*+27	16	22
33rd ZREAC *(Rabi-summer)* of North Saurashtra Agro-climatic Zone	Targhadia	October 23, 2020	1*+3	1	10
34th ZREAC (*kharif*) of South Saurashtra Agro-climatic Zone	Junagadh	January 20-21, 2021	1*+40	21	56
34th ZREAC (*kharif*) of North Saurashtra Agro-climatic Zone	Targhadia	January 22, 2021	1*+3	2	8
		Total	**6*+73**	**40**	**96**

*Indicate no. of varieties released

Agricultural Research Sub Committee (AGRESCO - Discipline wise)

There are nine 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	Fruits, Vegetables, Flowers and Spices
Agricultural Engineering	Soil & Water Conservation Engineering, Farm Machinery & Power Engg., Renewable Energy Engineering, Processing & Food Engineering
Animal Health	Animal Breeding, Animal Nutrition, Livestock Production & Management, Anatomy, Medicine & Surgery, Animal Genetics *etc.* Fisheries Resource Management, Post-harvest Technology, Aquatic Environment, Aquaculture, Fishery Hydrology and Fishery Engineering,
Animal Production & Fisheries Science	
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 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 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 ensing 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 AGRESCO meeting.

Various Agricultural Research Sub Committee meetings were held during February to March 2021 at Junagadh. Seven new crop varieties, 69 farmers' recommendations, 51 scientific recommendations and 95 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 AGRESCO (Discipline wise) subcommittee meetings organized

Sub Committee	Date	No. of Recommendations		New Technical Programs	On-going Research Projects
		Farmers	Scientific		
Social Science	February 09, 2021	-	08	14	11
Basic Science	February 11-12, 2021	02	06	04	35
Animal Health	February 16-17, 2021	01	06	-	06
Animal Production & Fisheries Science		12	09	-	19
Agricultural Engineering	February 18-19, 2021	10	-	11	32
Crop Production	March 02-03, 2021	22	16	24	168
Crop Improvement	March 04-05, 2021	07*	02	02	-
Horticulture	March 06, 2021	07	-	13	22
Plant Protection	March 08-09, 2021	15	04	27	358
Total		**07*+69**	**51**	**95**	**651**

*No. of crop varieties released

Joint Agricultural Research Sub Committee (Joint AGRESCO)

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 AGRESCO present the findings of their respective committees for approval. This committee meeting is presided over by the Hon'ble Vice Chancellor. Joint AGRESCO will finalize the recommendations and new technical programs for research, which is to be presented in the ensuring 17th Combined Joint AGRESCO of State Agricultural Universities.

The 17th Joint AGRESCO meeting of JAU was held at College of Agricultural Engineering & Technology, JAU, Junagadh on March 19, 2021 under the chairmanship of Dr. V. P. Chovatia, Hon'ble Vice Chancellor, JAU, Junagadh. All AGRESCO conveners of various committees presented their reports and approved. Seven new crop varieties, 69 farmers' recommendations, 49 scientific recommendations and 92 new technical programs were approved in the meeting.

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

This is the apex body to finalize the research recommendations as well as the new technical programs at state level. The meeting is held at the venues in the rotational mode. The members of this committee include Hon'ble Vice Chancellors, Directors of Research, Directors of Extension Education, Associate Directors of Research,

Conveners of various AGRESCO subcommittees and senior scientists of various disciplines of all State Agricultural Universities. Director of Agriculture, Director of Horticulture and Director of Animal Husbandry are also the members of the committee. Separate sessions are organized discipline-wise, in which conveners of various AGRESCO 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 17th Combined Meeting of Agricultural Research Council (AGRESCO-2021) of SAUs and Kamdhenu University was held through virtual mode, organized by Sardarkrushinagar Dantiwada Agricultural University, SKNagar during different schedules at different days. These meetings were organized during April 27 to July 15, 2021. Hon'ble Vice Chancellors of JAU, AAU, NAU, SDAU and KU namely Dr. V. P. Chovatia, Dr. K. B. Kathiria, Dr. Z. P. Patel, Dr. R. M. Chauhan and Dr. N. H. Kelawala were remained present and graced the occasion.

During 17th Combined Joint AGRESCO meeting, seven new crop varieties *viz.* Groundnut (GG 37 and GG-38), Pearl millet (GHB-1231 and GHB-538 (EDV-DM)), Chickpea (GG 7 and GKG-1) and Cotton (G.Cot.Hy.24-BG-II) of JAU were recommended for release in the state. Besides, 67 technologies/ recommendations were made for farmers and 40 recommendations were made for scientific community. In addition, as many as 84 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.

Sub Committee	No. of Recommendations		New Technical Programs
	Farmers	Scientific	
Crop Improvement	7*	02	01
Crop Production	20	15	14
Plant Protection	15	03	25
Horticulture & Forestry	07	-	16
Agricultural Engineering	10	-	10
Animal Health	01	06	-
Animal Production & Fisheries Science	13	04	-
Basic Science	01	07	06
Social Science	-	03	12
Total	**7*+67**	**40**	**84**

*Varieties released

All India Coordinated Research Projects (AICRPs)

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 of India are being organized. 20 AICRP projects are operating in the university. The monitoring of the projects is also carried out by respective Project 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 presents results to the quinquennial review team (QRT). All AICRP projects operating in the university are regularly reviewed and monitored as per the ICAR norms. They identify and evaluate the performance of the research projects according to national standards.

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 Research Station, Amreli	September 28, 2020	1. Dr. V. K. Tiwari, Senior Scientist, Zonal Agril. Res. Station, RVSKV, Morena (M.P.) 2. Dr. Rakesh Verma, Scientist, IISR, Indore. (Monitoring through Video conferencing)
AICRP on Groundnut	Main Oilseeds Research Station, Junagadh	October 01-03, 2020 (Online Mode)	1. Dr. S. K. Bera, PI-Crop Improvement, DGR, Junagadh 2. Dr. B. S. Yenagi, PI-Crop Production, UAS, Dharwad 3. Dr. K. Vemana, PI-Crop Protection, ARS, Kadiri
ICAR Seed Project-Seed production in Field Crops (Online)	Department of Seed Science and Technology	October 09-10, 2020 (Online)	1. Dr. K. Madhusudan, UAS, Bengaluru 2. Dr. Zahoor Ahmed Dhar, SKUAST, Srinagar 3. Dr. R. Arul Prakash, TNAU, Coimbatore 4. Dr. Omvati Verma, GBPUAT, Pantnagar 5. Dr. Udayabhaskar K., ICAR-IISS, Bangalore
AICCIP on Cotton	Cotton Research Station, Junagadh	October 15, 2020	Dr. M. C. Patel, Research Scientist (Cotton), Dr. G. O. Faldu, Assoc. Res. Sci. and Dr. R. D. Patel, Asst. Res. Sci. NAU, Surat
AICRP on Castor	Main Oilseeds Research Station, Junagadh	December 09, 2020	1. Dr. C. Lavanya, Principal Scientist & PI (AICRP Castor) 2. Dr. Mohan Kumar, Agronomist, UAS, GKVK, Bengaluru 3. Dr. V. Divya Rani, Plant Pathologist, RARS, Palem 4. Dr. B. Geeta, Entomologist, ICRS, Yethapur
ICAR Seed Project	Department of Seed Science and Technology	December 11, 2020	1. Dr. S. A. Patil, Former Director Chairman of QRT, and Dr. Malvika Dadlani, Joint Director (Research), ICAR-IARI-New Delhi 2. Dr. Sanjay Kumar, Director, ICAR-IISS, Mau, Varanasi-UP 3. Dr. D. K. Yadava, ADG (Seed), ICAR-New Delhi 4. Dr. N. V. Naidu, Former Director of Research, ANGRAU-Guntur 5. Dr. S. M. Hussain, Ex-Head, Division of Crop Improvement, ICAR-IISS, Indore

Name of Project	Department/ Research Station	Date of Monitoring	Name and designation of member of monitoring
AICRP on Wheat & Barley	Agricultural Research Station, Amreli	February 18, 2021	1. Dr. Vikas Gupta (GPB) and R. P. Meena (Agronomy), ICAR-IIWBR, Karnal, Haryana 2. Dr. J. B. Singh (GPB), ICAR-IARI, Indore 3. Dr. S, I. Patel (Pl. Path.), WRS, SDAU, Vijapur
AICRP on Wheat	Wheat Research Station, Junagadh	February 19, 2021	
AICRP on Vegetable Crops	Vegetable Research Station, JAU, Junagadh	February 27,2021	Dr. P. M. Singh, Director, IIVR, ICAR, Varanasi and Dr. Rajesh Kumar, I/C Project coordinator, AICRP-VC, ICAR, Varanasi

Table 4.2.7 List of AICRPs functioning in the university (Fund share, ICAR 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 Res. 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 Engineering & 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 Plasticulture Engineering & Technologies	2005	Dept. of Renewable Energy Engg., CAET, Junagadh

Sr. No.	Budget Head	Scheme	Sanction Year	Location
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 External Funded Research Projects functioning in the university

Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
1	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
2	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
3	18005-04, 05 & 15	Agricultural demonstration activities in SSP command area Phase-II	2010	SSNNL, Govt. of Gujarat	DFRS, Vallbhipur, Agri. School, Halvad and Cotton Research Station, Kukada
4	18005-18	Establishment of model organic farm	2015	GoG	Dept. of Agron., Junagadh
5	18005-01	Experimental agro-met advisory services	1996	GOI	Dept. of Agron., Junagadh / MDFRS, Targhadia
6	18126-02	Centrally sponsored scheme (Spices)	2006	GOI	Vegetable Research Station, Junagadh
7	18127-00	Seed production in agricultural crops and fisheries	2006	GOI	(Oilseed-Megaseed) Junagadh
8	18127-00	Seed production in agril. crops and fisheries (Oilseeds-Megaseeds)	2006	GOI	Main Oilseed Research Station and Dept. of Seed Sci. & Tech., Junagadh
9	18803-01 to 12	Megaseed revolving fund	2006		
10	18804-01 to 04	Seed production in agricultural crops	2006		

Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
11	18005-06	Forecasting agricultural output using space, agro meteorology and land based observations (FASAL)	2011	GOI	Dept. of Agronomy, Junagadh
12	2012	All India network research project on onion and garlic	2009	ICAR-Network	Vegetable Research. Station, Junagadh
13	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
14	2042-02	National initiative on climate resilient agriculture - dry land	2011	ICAR-Network	Main Dry Farming Res. Station, Targhadia
15	2002-03	National surveillance program for aquatic animal diseases	2013	ICAR-Network	College of Fisheries Science, Veraval
16	2002-5	Implementation of protection of plant varieties and farmer's rights legislation	2002	ICAR-Network	Main Pearl millet Res. Station, Jamnagar
17	2004-1	Project for frontline demonstration in wheat		ICAR-Network	Wheat Research Station, Junagadh
18	2008-3	Project for frontline demonstration in sesame	2007	ICAR-Network	Agriculture Research Station, Amreli
19	2008-12	Scheme for breeder seed production of oilseeds crops (ICAR revolving fund)	2007	ICAR-Network	Main Oilseed Research Station, Junagadh
20	2009-6	Front line demonstration on cotton	2001	ICAR-Network	Cotton Research Station, Junagadh
21	2254	Study storage losses of food grains	2013	ICAR-Network	Dept. of PFE, CAET, Junagadh
22	2374-1	FLD on Chickpea	-	ICAR-Network	Pulses Research Station, Junagadh
23	2374-6	FLD on Pigeon pea			
24	2504-00	Revolving fund horticulture (Nursery)	-	ICAR-Network	Dept. of Horticulture, Junagadh
25	2704-40	Project for frontline demonstration on groundnut	1999	ICAR-Network	Main Oilseed Res. Station, Junagadh/ Agril. Research Station, Amreli
26	2704-43	Project for frontline demonstration in pearl millet	1989	ICAR-Network	Main Pearl millet Research Station, Jamnagar
27	2002-07	Consortia research platform (CRP) on biofortification	2014		

Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
28	18132	Creation of seed-hubs for increasing indigenous production of pulses in India	2016	ICAR-Network	Dept. of Seed Science & Tech., Junagadh
29	18303-14	Technical assistance for wild life health care, diseases diagnosis and therapeutic management	2017	GOG	College of Veterinary Science & Animal Husbandry, Junagadh
30	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
31	18009-33	Proliferation of Bt-gene in native cotton varieties of Gujarat	2017	GOG	Cotton Research Station, Junagadh
32	2009-09	Testing of Bt. Cotton	2017	ICAR	Cotton Res. Stat., Junagadh
33	18246-91	River flow simulations integrating satellite data in forested catchment	2017	GOG	CAET, JAU, Junagadh
34	18009-34	Seed infrastructure under NMOOP	2017	GOG	Agril. Res. Station, Amreli
35	1855-03	Mapping and valuation of economics, social and environmental benefits of conserving Gir Forest area	2018	GOG	Dept. of Economics, JAU, Junagadh
36	2009-07	Insecticide Resistance Management: Dissemination of pink bollworm management strategies	2018	ICAR	Cotton Research Station, JAU, Junagadh
37	18132-02	Creation of seed-hubs for enhancing quality seeds availability of major oilseeds crops - groundnut under NFSM - NMOOP	2018	GOI	Department of Seed Science & Technology, JAU, Junagadh
38	2008-08	Project for production of breeder seed of annual oilseeds crops.	1987	ICAR	Main Oilseed Research Station, JAU, Junagadh
39	2260-3	Development of protocols for procurement, safe storage and milling outturn of major pulses	2019	ICAR	Dept. of Processing & Food Engineering, CAET, JAU, Junagadh
40	2008-19	Mainstreaming of Sesame germplasm for productivity enhancement through genomics assisted core development and trait discovery	2020	ICAR	Agricultural Research Station, JAU, Amreli

Sr. No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
41	18247-35	Product testing for pesticides residue to promote organic farming and export of Agricultural produce (RKVY)	2019	GoG	Dept. of Biotechnology, JAU, Junagadh
42	18247-36	Seed Replacement Rate Enhancement for the year 2019-20 (RKVY)	2019	GoG	Dept. of Seed Science & Tech., JAU, Junagadh
43	18274-37	Centre of Excellence for quality testing of cotton (RKVY)	2019	GoG	Cotton Research Station, JAU, Junagadh
44	18247-39	Production of value added cow based by product to sustain Gaushalas (RKVY)	2019	GoG	Cattle Breeding Farm, JAU, Junagadh
45	18247-41	Commercial Exploitation of Date palm through Tissue culture	2019	GoG	Dept. of Genetics & Plant Breeding, JAU, Junagadh
46	18247-43	Strengthening of seed multiplication farm (RKVY)	2019	GoG	Dept. of Seed Science & Tech., JAU, Junagadh

4.3 Crop Improvement

Crop Improvement includes development of new crop varieties and maintenance of germplasm of mandate crops of the region.

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 ensuing season.

Table 4.3.1 Production of Nucleus / Breeder Seeds

Sr. No.	Crop	Variety	Nucleus Seed (q)	Breeder Seed (q)		Total (q)
				National	State	
1	Groundnut	GG-2	0.90	-	15.00	15.90
		GG-5	0.30	-	27.90	28.20
		GG-7	0.30	-	5.40	5.70
		GG-8	0.36	-	0.60	0.96
		GJG-9	7.90	40.00	130.00	177.90
		GJG-31	2.70	60.00	5.10	67.80
		GJG-32	53.30	350.00	620.00	1023.30
		GJG-33	3.80	-	-	3.80
		GAUG-10	6.00	-	42.00	48.00
		GG-11	6.60	-	33.00	39.60
		GG-16	1.34	-	1.50	2.84
		GJG-17	5.10	-	90.00	95.10
		GJG-19	1.42	-	-	1.42
		GG-20	45.20	20.00	700.00	765.20
		GG-21	0.96	10.00	1.00	11.96
		GJG-22	93.73	130.00	1000.00	1223.73
		GJG HPS-1	0.60	-	3.00	3.60
		GJG HPS-2	8.25	-	-	8.25
		Sub Total	**238.76**	**610**	**2674.5**	**3523.26**
2	Pearl millet	GHB 558	0.01	0.06	0.55	0.62
		GHB 538	0.03	0.08	6.79	6.90
		GHB 744	0.01	0.04	2.28	2.32
		GHB 732	0.01	0.00	5.01	5.02
		GHB 905	0.02	0.12	3.77	3.91
		GHB 1129	0.02	0.00	0.46	0.47
		GHB 1225	0.01	0.00	0.75	0.76
		Sub Total	**0.10**	**0.30**	**19.60**	**20.00**
3	Sesame	G. Til-1	0.05	-	-	0.05
		G. Til-2	0.50	0.05	0.97	1.52
		G. Til-3	0.30	0.05	5.00	5.35
		G. Til-4	0.30	0.80	1.31	2.41
		GJT-5	0.15	0.10	0.10	0.35
		G. Til-6	0.10	0.20	0.10	0.40
		G. Til-10	0.10	0.05	1.30	1.45
		Sub Total	**1.50**	**1.25**	**8.78**	**11.53**

Sr. No.	Crop	Variety	Nucleus Seed (q)	Breeder Seed (q)		Total (q)
				National	State	
4	Chickpea	GG 1	0.60	-	8.00	8.60
		GG 2	1.50	-	6.50	8.00
		GJG 3	10.20	42.50	109.77	162.47
		GG 4	3.35	18.00	-	21.35
		GG 5	9.40	9.51	69.00	87.91
		GJG 6	4.10	14.50	23.50	42.1
		Sub Total	**29.15**	**84.51**	**216.77**	**330.43**
5	Pigeon pea	GJP 1	0.02	0.01	3.10	3.13
		Sub Total	**0.02**	**0.01**	**3.10**	**3.13**
6	Wheat	GW 366	4.20	58.80	10.40	73.40
		GJW 463	4.20	22.40	46.40	73.00
		GW 496	-	-	67.60	67.60
		Lok 1	-	-	34.40	44.40
		Sub Total	**8.40**	**81.20**	**158.80**	**248.40**
		Grand total	**277.93**	**777.27**	**3081.55**	**4136.75**

The crop seeds produced in the farms were processed at Megaseed processing plant. The processed good quality truthful/ certified/ foundation seeds were sold to farmers under the trade name of *"Gir Sawaj"* and its detail is given in below table. Very good response was observed among the farmers to avail this facility.

Table 4.3.2 Production of truthful, foundation and certified seeds of field crops under mega- seed and Seed Hub projects

Sr. No.	Crops	Production (q)		
		Truthful	Foundation	Certified
1	Groundnut	367.37	176.10	1209.60
2	Chickpea	400.96	48.00	1040.00
3	Sesame	22.99	-	-
4	Wheat	1764.00	560.00	52.50
5	Cotton	47.00	-	-
6	Castor	15.00	-	-
7	Cumin	20.80	-	-
8	Coriander	32.00	-	-
9	Soybean	143.16	-	-
10	Mungbean	9.06	-	-
11	Urdbean	112.54	-	-
12	Pigeon pea	24.00	8.00	111.20
13	Sugarcane Setts	1000.00	-	-

Sr. No.	Crops	Production (q)		
		Truthful	Foundation	Certified
14	Sorghum	30.00	-	-
15	Garlic	50.00	-	-
16	Onion	30.00	-	-
17	Papaya Seeds	0.50	-	-
18	Vegetable seeds	12.00	-	-
	Total	**4081.38**	**792.10**	**2413.30**
	Grand Total	**7286.78**		

New crop varieties

Seven new crop varieties *viz.* Groundnut (GG 37 and GG-38), Pearl millet (GHB-1231 and GHB-538 (EDV-DM)), Chickpea (GG 7 and GKG-1) and Cotton (G.Cot.Hy.24-BG-II) were recommended for farmers during the year 2020-21.

Groundnut: Gujarat Groundnut 37 [GG 37: Sorath Gaurav]

The farmers of Gujarat state growing groundnut during *summer* season are recommended to grow Spanish bunch groundnut variety Gujarat Groundnut 37 [GG 37: Sorath Gaurav]. This variety has recorded mean pod yield of 3218 kg/ha, which was 20.77, 19.11 and 14.33 *per cent* higher over the check varieties, GG 6 (2398 kg/ha), GJG 31 (2702 kg/ha) and TG 37A (2815 kg/ha), respectively. This variety has also recorded high kernel yield (2350 kg/ha), oil yield (1148 kg/ha) and number of pods per plant over the check varieties. This variety was found comparable to the check varieties against tikka, stem rot and collar rot diseases. The damage due to thrips in GG 37 was also comparable to the check varieties.

Groundnut: Gujarat Groundnut 38 [GG 38: Sorath Navin]

The farmers of Gujarat state growing groundnut during *kharif* season are recommended to grow Spanish bunch groundnut variety Gujarat Groundnut 38 (GG 38: Sorath Navin). This variety has recorded mean pod yield of 2966 kg/ha, which was 31.53, 33.12 and 10.87 *per cent* higher over the check varieties, GG 7 (2255 kg/ha), GJG 9 (2228 kg/ha) and TG 37A (2675 kg/ha), respectively. This variety has also recorded high kernel yield (2146 kg/ha) and high oil yield (1050 kg/ha) over the check varieties. This variety was found comparable to the check varieties against tikka, rust, stem rot and collar rot diseases. The damage due to leaf defoliators in GG 38 was also comparable to the check varieties.

Chickpea: Gujarat Gram 7 [GG 7: Sorath Suraj]

Farmers of Gujarat state growing chickpea under conserved moisture (un-irrigated) condition are recommended to grow Gujarat Gram 7 (GG 7: Sorath Suraj) variety. This variety has produced 1859 kg/ha seed yield which was 43.3, 30.3, 18.4 and 9.0 *per cent* higher over check varieties Gujarat Gram 1 (1297 kg/ha), Gujarat Gram 2 (1427 kg/ha), Gujarat Junagadh Gram 3 (1570 kg/ha) and Gujarat Junagadh

Gram 6 (1706 kg/ha), respectively. Seeds of this variety are large size and brown in colour. This variety is resistant to stunt disease and resistant to moderately resistant against wilt disease. It showed low pod borer damage. This variety has higher protein (23.65 %) and zinc (33.50 ppm) content as compared to the check varieties.

Chickpea: Gujarat Kabuli Gram 1 [GKG 1: Sorath Kabuli]

Farmers of Gujarat state growing kabuli chickpea are recommended to cultivate early maturing variety Gujarat Kabuli Gram 1 (GKG 1: Sorath Kabuli). In South Saurashtra, it recorded 2790 kg/ha seed yield, which is 14.7, 22.8 and 42.6 *per cent* higher over check varieties KAK 2, JGK 1 and PG 0517, respectively under irrigated condition. In north Saurashtra, it produced 1875 kg/ha seed yield, which is 29.8 and 20.7 *per cent* higher over KAK 2 and JGK 1, respectively and in Middle Gujarat, it recorded 1751 kg/ha seed yield which is 2.2 and 8.6 *per cent* higher over KAK 2 and PG 0517, respectively under irrigated condition.

In Bhal and Coastal areas, this variety has produced seed yield 1219 kg/ha which is 8.2, 7.9 and 50.1 *per cent* higher over check varieties KAK 2, JGK 1 and PG 0517, respectively under un-irrigated condition, where in south Gujarat, it gave 963 kg/ha seed yield, which is 5.4, 7.6 and 6.9 *per cent* higher over check varieties KAK 2, JGK 1 and PG 0517, respectively under un-irrigated condition. As see ds of this variety are of extra-large size (43.5 g/100 seeds), it is suitable for export purpose. This variety has good level of resistance against stunt disease with low pod borer damage. It has higher dal recovery (67.45 %), protein (23.60 %), iron (63.78 ppm) and zinc (35.40 ppm) content.

Pearl millet variety: Gujarat Hybrid Bajra 1231 [GHB 1231: Sawaj Shakti]

The summer pearl millet growing farmers of Gujarat state and semi *rabi* pearl millet growing farmers of Saurashtra region are recommended to grow Gujarat Hybrid Bajra (GHB 1231: Sawaj Shakti) as a dual purpose (grain and dry fodder) biofortified hybrid. During summer, this hybrid recorded average 5737 kg/ha grain yield, which was 48.4 and 12.4 *per cent* higher than check hybrids GHB 558 and GHB 732, respectively. It has also recorded average 8193 kg/ha dry fodder yield, which was 27.1 and 7.5 *per cent* higher than check hybrids GHB 558 and GHB 732, respectively.

During semi *rabi,* this hybrid recorded average 4485 kg/ha grain and 8212 kg/ha dry fodder yield, which was 30.9 and 16.1 *per cent* higher than check hybrid GHB 538 in Saurashtra region. The proposed hybrid is resistant against major pearl millet diseases like downy mildew, blast and rust and pest like shoot fly and stem borer. The grains of this hybrid possess higher content of Fe (> 70 ppm) and Zn (> 40 ppm) which is additional benefit to the farming and consumer community of pearl millet for their nutritional security.

Pearl millet variety: Essentially Derived Gujarat Hybrid Bajra 538 for Downey Mildew [GHB 538 (EDV for DM): Maru Sona]

The farmers of Gujarat state growing pearl millet during *kharif* season are recommended to grow Gujarat Hybrid Bajra 538 (EDV for DM) [GHB 538 (EDV for DM): Maru Sona] as a Downey mildew resistant and early maturing hybrid. This hybrid recorded average grain yield of 2589 kg/ha which is 3.5 *per cent* higher than check hybrid GHB 538. It has also recorded 6320 kg/ha dry fodder yield which is 10.8 *per cent* higher than check hybrid GHB 538. The proposed hybrid is resistant against pearl millet diseases like blast and rust and pests like shoot fly and stem borer.

Cotton variety: Gujarat Cotton Hybrid-24 BG-II [G.Cot.Hy-24 BG-II: Sorath Swet Kanak]

The farmers of Gujarat state growing Bt cotton hybrid (*Gossypium hirsutum* L.) are recommended to grow cotton hybrid Gujarat Cotton Hybrid-24 BG-II (G.Cot.Hy-24 BG-II: Sorath Swet Kanak) under irrigated condition. This hybrid has recorded 3070 kg/ha seed cotton yield, which was 45.4, 53.3, 45.1 and 20.9 *per cent* higher over BG-II check hybrids *viz*., G.Cot.Hy-12 (1943 kg/ha), RCH-2 (1843 kg/ha), MRC-7351 (2285 kg/ha) and PCH-4599(2741 kg/ha), respectively. This hybrid gave lint yield of 1076 kg/ha, which was 55.7, 61.1, 60.2 and 29.3 *per cent* higher over BG- II check hybrids G.Cot.Hy-12 (635 kg/ha), RCH-2 (614 kg/ha), MRC-7351 (726 kg/ha) and PCH-4599 (899 kg/ha), respectively. It possesses 33.9 % ginning outturn. This hybrid is medium in maturity. It is found resistant to alternaria leaf spot and bacterial leaf blight disease and found moderately resistant against sucking pests.

Recommendation for Scientific Community

Application of brassinolide to mitigate saline stress during germination and growth period in chickpea

It is recommended to scientific community that pre-soaking of chickpea seed with 0.25 ppm brassinolide (B2) for 2 hrs before sowing helps to mitigate salinity stress up to 6.0 dS/m with 50 % yield reduction as compared to control.

Micropropagation in Kankoda (*Momordica dioica* Roxb.)

Surface sterilization: Internodal explant of kankoda to be used after surface sterilization with carbendazim for 30 minutes followed by 0.1 % Mercuric chloride treatment for 15 minutes and washed with sterilized distilled water for four to five times for removing traces of the chemicals.

Shoot multiplication: Low concentration of kinetin (MS + K1) is effective for getting early shoot initiation and maximum number of shoots.

In-vitro rooting: Half strength MS media supplemented with high concentration of IBA (IBA3) is effective for getting early root initiation.

Hardening: A pot mixture of soil: sand (1: 1 volume basis) is effective for getting 60-65 % and 90-95 % survival rate of plantlets for primary and secondary hardening, respectively under greenhouse condition.

4.4 Crop Production

Crop Production group mainly includes Agronomy, Agricultural Chemistry & Soil Science and Weed Control. Recommendations related to nutrient management, cultural practices, irrigation management and weed management are the different aspects of crop production.

Analysis of soil, irrigation water and plant is carried out with well-equipped laboratories at Department of Biotechnology, Agricultural Chemistry and Krishi Vigyan Kendras (KVKs) of JAU at reasonable price and its detail is given below.

Table 4.4.1 Analysis of Soil, Plant & Irrigation Water Sample

Sr. No.	Detail	No. of Sample analyzed
1	Soil sample analysis	2918
2	Irrigation water analysis	1804
3	Plant sample analysis	1455
	Total	**6177**

Recommendation for Farmers

Nutrient Management

Integrated nutrient management in soybean

The farmers of South Saurashtra Agro-climatic Zone growing *kharif* soybean are recommended to apply either Biocompost 2 t/ha + FYM 2.5 t/ha + *Rhizobium* 2 L/ha + PSB 2 L/ha or Biocompost 4 t/ha or FYM 5 t/ha as soil application to obtain higher yield and net realization along with maintenance of soil fertility.

Effect of tillage and post-emergence herbicides on growth and yield of soybean

The farmers of Gujarat growing *kharif* soybean are recommended to prepare the field by rotavator and apply pendimethalin 0.9 kg/ha (30 % EC @ 60 ml/10 L water) as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop propargyl 245 g/ha (16.5 % + 8 % EC @ 20 ml/10 L water) as post-emergence at 30 DAS for effective weed management and to obtain higher seed yield and net realization.

Application of bio-formulations in summer groundnut production

The farmers of South Saurashtra Agro-climatic Zone growing groundnut during summer season are recommended to apply 75 % RDF (18.75-37.5-37.5 kg N-P_2O_5-K_2O /ha) with seed treatment of NPK liquid biofertilizer (2 ml + 3 ml water/kg seed) and Zn solubilizing bacteria (1 ml + 4 ml water/kg seed) or 50 % RDF (12.5-25-25 kg N-P_2O_5-K_2O /ha) with seed treatment of bio-grow biofertilizer (1 ml + 4 ml water/kg seed) for obtaining higher yield and net return.

Effect of foliar application of water soluble fertilizer on growth, yield and nutrient uptake of summer groundnut

The farmers of South Saurashtra Agro-climatic Zone growing groundnut during summer season are recommended to apply 75 % RDF (18.75-37.5-37.5 kg N-P_2O_5-K_2O /ha) as basal and spray 1.5 % water soluble fertilizer (19-19-19 % N-P-K) at 45, 60 and 75 DAS for obtaining higher yield and net return.

Effect of multi-micronutrient formulations on chickpea

The farmers of South Saurashtra Agro-climatic Zone growing chickpea in medium black calcareous soil are recommended to apply micronutrients as per soil test value or multi micronutrients formulation Grade-V 40 kg/ha as basal in addition to recommended dose of fertilizers (20-40-0 N-P_2O_5-K_2O kg/ha) to chickpea for obtaining higher yield and net return.

Effect of foliar application of various fertilizers on growth, yield and nutrients uptake by onion

The farmers of South Saurashtra Agro-climatic Zone growing onion in medium black calcareous soil are recommended to apply 75 % RDF (56-45-37.5-15 kg N-P_2O_5-K_2O-S /ha) + 1 % (100 g/10 L water) foliar spray of water soluble fertilizer (19-19-19 % N-P-K) and 1 % Novel organic liquid nutrient at 45 and 60 day after transplanting for getting higher yield and net return.

Effect of foliar application of water soluble fertilizer on growth, yield and nutrients uptake by Bt cotton

The farmers of South Saurashtra Agro-climatic Zone growing Bt cotton in medium black calcareous soil are recommended to apply 75 % RDF (180-37.5-112.5 N-P_2O_5-K_2O kg/ha) + two sprays of 2 % water soluble fertilizer (19-19-19 % N-P-K) at 50 and 75 DAS for getting higher yield and net return.

Effect of NP fertilization on yield of sorghum under conserved soil moisture in Ghed area

The farmers of South Saurashtra Agro-climatic Zone (Ghed area) growing sorghum under conserved soil moisture are recommended to apply 40 kg N and 20 kg P_2O_5/ha for obtaining higher yield and net return as well as sustaining soil fertility. The nitrogen should be applied in two equal splits *i.e.* 50 % as basal at the time of sowing and 50 % as top dressing by drilling in 10 cm soil depth at 45-50 days after sowing.

Cultural Practices

Evaluation of various green manure crops under different time of sowing

The farmers of South Saurashtra Agro-climatic Zone interested in green manuring are recommended to sow sunnhemp or dhaincha during June-July and incorporate in soil at initiation of flowering for adding higher quantity of green biomass, N, P and K in soil.

Identification of remunerative groundnut based cropping systems under rainfed situation in India

The farmers of South Saurashtra region adopting intercropping system in semi-spreading groundnut during *kharif* season are recommend to grow groundnut + sesame (2:1) intercropping during *kharif* season and onion during *rabi* season for obtaining higher groundnut equivalent yield and net return.

In-situ moisture conservation in rainfed sesame for higher resource use efficiency, productivity and profitability

The farmers of North Saurashtra Agro-climatic Zone growing sesame during *kharif* season under rainfed condition are recommended to sow sesame by broad bed and furrow system (40 cm width and 15 cm depth of furrow and 140 cm bed between two furrows) and apply wheat straw mulch 5 t/ha on broad bed at 15 days after sowing for getting higher seed yield and net return.

Performance of sesame genotypes differing in maturity and plant types and their response to plant geometry in summer season

The farmers of North Saurashtra Agro-climatic Zone growing summer sesame are recommended to prefer sesame varieties differing in maturity and plant type for higher seed yield and net return with different plant spacing as shown below.

- Variety with profuse branches and late maturity (G.Til 10) at 30 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 15 cm x 10 cm or 30 cm x 10 cm spacing

Irrigation Management

Standardization of potash levels and apportioning time in summer groundnut under drip irrigation

The farmers of South Saurashtra Agro-climatic Zone growing groundnut during summer season are recommended to apply potash @ 40 kg/ha through fertigation in 6 equal splits at 8 days interval (1st split at 20 DAS) along with recommended dose of N and P (25-50 kg N-P_2O_5 /ha) as basal for obtaining higher yield and net return.

Details of drip irrigation system are as under.

Details		Operating time	
		Month	Minutes
Lateral spacing	: 60 cm	February	75-80
Dripper spacing	: 45 cm	March	100-110
Dripper discharge rate	: 4 lph	April	120-125
Operating pressure	: 1.2 kg/cm^2	May	130-135
Operating frequency	: Alternate day		

Effect of land configuration and drip irrigation on productivity of wheat

The farmers of South Saurashtra Agro-climatic Zone growing wheat are recommended to adopt drip irrigation at 0.8 ETc in flat bed for acquiring higher yield ,higher net return and save irrigation water over broad bed furrow and flood irrigation. Drip irrigation system details are as under.

Details of drip system		Operating time	
Lateral spacing	: 90 cm	a) November	: 1 hour
Inline dripper spacing	: 40 cm	b) December	: 1 hour 30 min
Dripper discharge	: 2 lph	c) January	: 2 hours
Operating pressure	: 1.2 kg/cm^2	d) February	: 2 hours 15 min
Operating frequency	: Alternate day		

Weed Management

Weed management in coriander

The farmers of Gujarat growing coriander are recommended to keep weed free condition up to 45 DAS by hand weeding as and when required for effective weed management and to obtain higher seed yield and net realization.

Weed management in chickpea

The farmers of Gujarat growing irrigated chickpea are recommended to keep weed free condition up to 45 DAS by interculturing and hand weeding as and when required for effective weed management and to obtain higher seed yield and net realization.

Weed management in summer guar

The farmers of Gujarat growing summer guar are recommended to keep weed free condition up to 45 DAS by interculturing and hand weeding as and when required for effective weed management and to obtain higher seed yield and net realization.

Weed management in green gram

The farmers of Gujarat growing *kharif* green gram are recommended to do interculturing and hand weeding at 20 and 40 days after sowing for effective

weed management and to obtain higher seed yield and net realization.

Weed management in black gram

The farmers of Gujarat growing *kharif* black gram are recommended to do interculturing and hand weeding at 20 and 40 days after sowing for effective weed management and to obtain higher seed yield and net realization.

Performance of different weed management practices on pearl millet productivity

The farmers of Gujarat growing pearl millet in *kharif* season are recommended to do hand weeding at 3rd and 5th weeks after sowing for effective weed management and achieving higher grain yield and net realization.

Recommendation for Scientific Community

Weed management in coriander

Under Saurashtra region, effective weed management along with higher seed yield of coriander can be achieved by application of tank-mix pendimethalin 450 g/ha + oxadiargyl 30 g/ha as pre emergence *fb* HW at 30 DAS or paraquat 500 g/ha as early post-emergence at 7 DAS *fb* HW at 30 DAS or pendimethalin 750 g/ha as pre-emergence *fb* HW at 30 DAS.

Weed management in chickpea

Under Saurashtra region, effective weed management along with higher seed yield of chickpea and net return can be achieved by application of pendimethalin 750 g/ha as pre-emergence *fb* IC & HW at 30 DAS or pre-mix pendimethalin + imazethapyr 750 g/ha as pre-emergence *fb* IC & HW at 30 DAS.

Weed management in summer guar

Under Saurashtra region, effective weed management along with higher seed yield of guar and net return can be achieved by application of tank-mix pendimethalin 450 g/ha + oxadiargyl 30 g/ha as pre-emergence *fb* IC & HW at 30 DAS or pre-mix pendimethalin + imazethapyr 750 g/ha as pre-emergence *fb* IC & HW at 30 DAS.

Weed management in green gram

Under South Saurashtra Agro-climatic Zone, effective weed management along with higher seed yield of *kharif* green gram and net return can be achieved by application of pre-mix pendimethalin + imazethapyr 750 g/ha as pre-emergence *fb* IC & HW at 40 DAS or pendimethalin 900 g/ha as pre-emergence *fb* IC & HW at 40 DAS.

Weed management in black gram

Under South Saurashtra Agro-climatic Zone, effective weed management along with higher seed yield of *kharif* black gram and net return can be achieved by application of pre-mix pendimethalin + imazethapyr 750 g/ha as pre-emergence *fb* IC & HW at 40 DAS.

Soil test based fertilizer recommendation for targeted yield of wheat

The soil testing laboratories are informed that the nutrients requirement for production of one quintal wheat grain was assessed as 3.81, 0.82 and 3.40 kg N, P_2O_5 and K_2O, respectively and the fertilizer prescription equations are: for N: [FN = 6.82 x T - 1.01 x SN - 0.27 x FYM], P: [FP_2O_5 = 1.80 x T - 2.25 x SP - 0.09 x FYM] and K: [FK_2O = 3.14 x T - 0.46 x SK - 0.27 x FYM] with FYM 10 t/ha. While without FYM, nutrients requirement for production of one quintal wheat grain was assessed as 3.52, 0.77 and 3.02 kg N, P_2O_5 and K_2O, respectively and the fertilizer prescription equations are: for N: [FN = 8.53 x T - 1.19 x SN], P: [FP_2O_5 = 2.61 T - 3.07 x SP] and K: [FK_2O = 5.03 x T - 0.68 x SK]. Targeted yield concept could be effectively adopted from 40 to 50 q/ha for site specific fertilizer recommendation to achieve high yield of wheat in the medium black calcareous soils of Saurashtra region of Gujarat.

Establishment of critical limit of zinc for summer green gram in medium black calcareous soils

For recommending Zn application to green gram crop grown in calcareous soils of Saurashtra, STL of Gujarat should consider the critical limit of 0.70 ppm in soil and 47 ppm in green gram plant at 45 DAS.

Establishment of critical limit of zinc for pigeon pea crop in medium black calcareous soils

For recommending Zn application to pigeon pea crop grown in calcareous soils of Saurashtra, STL of Gujarat should consider the critical limit of 0.63 ppm in soil and 33.9 ppm in pigeon pea plant at 60 DAS.

Effect of saline irrigation water on garlic

It is for information to scientific community especially for plant breeders that garlic variety GJG-5 recorded superior values of different salt tolerance criteria like higher mean salinity index (77.00 %), comparable mean bulb yield (54.78 g/pot), minimum yield decline (43.61 %) at EC 5.0 dS/m and 50% yield reduction at EC 9.32 dS/m as well as lower Na/K ratio in bulb (0.157) and straw (0.360). Garlic variety GJG-5 was found more salt tolerant as compared to GG-4, G-282 and GG-2 on the basis of salinity indices.

Effect of saline irrigation water on sesamum

It is for information to scientific community especially for plant breeders that sesamum variety Gujarat Til-3 recorded superior value of different salt tolerance criteria like higher mean seed yield (19.69 g/pot), comparable mean salinity index (71.82 %), yield decline (38.51 %) at 5.0 dS/m and 50 % yield reduction at EC 9.47 dS/m as well as lower Na/K ratio in seed (0.253) and straw (0.551).

Evaluation of salt tolerance of onion varieties with and without FYM

It is for information to scientific community especially for plant breeders that among the four varieties of onion *viz.,* Pilipatti, Agri. Found Light Red, Talaja Red, GJRO-11, the variety Agri. Found Light Red recorded significantly the highest bulb yield (7290 kg/ha), bulb girth (3.59 cm), bulb length (3.70 cm) and lowest Na/K ratio in straw (0.56) with saline irrigation water having EC 12.70 dS/m. Application of FYM 20 t/ha significantly increased bulb yield of onion. The variety Agri. Found Light Red found superior in salt tolerance up to saline irrigation water EC 12.70 dS/m.

Performance of different weed management practices on pearl millet productivity

Effective weed management along with higher yield and net returns from *kharif* pearl millet can be achieved by application of tembotrione 120 g/ha as post-emergence at 3-4 leaf stage of weeds.

Weed management in sugarcane with special reference to *Cynodon dactylon*

The scientific community is informed that pre-plough application of glyphosate 2.5 kg/ha followed by MB ploughing at 21 days after application of glyphosate and post-emergence directed spray of either glyphosate 2.5 kg/ha or fenoxaprop 75 g/ha at 45 days after planting gave higher cane yield and net returns as well as effective control of *Cynodon dactylon.*

Performance of sesame genotypes differing in maturity and plant types and their response to plant spacing in summer season

In North Saurashtra Agro-climatic Zone, sesame genotypes with few branches and early maturity (AT 375 and AT 377) as well as uniculm variety with late maturity (AT 363 and AT 374) gave higher seed yield and net return at 15 cm x 10 cm spacing.

Evaluation of pre and post emergence herbicide for chemical weed management in sesame

In North Saurashtra Agro-climatic Zone, effective weed management along with higher seed yield and net realization in rainfed sesame can be obtained by application of pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-ethyl 50 g/ha at 20 DAS.

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. Plant protection mainly includes two groups i.e. Entomology and Plant Pathology.

4.5.1 Production of *Sawaj* brand bio-agents and microbial products

During the year 2020-21, Department of Plant Pathology has produced and distributed bio-agents under the trade name *"Gir Sawaj"* as shown in table below. *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 4.5.1 Production of bio-agent and liquid bio-fertilizer

Sr. No	Name of Product	Quantity
1	*Trichoderma* (tonne)	3.347
2	*Rhizobium* (liter)	654
3	*Azotobacter* (liter)	682
4	PSB (liter)	1179
5	*KMB* liter)	170

Department of Entomology has produced various microbial agents under the trade name *"Gir Sawaj"* e.g. viruses, bacteria, fungi, protozones and nematodes are being used in IPM program as shown in below table. Among viral pathogens, nuclear polyhedrosis viruses of *Helicoverpa* (*H*NPV), *Spodoptera (S*NPV), 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 4.5.2 Production of microbial agents, traps, lure *etc.*

Sr. No.	Name of product	Quantity
1	*Beauveria* (tonne)	8.40
2	*Metarhizium* (tonne)	2.47
3	HNPV (litre)	193.5
4	SNPV (litre)	117.5
5	Trichocard (Nos.)	1100
6	Fruit fly traps (Nos.)	14677
7	Fruit fly lure for fruit crops (Nos.)	15770
8	Fruit fly lure for vegetable crops (Nos.)	1904
9	Pheromone trap (Nos.)	7888
10	Pheromone lure (Pink bollworm) (Nos.)	9500
11	Pheromone lure (*Heliothis*) (Nos.)	5988
12	Pheromone lure (*Prodenia*) (Nos.)	1580
13	Pheromone lure (Brinjal shoot and fruit borer) (Nos.)	178
14	Pheromone lure (*Fall armyworm*) (Nos.)	702
15	Mating Disruption Paste for Pink bollworm (Nos.)	793
16	Mating Disruption Paste for Brinjal shoot and fruit borer (Nos.)	38

Recommendation for Farmers

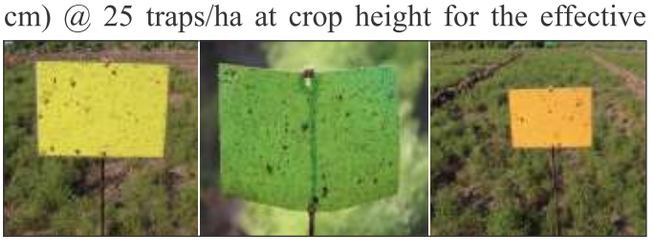
Entomology

Comparison of different colour sticky traps for monitoring of sucking pests in brinjal

The farmers of Gujarat are recommended to install yellow (RGB-255, 255, 0) or dark green (RGB-0, 128, 0) sticky traps (15 cm x 21 cm) @ 25/ha at crop height for the effective monitoring of jassid and whitefly in brinjal. The sticky trap is to be installed at one week after transplanting and it should be changed at weekly interval. Grease should be used as an adhesive material.

Comparison of different colour sticky traps for monitoring of sucking pests in seed spices

The farmers of Gujarat growing seed spices are recommended to install yellow (RGB-255, 255, 0) or dark green (RGB-0, 128, 0) sticky traps (15 cm x 21 cm) @ 25 traps/ha at crop height for the effective monitoring of aphids in coriander, cumin, fenugreek and fennel, while dark blue (RGB-0, 0, 255) and yellow (RGB-255, 255, 0) sticky traps (15 cm x 21 cm) @ 25 traps/ha at crop height for the effective



monitoring of thrips in cumin, fennel and ajwain. The sticky trap is to be installed at at one week after transplanting and it should be changed at weekly interval. Grease should be used as an adhesive material.

Bio-efficacy of different biopesticides against rugose spiralling whitefly in coconut (Adhoc recommendation)

The farmers of Gujarat having coconut orchards are recommended to apply three sprays of *Beauveria bassiana* 1.15 WP (Min. 1 x 10^8 cfu/g) 0.009 % (80 g/10 litre of water) or *Isaria fumosorosea* 1.15 WP (Min. 1 x 10^8 cfu/g) 0.009 % (80 g/10 litre of water) along with starch 1 % (10 g/lit), first spray at initiation of pest infestation, second and third spray at 10 days interval after first spray for effective management of rugose spiralling whitefly.

As per CIBRC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)		
2020-21	Coconut	Rugose Spiralling White fly	*Beauveria bassiana* 1.15 WP	46	4 kg	0.009	80 g	500 litre	First spray at initiation of pest infestation, second and third spray at 10 days interval after first spray
			Isaria fumosorosea 1.15 WP	46	4 kg	0.009	80 g		

Bio-efficacy of different insecticides against rugose spiralling whitefly in coconut (Adhoc recommendation)

The farmers of Gujarat having coconut orchards (1 to 3 year old palms) are recommended to apply three sprays of pyriproxyfen 10 % + bifenthrin 10 % EC 0.02 % (10 ml/10 litre of water) or spiromesifen 22.9 SC 0.027 % (12 ml/10 litre of water) or diafenthiuron 50 WP 0.05 % (10 g/10 litre of water) along with 1 % starch (10 g/litre of water), first spray at initiation of pest infestation, second and third spray at 10 days interval after first spray for effective management of rugose spiralling whitefly.

As per CIBRC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)		
2020-21	Coconut	Rugose Spiralling White fly	Pyriproxyfen 10 % + Bifenthrin 10 % EC	100	0.50 lit.	0.02	10 ml	500 lit.	First spray at initiation of pest infestation, second and third spray at 10 days interval after first spray
			Spiromesifen 22.9 SC	137	0.60 lit.	0.027	12 ml		
			Diafenthiuron 50 WP	250	0.50 kg	0.05	10 g		

Management of rugose spiralling whitefly through root feeding of insecticides in coconut (Adhoc recommendation)

The farmers of Gujarat having coconut orchards (>5 year old palms) are recommended to give root feeding (pencil size root) application of monocrotophos 36 SL @ 10 ml with 10 ml of water per palm, first at initiation of pest infestation and second at one month after first application for management of rugose spiralling whitefly. The interval between root feeding and harvesting of coconut should be 30 days.

As per CIB-RC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Qty. of Chemical suspension required/ha	Application schedule	Waiting period/ PHI (days)
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)			
2020-21	Coconut	Rugose Spiralling White fly	Monocrotophos 36 SL	0.637	1.77 lit.	-	-	-	First root feeding at initiation of pest infestation, and second at 1 month interval after first root feeding	30

Effect of different schedule based insecticides and biopesticides spray against fall army worm *Spodoptera frugiperda* (J. E. Smith) infesting maize

The farmers of Gujarat growing maize are recommended to apply schedule spraying of chlorantraniliprole 18.5 SC 0.005 % (3 ml/10 litre of water), emamectin benzoate 5 SG 0.0025 % (5 g/10 litre of water) and thiodicarb 75 SP 0.09 % (10 g/10 litre of water) at ten days interval after pest crosses ETL (5 egg masses or 1 mass of first instar larvae/20 plants) for the effective management of fall armyworm in maize. The interval between last spraying and harvesting of cobs should be 30 days.

The farmers interested in organic maize are recommended to apply schedule spraying of *Beauveria bassiana* 1.15 WP (1 x 10^8 cfu/g) 0.007 % (60 g/10 l of water), first at ETL and subsequent two sprays at 10 days interval for the effective management of fall armyworm in maize.

As per CIB-RC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule	Waiting period/ PHI (days)
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)			
2020-21	Maize	Fall armyworm	Chlorantraniliprole 18.5 SC	28	0.150 lit.	0.005	3 ml	500 lit.	First spray at initiation of pest infestation, subsequent second and third at 10 day interval	30
			Emamectin benzoate 5 SG	13	0.250 kg	0.0025	5 g			30
			Thiodicarb 75 SP	375	0.5 kg	0.09	10 g			30
			Beauveria bassiana 1.15 WP (1 x 10^8 cfu/g)	35	3.0 kg	0.007	60 g			-



Validationof IPM module for pink bollworm on cotton

The cotton growers of Gujarat are recommended to implement the following IPM module for management of pink bollworm.

1. Timely sowing (15th June to 15th July)
2. Installation of pheromone traps at 45 DAS @ 10/ha
3. Neem based formulation 1500 ppm (40 ml/10 lit.water) at 45 DAS

4. Release of *Trichogramma bactrae* 1.5 lakh/ha (thrice at weekly intervals) starting 50 DAS
5. ETL (10 % fruiting body damage) based application of recommended insecticides (Lambda cyhalothrin 2.5 EC@ 0.0025 % (10 ml/10 lit. of water) and Deltamethrin 2.8 EC @ 0.0028 % (10 ml/10 lit. of water))
6. Timely termination of crop at 180-190 DAS

As per CIB-RC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ ha	Application schedule	Waiting period/ PHI (days)
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)			
2020-21	Cotton	Pink bollworm	Lambda cyhalothrin 2.5 EC	12.5	500	0.0025	10 ml	500 lit.	First spray at pink bollworm cross the ETL (10 % damage in green boll) and second spray after 15 days of first spray for effective control of pink bollworm.	21
			Deltamethrin 2.8 EC	14	500	0.0028	10 ml			-

Estimation of yield losses for cotton pink bollworm

The Bt cotton growers of Saurashtra are recommended to apply, thiodicarb 75 WP @ 0.015 % (2 gm/10 lit. of water) at 60 days after sowing, chlorpyriphos 20 EC @ 0.04 % (20 ml/10 lit. of water) at 90 days after sowing and lamda cyhalothrin 2.5 EC @ 0.0025 % (10 ml/10 lit. of water) at 120 days after sowing to avoid the yield loss of 41.5 % from pink bollworm in cotton.

As per CIBRC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule	Waiting period/ PHI (days)
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)			
2020-21	Cotton	Pink Bollworm	Thiodicarb 75 WP	750	1000	0.015	02 gm	500 litre	First spray at 60 days after sowing and second and third spray after 90 and 120 days of sowing for Effective control of pink bollworm.	30
			Chlorpyriphos 20 EC	250	1250	0.04	20 ml			-
			Lambda Cyhalothrin 2.5 EC	12.5	500	0.0025	10 ml			21

(B) Plant Pathology

Efficacy of fluorescens producing *pseudomonas* against collar rot (*Aspergillus niger*) of groundnut

Farmers of Gujarat growing *kharif* groundnut are recommended to treat the seed with *Pseudomonas fluorescens* 0.5 % WP (TNAU Strain Accession No. ITCC BE 0005) (2 x 10^6cfu/g) @ 20 g/kg seed and soil application of *P. fluorescens* 0.5% WP (2 x 10^6cfu/g) @ 2.5 kg in 250 kg of castor cake/ha at the time of sowing and 250 kg sand at one month after germination for effective management of collar rot of groundnut.

As per CIBRC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ ha	Application schedule
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)		
2020	Groundnut	Collar rot	*Pseudomonas fluorescens* 0.5 % WP (TNAU Strain Accession No. ITCC BE 0005) (2 x 10^6 cfu/g)	--	20 g/kg seed + 1.5 kg + 2.5 kg	2 x 10^6 cfu/g	-	-	As a seed treatment and soil application with 250 kg castor cake at the time sowing and 2.5 kg sand at one month after sowing

Efficacy of fluorescens producing pseudomonas against foliar diseases (leaf spots and rust) of groundnut

The farmers of Gujarat growing *kharif* groundnut are recommended for foliar spray of hexaconazole 5 % SC (10 ml/10 lit water) at 40 DAS + foliar spray of talcum powder based *Pseudomonas fluorescens* 0.5 % WP (TNAU Strain Accession No. ITCC BE 0005) (2 x 10^6cfu/g) (100 g/10 lit. water) at 60 and 80 DAS OR foliar spray of hexaconazole 5 % SC (10 ml/10 litre water) at 40, 60 and 80 DAS for effective management of leaf spots of groundnut .

As per CIB-RC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Qty. of Chemical suspension /ha	Application schedule	Waiting period/ PHI (days)
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)			
2020	Ground nut	Leaf spot of groundnut	Hexaconazole 5 % SC	25	0.5 l	0.005	10 ml	500 l	Foliar spray at 40 DAS	30
			Pseudomonas fluorescens 0.5 % WP (TNAU Strain Accession No. ITCC BE 0005) (2 x 10^6 cfu/g)	-	5 kg	2 x 10^6 cfu/ml	100 g	500 l	Foliar spray at 60 and 80 DAS	-
			OR							
			Hexaconazole 5 % SC	25	0.5 l	0.005	10 ml	500 l	Foliar spray at 40, 60 and 80 DAS	30

Chemical control of early and late leaf spot and rust diseases of groundnut

The farmers of Gujarat growing *kharif* groundnut are recommended to spray pyraclostrobin 12.5 % + epoxiconazole 4.7 % SE 0.025 % (15 ml/10 litre of water) or carbendazim 12 % + mancozeb 63% WP 0.15 % (20 g/10 litre of water), first spray at disease initiation and subsequent two at 20 days interval for managing the early and late leaf spot and rust diseases.

As per CIB-RC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule	Waiting period/ PHI (days)	Remarks
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)				
2021	Ground nut	Early and late leaf spot and rust	Carben-dazim 12 % + Mancozeb 63 % WP	750.0	1.000 kg	0.15	20 g	500	First spray at 50 days after sowing and subsequent two sprays at 20 days interval.	-	These fungicides are registered in CIB & RC for groundnut crop for management of leaf spot diseases.
			Pyracl-ostrobin 12.5 % + Epoxi-conazole 4.7 % SE	129.0	0.750 l	0.025	15 ml			21	

Effect of biofertilizers on the yield of oyster mushroom (*Pleurotussajorcaju*)

The Oyster mushroom (*Pleurotussajor-caju*) growers of Gujarat are recommended to treat wheat straw substrate with Azotobacter (1 X 10^8cfu) and PSB (1 X 10^8cfu) each at 0.2 per cent using spawn rate of three per cent in three kg of substrate for higher sporophore production and biological efficiency.

Effect of different substrates on nutritional and biochemical properties of oyster mushroom (*Pleurotussajor caju*)

The Oyster mushroom growers of Gujarat are recommended to use wheat straw or chickpea substrate for higher production, better nutritional and biochemical properties.

Integrated management of foliar diseases in high density planting of cotton

The farmers of Gujarat growing high density (60 cm x 45 cm) Bt cotton are recommended to apply (Fluxapyroxad 167 g/l +Pyraclostorbin 333 g/l SC) + Streptocycline at 7.5 + 0.75 g/10 liter of water, first spray at initiation of diseases and second spray at 20 days after first spray for effective management of bacterial blight and fungal leaf spots. Maintain Pre harvest interval of 27 days.

As per CIBRC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule	Waiting period/ PHI (days)	Remarks
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)				
2020	Cotton	Foliar diseases	Fluxapyroxad 167 g/l + Pyraclostorbin 333 g/l SC	187.5	0.375 lit.	0.0374	7.5 ml	500 lit	First spray at initiation of diseases & second sprayafter 20 days	27	Registered in CIB-RC
			Streptocycline	37.5	0.0375 kg	0.075	0.75 g			-	-

Management of sooty mould in cotton

The farmers of Gujarat growing Bt cotton are recommended to spray flonicamid 50 WG 0.15 % (3 g/10 liter of water) or Flonicamid 50 WG and (fluxapyroxad 167 g/lit + pyraclostrobin 333 g/lit SC) 0.15 & 0.375 % (3g and 7.5 ml/10 lit of water) when aphid crosses ETL (10 aphids/leaf) and second spray at 15 days interval after first spray for effective management of sooty mould. The secretion of honeydew like substances is medium for saprophytic fungi. Maintain Pre Harvest Interval of 25 and 27 days for flonicamid 50 WG and Flonicamid 50 WG + (fluxapyroxad 167 g/lit + pyraclostrobin 333 g/lit SC), respectively.

As per CIB-RC format:

Year	Crop	Target	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule	Waiting period/ PHI (days)
				g.a.i./ ha	Qty. of formulation/ ha	Conc. (%)	Dilution in water (10 lit.)			
2020	Cotton	Aphids, Jassids, Thrips & Whiteflies	Flonicamid 50WG	75 g	0.150 kg	0.15	3 g	500lit	First spray at when aphis population is crossed ETL & next sprays at interval of 15 days	25
			Flonicamid 50 WG and (fluxapyroxad 167 g/lit + pyraclostrobin 333 g/lit SC)	75 g & 187.5 g	0.150 kg & 0.375 lit	0.15 & 0.375	3 g and 7.5 ml			27

Recommendation for Scientific Community

Entomology

Management of rugose spiralling whitefly through root feeding of insecticides in coconut

For effective management of rugose spiralling whitefly in coconut (>5 year old palms), root feeding (pencil size root) application of spiromesifen 22.9 SC @ 5 ml with 10 ml of water per palm, first at initiation of pest infestation and second at one month after first application.

Monitoring of fall army worm, *Spodoptera frugiperda* (J. E. Smith) infesting maize in saurashtra region

The infestation of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) was monitored in different districts of North and South Saurashtra region of Gujarat in maize and the highest infestation was observed in Amreli (46.67-60.13 %) followed by Rajkot (19.33-35.00 %) and Junagadh (22.15-24.50 %) districts. The infestation was comparatively higher in *kharif* season (3.33-60.13 %) as compared to *Rabi* season (3.79-58.33 %).

Testing the bio-efficacy of insecticides against thrips in castor

Application of two sprays of spinosad 45 SC 0.009 % (2 ml/10 l of water) or dinotefuran 20 SG 0.008 % (4 g/10 L of water) or flonicamid 50 WG 0.02 % (4 g/10 L of water) or cyantraniliprole 10 OD 0.01 % (10 ml/10 L of water) at 7 days interval starting from pest infestation for effective management of castor thrips.

Plant Pathology

Viability of Gir Sawaj-brand biofertilizers: *Azotobacter, Rhizobium* and PSM under different storage conditions in commercial packing

GIR SAWAJ brand *Azotobacter, Rhizobium* and PSM remain viable up to 13 months from date of packaging in different storage conditions i.e. storage at ambient temperature, storage at 28° C and storage in refrigerator at 10° C.

4.6 Horticulture and Forestry

Horticulture and Agro Forestry carry out the research on fruits science, vegetables science, post-harvest technology of fruits & vegetables, floriculture & Landscape Architecture and research on spices. This also includes the development of new fruit and vegetable crop varieties.


Planting material of fruit crops, seedling and Ornamentals & Medicinal plants are provided to the farmers and stake holders at dispatching centre of Junagadh, Mangrol and Mahuva as per below table.

Table 4.6.1 Production of planting material of horticultural and other crops

Sr. No.	Planting Material	Production (Nos.)
1	Fruit crop graft	8693
2	Fruit crops saplings	83180
3	Seedlings	60269
4	Ornamentals & Medicinal plants	52082
	Total	**204224**

Recommendation for Farmers

Effect of pinching methods on different varieties of carnation under protected condition

Farmers of Gujarat are interested in flower cultivation under protected structure (Fan and Pad cooling polyhouse) are recommended to grow carnation with single and half pinching to get higher yield and net return.

Effect of different mulching and integrated liquid organic nutrients on growth, yield and quality in banana cv. Grand Naine

Farmers of Saurashtra growing organic banana Cv. Grand Naine are recommendedto apply 25 micron silver mulch with drenching of Jivamrut @ 500 l/ha through fertigation ten times with one month interval plus spraying of sea weed extract @ 3 % (300 ml/10 lit. of water) in six time with two month interval starting from 2nd month after transplanting along with FYM @ 10 kg per plant for getting good quality, higher yield and net return.

Evaluation of different varieties of guava and its genotypes under HDP

The farmers of Saurashtra growing guava under high-density planting (3.0 m x 1.5 m) are recommended to grow variety L-49 or Lalit or Shweta for obtaining higher yield and net return.

Effect of bio stimulants and bio fertilizers on flowering, fruiting, yield and quality of pomegranate (*Punica granatum* L.) cv. Bhagva

Farmers of Saurashtra growing pomegranate are recommended to apply Humic acid 1 % (100 ml/10 lit. of water) in two spray at full bloom stage and at 15 days after fruit set stage with drenching of bio fertilizer *Azotobacter* + PSB + KSB each @ 5 ml/plant of full bloom stage in addition to RDF for getting higher yield and net return.

Effect of de-leafing and graded multi micronutrients on growth, flowering and flower yield of spider lily (*Hymenocallis litterolis* L.) cv. Local

Farmers of Saurashtra growing spider lily are recommended to do de-leafing during *Kharif* (at the end of June) with spray of multi-micronutrient grade IV @ 1 % (100 g./10 lit. water) in three equal splits at 15 days before de-leafing and 30 and 45 days after deleafing to get higher yield and net return.

Evaluation of cucumber variety under net house and poly house condition

Farmers of Gujarat are cultivating cucumber under protected condition are recommended to grow cucumber in 50 % white shade net instead of polyhouse to get higher yield and net return.

Feasibility of organic farming in coconut (*Cocos nucifera*) under saline water irrigation condition

The farmers of Saurashtra are interested organic cultivation of coconut cv. West Coast Tall (WCT) are recommended to apply FYM @ 60 kg per plant or FYM at 15 kg + Castor cake at 2.25kg + Vermicompost at 8 kg + Neem cake at 2.25 kg per plant to get higher nut yield and improved organic carbon and microbial status in soil under saline irrigation condition (EC 10-14 dSm^{-1}).

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 *etc.*

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.

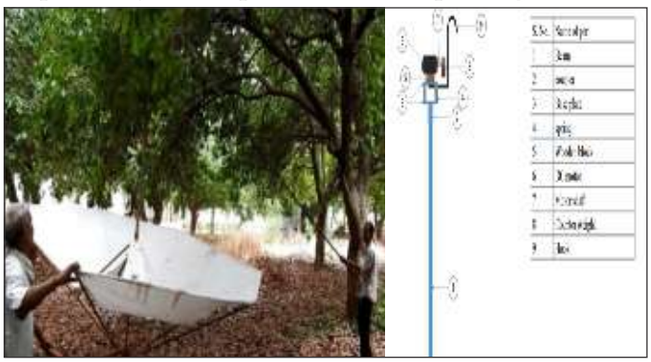
Table 4.7.1 No. of Farm Machineries/ Implements/ equipments (category wise) tested at testing centre of FMPE, CAET

Category	Name of Equipment / Machine	Nos.
A	Land development, tillage & seedbed preparation equipment	79
B	Sowing and planting equipment	39
C	Intercultivation equipment	7
D	Plant protection equipment	13
E	Harvesting and threshing equipment	2
F	Equipment for residue management	9
G	Post-harvest and agro processing equipment	1
H	Hand tools	1
	Total	**151**

Recommendation for Farmers

Development and Evaluation of manually Operated Jamun Harvesting Device

The farmers are recommended to use the manually operated branch shaking type harvesting device for Jamun fruits developed by the Junagadh Agricultural University. The device has 228 % higher harvesting capacity, and reduction in harvesting cost and harvesting losses up to 49 % and 18 %, respectively as compared to manual picking method.



Effect of Packaging on Storage behaviour of Chickpea grain

The farmers, entrepreneurs and large scale storage unit holder are recommended to pack chickpea (7.50 % moisture content, wb) in PP woven laminated bag or PICS bags. It retains food and seed quality of chickpea storage up to 12 months and reduces storage losses.

Studies on Bio-char Production and Gaseous Fuel for Thermal Purpose through Open-core Gasification of Biomass

The farmers and entrepreneurs are recommended to use the gasifier designed by the Junagadh Agricultural University having thermal capacity 80 MJ/h for productio of biochar and thermal energy. The maximum gasification efficiency -75.59 % and biochar - 24.91 % are obtained at gas flow rate 22 Cu. m/h by using shredded cotton stalk as feed stalk.

Studies on Crop Cultivation under Solar Photovoltaic Power Plant Panels

The farmers of Gujarat state are recommended to use JAU model Agrivoltaic system designed by Junagadh Agricultural University for cultivation of *Rabi* tomato to get an additional income along-with electricity generation.

Design and Development of Pomegranate Juice Extractor

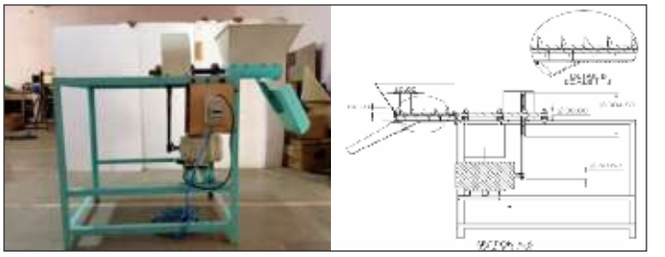
The farmers and entrepreneurs are recommended to use pomegranate juice extractor developed by Junagadh Agricultural University to reduce the cost of juice extraction with quality juice.

Low Temperature Grinding of Spices (Fenugreek)

The processors are recommended to grind fenugreek seed feed at low temperature (-10±2 °C) and using coolant (propylene glycol) circulation (15 lpm) through jacketed grinding mill for better recovery of biochemical compounds, volatile oil and volatile compounds.

Design and Development of Low Cost On-farm Sesame Dehuller

The sesame producers and processers are recommended to use a low cost sesame dehuller developed by Junagadh Agricultural University for dehulling of sesame seed. The sesame seeds are required to be soaked in water for 120 min. and then dehulling to be carried out for 6 min in developed machine at 150 rpm dehulling speed for getting maximum efficiency (79.29 %). The estimated sesame dehulling benefit cost ratio by this machine is 1.95.



Development of Online Screen-Gravel Filter for Groundwater Recharge

The farmers, NGOs, line department of Government of Gujarat are recommended to adopt online screen cum sand groundwater recharge filter developed by the Junagadh Agricultural University. The developed filter consists of sand filtration layer placed in between two composite screens viz. macro screen and micro screen. It avoids excavation and construction work. It is portable, easy to clean and auto flushing requiring to wash or change a sand layer in every year. It has a filtration efficiency of more than 80 %.

Filter Specifications:

- Bottom composite screen : Macro screen is underlain micro screen
- Thickness sand filtration bed 15 cm and size of sand 1mm
- Top composite screen : Micro screen is underlain macro screen
- Macro screen : 18 gauge GI having 40 % perforation of 12 mm circular holes
- Micro screen: S.S. 304 grade having 0.75 mm screen size.

Effect of Drip Lateral Geometry on Productivity of Wheat

The farmers' of South Saurashtra Agro climatic Zone growing wheat are advised to adopt drip irrigation for acquiring higher yield (up to 29,(% higher net return (upto 51 %) and saving upto 18 % irrigation water over control.

Details of drip system	Irrigation scheduling
Lateral spacing : 67.5 cm Dripper spacing: 60 cm Dripper discharge: 4 lph (16-4-60, 3 rows of wheat per lateral) Operating pressure : 1.2 kg/cm^2	At alternate days interval a) November: 30 min b) December: 50 min c) January: 1 hour d) February: 1 hour 10 minute

Adaption to Climate Change: Effect of Hydrogel and Organic Manures to Mitigate Abiotic Stress in Groundnut

The farmers of North Saurashtra Agro-climatic Zone growing groundnut under dry farming conditions are recommended to apply hydrogel @ 2.5 kg/ha before sowing (1:10 mixture of hydrogel and sand through drilling in the furrow) and FYM @10 t/ha for mitigating moisture stress during dry spells and obtaining maximum rain water use efficiency, higher productivity and net returns.

4.8 Basic Science

Basic Science group works on the areas of plant Biochemistry & Biotechnology, Plant Physiology and Plant molecular Biology. It includes research on Genetic manipulation of crops for stress resistance, molecular biology and genetic engineering work in plant sciences.

Recommendation for Farmers

Influence of Plant Growth Retardants on Morpho-Physiological Traits and Yield in High Density Planting Cotton (*Gossypium hirsutum* L.)

The farmers of Saurashtra region growing irrigated Bt cotton hybrids under HDPS (90 cm x 30 cm) are recommended to spray growth inhibitor Mepiquat Chloride (MC) @ 50 ppm (0.5 g a.i./10 litre water) at boll development stage for balanced growth, higher seed cotton yield and net return.

Recommendation for Scientific Community

Canopy Management in HDPS Cotton under High Fertility Condition

The farmers of Saurashtra region growing irrigated non Bt cotton hybrids under HDPS (60 cm x 15 cm) are advised to spray growth inhibitor Mepiquat Chloride (MC) @ 40 ppm (0.4 g a.i. /10 lit. water) at 60 & 75 DAS for balanced growth, higher seed cotton yield and net return. This is due to increase in the number of sympodia & sympodial length, number of bolls & boll weight and maximum transportation of photosynthates into bolls.

Elemental, Nutritional and Microbiological Analysis of Panchagavya (Ancient Liquid Organic)

The Scientific community involved in Panchagavya research or microbial research are recommended to use 19th day old Panchagavya to study maximum microbial diversity. The higher proportion of α-proteobacteria was observed in 19th day of Panchagavya preparation while 21st Day Panchagavya formulation was found to be dominated by Firmibacteria, β-proteobacteria or Actinobacteria. The presence of unknown /novel microbes were higher in 21st day old Panchagavya on the basis of results of Metagenomic analysis.

a) Panchagavya contained dominant bacteria of nitrogen fixing, phosphate solubilizers and potash mobilizers. Moreover, it showed antagonism towards plant pathogenic fungi like *Helminthosporium* (47,(% *A. flavus* (45 %), *A. niger* (35 %) and *Sclerotiumrolfsii* (40 %) *in vitro*. Elemental composition of Panchagavya showed higher concentration of Fe (158.94 ppm), Ca (2789.99 ppm), Mg (1553.76 ppm) and Mo (25.50 ppm). It also contained N-Methyl-2-pyrrolidinone used as insecticide, herbicide and fungicide. Phenylacetaldehyde is a second major compound found which has very important antibiotic compound.

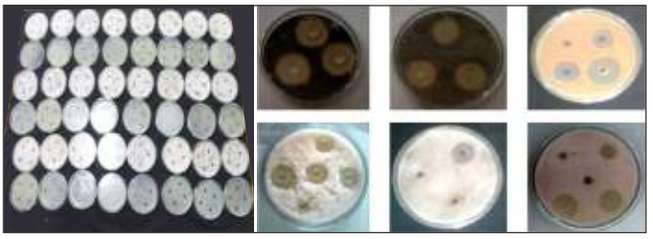
b) Bijamrut elemental analysis revealed that it contains Cu (4.19 ppm), Fe (111.16 ppm), Mn (1.56 ppm), Zn (2.40), Ca (1211.63 ppm) and Mg (1084.65 ppm) which can provide immunity against various diseases and improve seed germination. It also contained important compound 5(6)-EpETrE-EA which has antagonist activity against pathogenic microbes. 17 beta-Nitro-5 alpha-androstane is the aza-steroid which enhances the germination of plant seed.

c) Liquid organic preparation of Jivamrut has bacteria, fungi, actinomycetes, N-fixers and P-solubilizers and K-mobilizers. Jivamrut inhibited *Helminthosporium* (40 ,(% *A. flavus* (30 %), *A. niger* (25 %) and *Sclerotiumrolfsii* (35 %), *Fusarium oxysporum* (35 %). Jivamrut contains high concentration of Fe (115.09 ppm), Ca (1575.78 ppm), Mg (621.57 ppm) and Co (88.90 ppm). LC-QToF analysis showed Pyropheophorbide is an antioxidant found in Jivamrut.

d) Amrutpani is a good source of micronutrient which includes high concentration of Fe (208.44 ppm), Ca (2276.73 ppm), Mg (1119.15 ppm) and Ti (73.05 ppm). LC-QToF analysis revealed that Adouetine Z is an insecticidal cyclic peptide and

(5 alpha, 8 beta, 9 beta) - 5, 9-Epoxy-3, 6-megastigmadien-8-ol is an antioxidant compound found in Amrutpani.

e) Sanjivak has antagonist activity and micronutrient content with important compound like Methyl jasmonate.



Studies on Phytochemicals and Metabolomics Profiling of Seaweeds

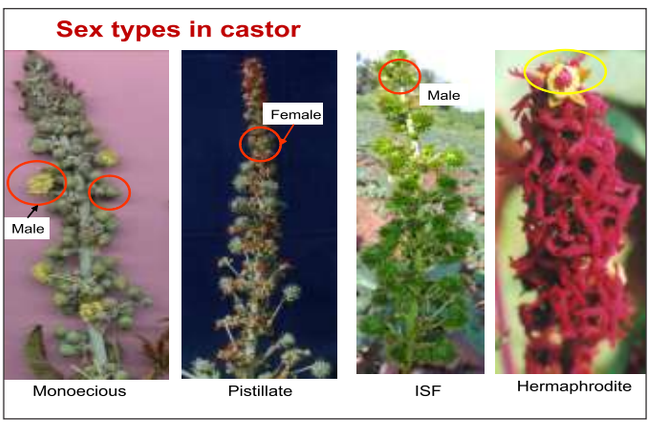
The seaweed resources *viz.,* Green, Red and Brown seaweeds analyzed through Ms/Ms based platform showed presence of 375 unique compounds. These seaweeds were found to contain important oil content, vitamin D3 and many bioactive compounds that can be used as nutraceutical products. In case of ω-3 polyunsaturated fatty acids, eicosapentaenoic acid (EPA) was found in seaweed species, viz., *Sarconema filiforme* (5.02 %) and *Spatoglossum asperum* (4.04 %). Vitamin D-3 was found in *Caulerpa Lenthilifolia* (16.7 %), *Caulerpa sertulorioides* (8.5 %), *Ulva fasciata* (10.7 %), *Halimeda tuna* (12.7 %), *Hydroclatharus clathratus* (18.9 %), *Halymenia venusata* (6.5 %), *H. porphyraeformis* (20.6 %), *Dictyopteris marginatum*, Gelidiopsisrepens (18.2 %) and *Heterosiphonia muelleri* (26.1 %). Some species of seaweeds viz, *Dictyopterisdelicatula* (2.68 %), *Heterosiphonia muelleri* (0.24 %), *Dictyopterismarginatum (stoecospermum)* (4.07 %), *Spatoglossum asperum* (8.1 %), *Padina gymnospora* (4.86 %), *Caulerpa lenthilifolia* (0.96 %) contained docosahexaenoic acid (DHA). These compounds are not found in plants.

Transcriptome and Proteomic Characterization for Identification of Candidate Genes Responsible for Pistillate Inflorescence and Its Reversion in Castor

The scientific communities involved in Castor improvement are recommended to use the set of 14 primers as mentioned below to distinguish the pistillate and monoecious plants in castor. They are also advised to use the castor database developed (http://webtom.cabgrid.res.in/castdb/) for the identification of gene of interest and selection of SSRs and their primers to be used under Marker Assisted Selection and molecular breeding.

Sr. No	Name of the Gene	Forward primer	Reverse Primer	Gene Function
1	Dynamin-2A	GCTAAGCAAGGGT TC GTCAG	CTGGCAGGTCGATCAA TTTT	Response to hormone stimulus
2	Auxin response factor	CACACATGGTGGG TT CTCAG	TGAGTTGGTGGTTGCA TTGT	Organ development; and post-embryonic development
3	ATP-binding protein	CATTGGACAGGT CCT CCACT	AAGCAAGGTGAAGCA AGGAA	Regulation of ARF protein signal transduction
4	Spermidine synthase	GGTGCTGCATTTC TC TCCTC	TGCCCTGGAATAAATC TTGC	Polyamine biosynthetic process
5	Xaa-pro amino peptidase	GGATGGAAGCTTTG G CATAA	GCCCTTCTCACCAAAA TTGA	Auxin transport

Sr. No	Name of the Gene	Forward primer	Reverse Primer	Gene Function
6	Conserved hypothetical protein	TCGAATGAAGAGGC C ATTCT	GTGAGAAGGGCAAAA GCAAG	Abscisic acid metabolic process
7	MADS box protein	AAAGGTTGGCCTGA GGAGTT	GTCACTTGCCTGTTGC TTGA	Transcription, DNA-dependent
8	RNA polymerase sigma factor rpoD1	GATCTTCAGGCAAG CACTCC	ATATCCTCCCCTTGGTC CAC	DNA-dependent transcription, initiation
9	Protein with unknown function	TTGTCAAGGGCCAG TTCTTT	TTGACCTGCTGTGTCCC ATA	Guanylribonucleotide binding
10	Arginine/serine-rich splicing factor	CGGAAGCTTGATGA CACTGA	GGCTTCTACTTCGGCTC CTT	Sex differentiation
11	Acid phosphatase	TCCTGTAACCGTTC C TTTCG	TGTTCAGGCTCGAAAC CTCT	Phosphatase activity
12	DNA replication helicase dna2	AGGCTGTGAATAAC C CAACG	CCCAATATCTTCGCCTT GAA	DNA metabolic process
13	Eukaryotic translation initiation factor2c	CACGACTTTTTCCC G TTGAT	GAACTCCCTCTGGTGG CATA	Translation
14	s-adenosyl-methyltransferase	TCTCCGTTCTTTCGT CGATT	GGGTCAACATCCATTC CAAC	rRNA methylation



Genome Sequencing of Cumin (*Cuminumcyminum*L.) to reveal insight of its Genomic Architecture

The scientific community involved in Cumin improvement are recommended to use genomic information generated (https://drive.google.com/file/d/ 1ukln R77l YWJcR Ip8m40lLpm OP_ujqJz/view ?usp=sharing)for cumin in Marker Assisted Selection for the improvement of cumin. They are also advised to use the genes identified as mentioned below and SSRs identified in Marker Assisted Selection.

Sr. No.	Character	Number of genes	Gene identified
1.	Flavonoid	21	U78D2, C75A2, C75A4, C75B3, C93C2, F3PH, FAOMT, FL3H3, MOMT, SOMT2, SOT5, UFOG, UFOG1, UFOG2, UFOG3, UFOG4, UFOG5, UFOG6, UFOG7, UGFGT and Y1103
2.	Chalcone synthase	9	6DCS, CHS1, CHS2, CHSA, CHSB, CHSD, CHSL1, CHSY, PKS5
3.	Chalconeisomerase	4	CFI, CFI1, CFI2B, CFI3

Sr. No.	Character	Number of genes	Gene identified
4.	Flavanone synthase	3	C93C1, FNSI, C93B1
5.	Terpenoid synthase	15	BAMS, GBIS1, GBIS2, HUMS, TPS01, TPS05, TPS07, TPS08, TPS09, TPS16, TPS18, TPS22, TPS26, TPS29, TPS30
6.	Disease resistance	89	ADR2, CDR1, CHS1, CSA1, DF230, DR206, DRL12, DRL13, DRL14, DRL15, DRL16, DRL17, DRL18, DRL19, DRL2, DRL20, DRL21, DRL23, DRL24, DRL25, DRL26, DRL27, DRL28, DRL29, DRL3, DRL30, DRL31, DRL32, DRL33, DRL34, DRL36, DRL37, DRL38, DRL39, DRL4, DRL40, DRL41, DRL42, DRL43, DRL45, DRL5, DRL7, DRL8, DRL9, DSC1, DSC2, EDR1, EDR2, EDR2L, EDR4, LAZ5, LOV1A, NDR1, R13L1, R13L2, R13L3, R13L4, RFL1, RGA1, RGA2, RGA3, RGA4, RLM1B, RLM3, RP8HA, RP8L2, RP8L3, RP8L4, RPM1, RPP1, RPP13, RPP4, RPP5, RPP8, RPS2, RPS4C, RPS4L, RPS4W, RPS5, RPS6C, RPS6R, RPS6R, SUMM2, TAO1, WR52C, WR52N, WR52R, WR52W, Y4117
7.	Antifungal	4	DEF1, DEF15, DEF2, DEF4
8.	Early flowering	13	ASHH2, EFM, ELF3, ELF6, HD16N, PAF1, PIE1, REF6, RUP1, RUP2, SKIP, SWC6, VIP6
9.	Aromatic	11	5MAT, ANTA, AVT3A, AVT3B, AVT3C, DDC, ISS1, PGL1, PGL2, PGL3, SOT16
10.	Drought	8	AL7A1, DIS1, ERG14, HDG11, LSM5, SAD2, SDIR1, SSP1A
11.	Nematodes	2	ELF3, HSPR2

Transcriptome Analysis in Coriander for Identification of Candidate Genes against Stem Gall Disease

The scientific community involved in Coriander improvement is recommended to use the following set of 7 primers in the process of marker assisted selection for the identification of disease defense genes in coriander genotypes.

Sr. No	Gene Name	Forward Primer	Reverse Primer	Function
1.	RL31	GCCAAACCAAAA GGTGAGAA	CGGATACCCTTAGCC CAGAT	Jasmonic acid mediated signaling pathway
2.	A0A2Z5D854	CCACCGTTTCCAA TGCTAGT	GGAATCTCTCGGGCC TAAAC	Metal ion binding
3.	A0A166CJ74	ATTGGCTGAGCTT TGGATTG	GGCTTGATGCTCCAT TGTTT	Regulation of transcription DNA-template
4.	A0A166CJ74	CACGCATTTCTCC TCCTGAT	TCAGAGGGGGTTTTC TGATG	DNA-template

Sr. No	Gene Name	Forward Primer	Reverse Primer	Function
5.	Y1934	ACTCGGTGTCACGGTTTTTC	CAAAAGCCGAGATTGTGGAT	Molecular function DNA-binding
6.	TGA10	CCCTGTTGGGAAACTTCGTA	GCTGCAAAGGTCCAGCTATC	Nitrogen-activated protein kinase binding
7.	A0A164XUZ0	GAGTTGGAGTTCAGGGAGGA	GATGAGCGGGATATCTGGAA	Affects Fungal Development and Pathogenicity of *Fusarium graminearum*

Biochemical and Molecular Evaluation of A1 and A2 Casein Protein of Milk in Holstein Friesian Cow and Indigenous Gir Cow

The scientific community involved in cow improvement is recommended to use DNA markers to detect or distinguish A1A2 and A2A2 genotypic frequency among the Gir Bulls and Cows using below mentioned marker.

1	A1 Forward	5' CTTCCCTGGGCCCATCCA 3'
	A1 Reverse	5' AGACTGGAGCAGAGGCAGAG 3'
2	A2 Forward	5' CTTCCCTGGGCCCATCCC 3'
	A2 Reverse	5' AGACTGGAGCAGAGGCAGAG 3'

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 pure breed *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: 4.9.1 Distribution of Semen doses from CBF

Sr. No.	Particular	Gir Bulls	Jaffrabadi Bulls
1.	Frozen semen doses available in stock from last year (Nos.)	188847	112958
2.	Frozen Semen doses Produced (Nos.)	27310	21340
3.	Frozen Semen doses used for AI in Field (Nos.)	2475	2750
4.	Frozen Semen doses used for AI on Farm (Nos.)	620	185
5.	Frozen Semen doses sold to AI Workers (Nos.)	582	2004
6.	Frozen semen doses in stock (Nos.)	212480	129359
7.	Animals distributed to Grampanchayat, Gaushala, other Institute etc. (Nos.)	39	25

Table 4.9.2 Total number of cases treated at TVCC

Types of cases	Cattle	Buffalo	Equine	Canine	Others	Total
Medicine	926	1065	140	2035	575	**4741**
Gynecology	438	364	83	304	118	**1307**
Surgery	634	432	186	777	224	**2253**
Total	**1998**	**1861**	**409**	**3116**	**917**	**8301**

Table 4.9.3 Total no. of cases treated through Ambulatory Clinics and Clinical Camps

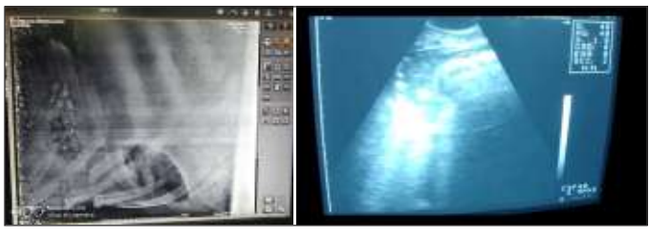
Type of case	Ambulatory Clinic	Clinical Camps
Medicine	611	87
Gynecology	146	15
Surgery	103	429
Deworming	-	19795
Total	**860**	**20326**

Recommendations for Farmers

Animal Health

Clinical studies on physical, ultrasonographic and radiographic assessment of suspected cases of diaphragmatic hernia in buffaloes

Buffaloes showing chronic recurrent tympany, which are not responding to common therapeutic management with progressive reduction in appetite, tendency of regurgitation and presence of hard scanty feaces are suggestive of diaphragmatic hernia. Presently, surgical management of diaphragmatic hernia is possible at veterinary hospitals, buffalo owners are recommended to visit the nearby veterinary hospital or contact a veterinary surgeon.



Animal Production

Association of body weight and biometric measurements with egg production and quality performance in White Leghorn layers

Poultry farmers are recommended to select white leghorn pullets with higher body weight and shank length at 14th, 16th and 18th week to get higher egg weight at 25th week of age.

Test-day recording as a tool to predict lactation milk yield in Gir cows

Livestock owners are recommended to predict lactation milk yield of Gir cows with precision of 99 % by sum-up of milk yield records at weekly interval, till the cow dries, using the equation 3.09+6.96×Sum and even sum-up of milk yield records at fortnightly interval, till the cow dries, using the equation 11.74+14.87×Sum.

Test-day recording as a tool to predict lactation milk yield in Jaffarabadi buffaloes

Livestock owners are recommended to predict lactation milk yield of Jaffarabadi buffalo with precision of 98 % by sum-up of milk yield records at weekly interval, till the buffalo dries, using the equation 12.36+6.92×Sum and even sum-up of milk yield records at fortnightly interval, till the buffalo dries, using the equation 21.32+14.69×Sum.

Effect of replacing concentrate mixture with moringa (*moringa oliefera*) leaf meal on growth performance and blood biochemical profiles in Gir calves

It is recommended to Gir cow owners to feed Moringa (*Moringa oleifera*) leaf meal by replacing 75 % (1.125 -1.150 kg) of protein requirement (from concentrate) for noticeable increase in growth rate in Gir calves.

Studies on nutritive value and feeding levels of Hedge Lucerne (*Desmanthus virgatus*) on milk production and composition in Gir cattle

It is recommended to Gir cow owners of Saurashtra region that Hedge Lucerne grass can be used instead of concentrate for fulfilment of 50 % crude protein requirement of milch animals to maintain milk production and fat percentage with high returns.

Studies on sole feeding of Marvel (*Dicanthium annulatum*) grass on milk production and milk composition in lactating Gir cows

It is recommended to Gir cow owners that sole feeding of green jinjavo grass or green maize fodder is

not advisable to milch animals, as it reduces milk production.

Recommendation for Scientific Community

Animal Health

Clinical studies on physical, ultrasonographic and radiographic assessment of suspected cases of diaphragmatic hernia in buffaloes

For confirmatory diagnosis of diaphragmatic hernia in buffaloes, ultrasonography and radiography provided interdependent prognostic features and the ultrasonography additionally facilitated to locate the reticulum in relation with adjacent thoracic structures than reticular location and manner of contraction.

Isolation and identification of active ingredients of selected medicinal plants and evaluation of *in-vitro* antioxidant and antidiabetic effects

The preparative-HPLC isolates of n-butanol fractions of *Enicostemaaxillare* (Mamejavo) leaves and *Cassia absus* (Chimed) seeds possess good *in-vitro* antioxidant effects. The preparative-HPLC isolate of n-butanol fraction of *Enicostemaaxillare* leaves also owing significant *in-vitro* antidiabetic activity due to presence of secoiridoid glycoside compound, swertiamarin (0.2 % w/w).

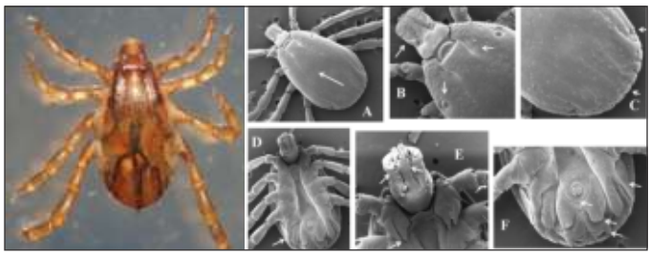
Evaluation of antioxidant potential of *Cassia absus* in cadmium-induced oxidative stress model of Zebrafish (*Daniorerio* Hamilton, 1822)

Feeding of Cassia absus seed powder @ 10 mg/fish/day has ameliorated the oxidative stress mediated pathological changes in liver, kidney, gills and brain of zebrafish exposed to 1 ppm cadmium chloride for 21 days. The various flavonoid compounds with antioxidant effect like isovitexin, 7,8,3',4',5'-pentamethoxyflavone, luteolin 7-rhamnosyl(1->6)galactoside, prunin and mirificin have been identified to be present in seeds of Cassia absus.

Morphological and molecular identification of ticks infesting the domestic and wild animals

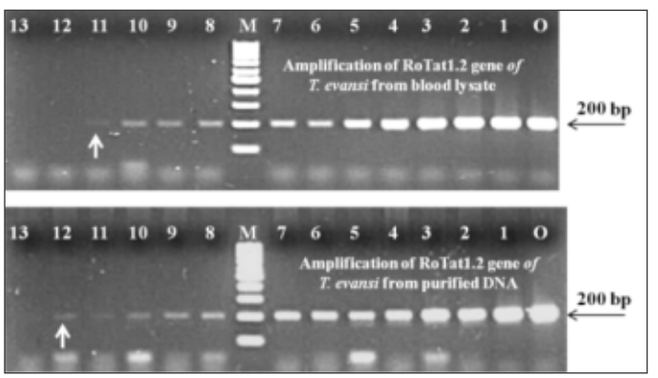
The PCR primers designed by Veterinary College, Junagadh Agricultural University can be used for the identification of *Hyalommaanatolicum, Rhipicephalus (Boophilus) microplus* and *Rhipicephalus sanguineus* through amplification and sequence analysis.

Primer seq (5'→ 3')	Species of ticks	Targeted genes	Size of amplicon
attttaccgcgatgaa	*R. (B.) microplus*	Cytochrome Oxidase 1	1539 bp
ttatttaataataatattattttga			
attttaccgcgatgaatat	*R. sanguin us*		1539 bp
ttacttaagaataatattattttg			
ttttgggtcctgagccg	*H. anatolicum*		818 bp
taaatatatgatgcgcccat			
attctcatcggtctaaactcag	*R. (B.) microplus*	16S rRNA	987 bp
gtacctttgcattaggggt			
ccctagagtatttatttcatta	*H. anatolicum*		820 bp
atacgtacctttagcattag			
aaaaaagtatcctaatccaacatc	*R. sanguineus*		912 bp



Development of rapid blood processing method for the detection of haemoprotozoan parasites through polymerase chain reaction (PCR)

The blood lysate method developed and optimized by Veterinary College, Junagadh Agricultural University is an alternative to purified whole blood genomic DNA for molecular detection (PCR) of haemoprotozoans such as *Babesia, Theileria* and *Trypanosoma* in cattle, buffaloes, horses and dogs is rapid, cost effective with less chances of cross-contamination, and is more convenient to operate under resource constraint laboratories.



Assessment of blood gas, acid-base and electrolyte alterations during diaphragmatic herniorrhaphy in buffaloes

The buffaloes suffering from diaphragmatic hernia exhibits metabolic alkalosis, hypokalemia and hypochloremia, warranting suitable corrective fluid therapy during surgical treatment.

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.

The Department of Fish Processing Technology, College of Fisheries Science, Veraval developed fish-based products such as fish and shrimp pickle (Bottle pack) varieties of dry salted fish/ shellfish (Pouch pack, vacuum pack, jar pack, Tray pack *etc.*), ready to eat value added cooked seafood (Cutlet, burger, wafer, ball, finger, snacks and fast seafood etc.) under the ELP programme "Seafood processing centre for value added products and byproducts development". This year online activities conducted during ELP like formulation of bankable fishery project for getting financial approval of establishment of small-scale industries in the field of fish processing sector and also formulate the research projects to improve research prospective in this field as well. Fisheries Research Station, Sikka has produced 71.81 lakh larvae of different species.

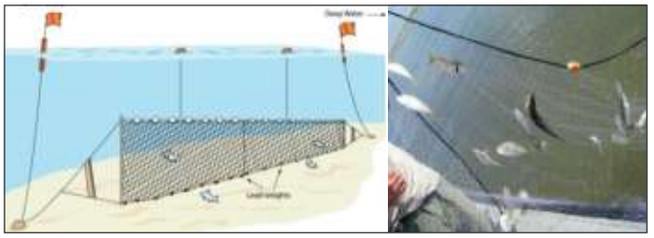
Recommendation for Fish Farmers

Composition and diversity of fish and shell fish catch of trawl net along the Mangrol coast, Gujarat

During year 2017-2020, total 85 marine species were recorded in catch composition of trawl net operated by the Mangrol fishermen which includes 68 fin fishes and 17 shellfish. Ribbonfish, Threadfin bream, Croaker, Cuttle fish and Squid form a major proportion of the catch. The maximum catch of Ribbonfish during February to April, Threadfin bream during September to November, Croaker during February to March and Cuttlefish during August month were recorded. Fishermen of Mangrol are recommended to fish the above- mentioned fish groups which are more available in the particular fishing ground.

Catch composition of commercial gill net operated along the Mangrol coast, Gujarat

Fishermen fishing with gill nets on the Mangrol coast are recommended to target carangids, croaker, lizard fishes, clupeids and mackerels during post monsoon months, carangids, croaker, lizard fish and cephalopods during winter and carangids, clupeids, croaker and ribbon fish during summer for better catch. Total 41 marine species were recorded in catch composition gill net operated along the Mangrol coast which includes 38 finfishes and 3 shell fishes.



Effect of Chitosan coating on the quality of Silver Pomfret (*Pampus argenteus*) steak in modified atmosphere packaging during chilled storage

It is recommended to fish processors to apply 1.0 % Chitosan coating on Silver Pomfret *(Pampus argenteus)* steaks before packing in modified atmosphere packaging (40 % CO_2, 30 % N_2, 30 % O_2) for better quality as well as longer shelf life up to 32 days during chilled storage (2 °C to 4 °C temperature).

Development of shelf stable, ready to fry fish crackers from bull eye fish *(Priacanthus hamrur)* meat and its quality characterization during storage.

Seafood processors are recommended to use 40:60 ratio of bulls eye fish meat: tapioca starch flour along with addition of 1 % xanthan gum for the production of fish crackers with improved quality, lesser oil absorption, better utilization of fish meat and expanded shelf life up-to 150 days under ambient storage temperature in LDPE pouch packaging.

Supplementation of selected marine macro algae in practical diets for Indian major carp, *Cirrhinus mrigala* fry

It is recommended to fish farmers to supplement the marine algae powder of *Porphyra tenera* 6 %, or

Gracilaria corticata 8 % or *Ulva raticulata* 6 % in feed of Indian major carp *Cirrhinus mrigala* fry fed 10 % of bodyweight twice a day to enhance the growth.

Survival and growth of Pearl oyster in cages in Gulf of Kachchh at Sikka and Okha

The fish farmers interested to grow pearl oyster in Gujarat are recommended that the pearl oysters grow well in the Gulf of Kachchh with survival rate of 98.3 % for the duration of 47 days. The aqua farmers are advised to grow pearl oyster in cages having lesser water current and wave action.

Effect of different level of protein on the growth and survival of *Terapon jarbua* (Forsskal, 1775) fry

Fish farmers rearing *Terapon jarbua fry* (Crescent banded tiger fish) are recommended to utilize feed containing 40 % crude protein at the rate of 10 % of fish body weight, twice a day, for higher growth and survival rate for a period of 60 days.

Recommendation for Scientific Community

Surveillance of shrimp diseases in shrimp farms of Gujarat

It is informed to the scientific community that during 2015-2020, several diseases like White spot disease (WSD), *Enterocytozoon hepatopenaei* (EHP) infection, white faces, white gut and black gill disease were observed throughout the culture period. *Enterocytozoon hepatopenaei* (EHP) infection and Infectious Myonecrosis (IMN) are newly emerging diseases observed in Shrimp farms of Gujarat.

Study of heavy metal analysis in the selected spp. of cephalopod, shrimp and fish of Saurashtra region

The concentration of heavy metals in the muscles of fishes, cephalopods and shrimp samples collected from Saurashtra sea coast (Arabian sea) are in the range of As (1.62±1.10 to 3.46±0.28), Be (0.12±0.02 to 0.43±0.02), Fe (24.02±1.53 to 88.41±1.4), Zn (22.12±1.63 to 44.40±2.08), Cd (0.02±0.01 to 1.51±0.01), Sb (12.33±0.57 to 84.91±2.63), Sn (0.87±0.03 to 12.91±0.18), Cu (03.24±1.14 to 18.18±2.12), Co (0.96±0.01 to 5.43±0.04), Ni (1.96±0.20 to 4.61±0.48), Pb (0.15±0.10 to 0.43±0.02), Cr (0.23±0.05 to 1.22±0.03), Ba (0.23±0.03 to 8.63±0.36) and Hg (0.22±0.03 to 0.47±0.04) ppm. Level of heavy metals in liver was found more than in the muscles of fishes, while it was higher in the tentacles than muscles of cephalopods. All heavy metals observed were within the universally accepted limits.

Diversity and distribution of Opisthobranch fauna at Sikka coast

It is informed to scientific community that the Sikka coast, located in Gulf of Kachchh, Gujarat harbours forty-seven species from 35 genera belonging to 18 families of Opisthobranch fauna viz. *Hydatina physis, Berthellina citrina, B. delicata, Doriopsis granulosa, Atagema rugosa, A. spongiosa, A. tristis, Jorunna funebris, Thordisa villosa*, *Rostanga* sp., *Peltodoris murrea, Carminodoris* sp.1, *Carminodoris* sp.2, *Sclerodoris tuberculata, Taringa sublutea, Tayuva lilacina Plocamopherus ceylonicus, Thecacera sp., Hypselodoris infucata, Goniobranchus bombayanus, G. fidelis, Goniobranchus sp., Mexichromis mariei, Phyllidiella zeylanica, Dendrodoris fumata, D. atromaculata, Doriopsilla miniata, Bornella stellifera, Janolus toyamensis, J. flavoanulatus, Melibe viridis, Phestilla lugubris, Phestilla sp., Trinchesia yamasui, Baeolidia salaamica, Anteaeolidiella poshitra, Phidiana militaris, Cratena poshitraensis, Pteraeolidia semperi, Sakuraeolis gujaratica, Bakawan rotundata, Philinopsis speciosa, Aplysia oculifera, Elysia ornata, E. expansa, E. thompsoni and E. tomentosa.*

Breeding and larval rearing of Opisthobranch fauna (*Elysia tomentosa, Hypselodoris infucata, Erronea onyx* (Cowry)

It is informed to scientific community that Elysia tomentosa, Hypselodoris infucata and Erronea onyx (cowry) can successfully rear and bred in captive condition. They can be reared in glass aquaria with seawater with ambient tempe rature and salinity. The fecundity of Elysia tomentosa ranged from 70,000 to 88,000 during the study and the egg ring size ranged from 100-550 mm and width measured 1 mm. The egg ring colour remains yellow. The size of embryo in the egg ring measured 78.96 *118.44 µ. The size of embryo after three days' reaches to 87*104.4 µ while size of larvae after 10 days reaches to 102*158µ. The incubation period extends up to 7-10 days. The fecundity of Hypselodoris infucata ranged from 40,000 to 1,25,000 and egg ring size ranged from 17-22 cm. The width of egg ring measured 0.5 cm. The colour of the egg remains off white which turns into light creamish at the time of hatching. The size of embryo in the ring measured 157*157 µ while the size of larvae measured 171* 250 µ and 265* 265 µ at the interval of 15 and 22 days respectively. The incubation period extends up to 5 -10 days. The Erronea onyx (Cowry) shows remarkable parental care by perching its eggs throughout incubation period. The number of egg capsule (gelatinous) ranged from 300-400 depending upon the size of brooders. The number of embryos per capsule ranged from 60-131 number. Incubation period extends up to 30-35 days. Egg capsule size was ranged from 1316*987µ to 1827*2896 µ. The size of embryo ranges from 158*118 µ. The size of larvae after 8 days of hatching reaches to the 240*290 µ while after 15 days the size reaches to the 235*566 µ.

4.11 Social Science

Social Science group works on the areas of Agricultural Economics, Agricultural Extension Education, Agricultural Statistics, Agribusiness Management and Home Science.

Agricultural economists worked on different research projects *viz.* Farm cost studies of important crops in Gujarat state; Economics of selected *kharif* vegetable crops grown in Saurashtra Region of Gujarat; Price forecasting for selected crops; Performance and Determinants of Plant Varietal Protection (PVP) Legislation in Indian Agriculture with Special Reference to Gujarat; Analyzing India's comparative advantage in world exports: An application of gravity model; Scheme for creating a permanent machinery for studying the cost of cultivation/ production of principal crops in Gujarat state. Yield, production and price forecast of different crops *viz.* groundnut, cotton, castor, cumin, coconut *etc.* were analyzed for suggestions to farmers.

Various research projects are running by Post Graduate Institute of Agribusiness Management Institute, JAU, Junagadh, which includes Business performance analysis of farmer producer organizations of Saurashtra region; Effect of Micro Irrigation System on Livelihood in Saurashtra Region; Export cost estimation and mileage of major commodities of Saurashtra; Women empowerment through milk producers' cooperative societies in Saurashtra region; Financial inclusion of farmers in Saurashtra region.

Recommendation for Scientific Community

Spatial and temporal integration analysis and price discovery mechanism of potato wholesale markets in Gujarat

For harnessing the benefits of market integration of potato wholesale markets in Gujarat State, the existing market information and dissemination infrastructure needs to be strengthened. In this regard, real-time market intelligence inputs, including price forecasting, should be made available throughout the potato supply chain either through training programmes or by hosting literature in public domain, thereby, enabling the producers to take proper production, storage and marketing decisions.

Business performance analysis of Farmer Producer Organizations of Saurashtra region

The Farmer Producer Organizations (FPOs) in Saurashtra region are advised to increase the number of business activities *vis a vis* improve the members' involvement for better business performance.

Adoption of scientific dairy husbandry practices by farmers in Amreli district

For increasing benefit of livestock owners of Amreli district, extension functionaries are suggested to give emphasis on extension activities for practices *viz.,* feeding of salt and mineral mixture, cleaning of udder and teats before milking with antiseptic, milking with full-hand method, navel disinfection of newborn calf and initiation of breeding of heifers on the basis of body weight/size.

4.12 Human Resource Development

During the year 2020-21, under HRD component of the University, as a part of capacity building for JAU scientists, 139 scientists/teachers were deputed to attend winter & summer school Short/Refresher Course, training; 249 attended seminar, symposium, conference, convention and 68 attended the workshops, group/annual/QRT meeting of their respective projects at national as well as state level.

4.13 Others

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 4.13.1 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	Sesame (Summer)	GJT 5	3	2.4	5.07	4.45	13.95
2	Sesame (*Kharif*)	G.Til 4	4	3.2	5.56	4.94	12.55
3	Wheat	GJW 463	10	4.00	59.75	54.53	9.58
4	Pearl millet (Summer)	GHB 538	12	4.8	45.55	42.75	6.59

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 (%)
5	Pearl millet (*Kharif*)	GHB 1129	07	2.8	22.41	21.03	6.56
		GHB 1225	07	2.8	22.83	21.21	7.64
		GHB 1231	11	4.4	24.48	21.88	11.88
6	Groundnut (Summer)	GJG 34	15	1.50	23.19	20.53	13.09
7	Groundnut (*Kharif*)	GJG 22	5	2	14.55	12.50	19.70
		GJG 32	45	18	20.39	17.40	17.44
		GG 41	2	0.80	20.50	17.50	17.66
8	Coriander	Guj. Co.-2	17	0.4	12.16	10.95	11.05
		Guj. Co.-3	16	0.4	12.76	10.70	19.25
9	Cumin	Guj. Cumin-4	20	0.8	9.40	7.94	15.53
10	Fenugreek	Guj. Fenugreek-2	2	0.4	16.50	14.15	16.61
11	Garlic	Guj. Garlic-5	8	0.4	68.70	61.00	12.62
12	Onion	GJRO - 11	2	0.4	363.62	288.62	25.98

Table 4.13.2 Summery 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	Cotton	Supplemental irrigation	11	6.0	17.45	16.34	6.8
		Interculturing to fill soil cracks once	12	3.0	17.55	16.55	6.0
		Ridge & furrow / Earthing up	13	5.2	18.02	16.89	6.7
		Summer deep tillage	10	4.0	17.23	16.54	4.2
		50 % RDF + 25 % through castor cake/ bio fertilizer (Basal)	05	2.0	17.78	16.85	5.5
		Foliar spray of potassium nitrate 1 %	12	4.8	17.09	16.43	4.0
		Integrated Cotton Crop Management	95	30	2199	2079	5.8
		Inter cropping	20	10	2309	1711	34.5
		IRM, PBW	50	20	2867	2354	21.79

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 (%)
2	Groundnut	Supplemental irrigation with MIS/ Alternate furrow	12	6.0	18.74	17.80	5.3
		Murrum application @ 8 t/ha / FYM 7.5 t/ha	10	4.0	18.87	17.91	5.4
		Semi spreading Groundnut variety GG-22	5	2.0	18.58	17.66	5.2
		50 % RDF + 25 % through castor cake/ bio fertilizer (Basal)	5	2.0	18.54	17.52	5.8
		50% NPK+10 t FYM/ha	5	0.2	17.73	10.95	62
3	Sesame (Summer)	Whole package	4	3.2	7.23	6.05	19.37
		Plant protection	2	1.6	5.81	5.56	4.50
4	Sesame (*Kharif*)	Whole package	4	3.2	3.70	3.09	20.10
		Intercropping	3	2.4	7.01	4.94	41.90
		Fertilizer management	5	4.0	4.04	3.61	11.40
		Plant protection	4	3.2	3.71	3.46	7.08
5	Wheat	100 % NPK + 10 t FYM/ ha	5	0.2	55.09	38.87	42
6	Castor (GCH-9)	Whole package	17	6.80	36.70	30.83	19.27
		Inter cropping with groundnut	6	2.40	41.04	28.66	49.11
7	Pigeon pea (GJP-1)	Pesticides for pod borer control	10	10	25.41	19.69	29
		Seed treatment, drenching and pest control	10	10	25.68	21.62	19
8	Groundnut + Castor	Inter cropping	7	2.8	29.05*	18.25	59.2
9	Cotton + Pulses	Inter cropping	4	1.6	25.59*	16.08	59.1

Note: 1. Improved technology includes crop production, plant protection and basic science.
* Yield of inter cropping is the main crop (as shown in column-2) equivalent yield.

Table 4.13.3 New research programs sanctioned

Sr. No.	Agency	No. of Research Programs	Amount (Rs. in Lakh)
1	ICAR	01	58.97
2	RKVY	18	111.859
3	Other Agencies	19	170.829
	Total	**38**	**341.658**